

## **PROJECT MANUAL**

### **PROJECT:**

SMITH MIDDLE SCHOOL STAGE UPGRADE (13172G)  
TROY HIGH SCHOOL MEDIA CENTER REMODELING (13174H)

BID PACKAGE NO. 32

### **OWNER:**

TROY SCHOOL DISTRICT  
4400 Livernois  
Troy, Mi. 48098

**TMP PROJECT NO.:** 13172G & 13174H

**DATE:** January 15, 2021

**ISSUED FOR:** CONSTRUCTION DOCUMENTS

### **ARCHITECT**

TMP ARCHITECTURE, INC.  
1191 West Square Lake Road  
Bloomfield Hills, Michigan 48302-0374

PH 248-338-4561  
FX 248-338-0223  
Email [info@tmp-architecture.com](mailto:info@tmp-architecture.com)

### **CONSTRUCTION MANAGER**

BARTON MALOW COMPANY  
26500 American Drive  
Southfield, Michigan 48034

PH 248-436-5000  
FX 248-436-5001  
Email [info@bartonmalow.com](mailto:info@bartonmalow.com)

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**STRUCTURAL CONSULTANT**

WILLIAM A. KIBBE & ASSOCIATES, INC.  
1475 South Washington Ave.  
Saginaw, Michigan 48601

PH 989-752-5000  
FX 989-752-5002

**MECHANICAL/ELECTRICAL CONSULTANT**

PETER BASSO ASSOCIATES, INC.  
5145 Livernois, Suite 100  
Troy, Michigan 48098

PH 248-879-5666  
FX 248-879-0007  
Email [info@pbanet.com](mailto:info@pbanet.com)

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**SECTION 00 0103 - PROJECT DIRECTORY****PART 1 GENERAL****2.01 OWNER:**

- A. Name: Troy School District
  - 1. Address: 4400 Livernois
  - 2. City: Troy
  - 3. State: Michigan
  - 4. Zip Code: 48098
  - 5. Telephone: [\_\_\_\_\_].

**2.02 CONSTRUCTION MANAGER:**

- A. Company Name: Barton Malow Company
  - 1. Address: 26500 American Drive
  - 2. City: Southfield
  - 3. State: Michigan
  - 4. Zip Code: 48034
  - 5. Telephone: 248-436-5000

**2.03 ARCHITECT:**

- A. Company Name: TMP Architecture, Inc..
  - 1. Address: 1191 West Square Lake Road.
  - 2. City: Bloomfield Hills.
  - 3. State: Michigan.
  - 4. Zip Code: 48302.
  - 5. Telephone: 248-338-4561.

**2.04 CONSULTANTS:**

- A. Structural Engineering:
  - 1. Company Name: William A. Kibbe & Associates, Inc.
    - a. Address: 1475 South Washington Ave.
    - b. City: Saginaw
    - c. State: Michigan
    - d. Zip Code: 48601
    - e. Telephone: 989-752-5000
- B. Mechanical Engineering:
  - 1. Company Name: Peter Basso Associates, Inc.
    - a. Address: 5145 Livernois, Suite 100
    - b. City: Troy
    - c. State: Michigan
    - d. Zip Code: 48098
    - e. Telephone: 248-879-5666
- C. Electrical Engineering:
  - 1. Company Name: Peter Basso Associates, Inc.
    - a. Address: 5145 Livernois, Suite 100
    - b. City: Troy
    - c. State: Michigan
    - d. Zip Code: 48098
    - e. Telephone: 248-879-5666
- D. Landscape and Civil Engineering:
  - 1. Company Name: [\_\_\_\_\_].
    - a. Address: [\_\_\_\_\_].
    - b. City: [\_\_\_\_\_].
    - c. State: [\_\_\_\_\_].
    - d. Zip Code: [\_\_\_\_\_].

TMP Architecture, Inc.

TMP13172G, 13174H

e. Telephone: [\_\_\_\_\_].

**PART 2 PRODUCTS - NOT USED**

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Not Used

**END OF SECTION**



**SECTION 00 0115 - LIST OF DRAWINGS**

**LIST OF DRAWINGS**

**1.01 GENERAL**

- A. Drawings: Drawings consist of the Contract Drawings including drawings listed on the TITLE SHEET page of the separately bound drawing set titled Smith Middle School Stage Upgrade (13172G) and TROY HIGH SCHOOL MEDIA CENTER REMODELING (13174H), dated January 15, 2021 and any subsequent Addenda and Contract modifications which may occur.

**END OF SECTION**



**SECTION 00 8200 - AVAILABILITY OF ELECTRONIC FILES****AVAILABILITY OF ELECTRONIC FILES****1.01 POLICY**

- A. As a service to Contractor, subcontractors, vendors, material suppliers and others needing electronic copies of Drawings, the Architect will provide CAD files electronically in accordance with the following policy:
1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
  2. It is further understood and agreed that the undersigned will hold TMP Architecture, Inc. and its Consultants harmless and indemnify TMP Architecture, Inc. and its Consultants from all claims, liabilities, losses, and so forth, including attorney's fees arising out of the use or misuse of the transferred files.
  3. It is understood and agreed that the files transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD version 2014 dwg files.
  4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
  5. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
  6. Compensation Fee for providing this material will be as follows:
    - a. Base Fee of \$250 for 1 to 3 Drawings.
    - b. Base Fee of \$500 for 4 to 10 Drawings.
    - c. For each additional Drawing after 10, the fee is \$40 per Drawing.
      - 1) Example: 11 Drawings = \$540.
  7. A signed copy of the Release Form and Fee must be provided before files will be released.

**1.02 REQUEST PROCEDURE**

- A. To receive Drawing CAD files the Release Form must be completed in full and submitted to the Construction Manager to be forwarded to the Project Manager at TMP Architecture, Inc.
1. A signed copy of the Release Form must be submitted.
    - a. Faxed or emailed copies will be accepted.
  2. Upon remittance of the signed Release Form and Fee, allow five working days for processing.
  3. Transmission of Drawings will be provided electronically after the receipt of Fee.

**1.03 RELEASE FORM**

- A. Release Form is located immediately after this Section. Refer to Section 00 8200.01 Electronic Files Release Form.

**END OF SECTION**





**SECTION 01 2500 - SUBSTITUTION PROCEDURES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Procedural requirements for proposed substitutions.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 2500.01 - TMP Substitution Request Form.

**1.03 DEFINITIONS**

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
  - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
  - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.

**PART 2 PRODUCTS - NOT USED****PART 3 EXECUTION****3.01 GENERAL REQUIREMENTS**

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
  - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
  - 2. Agrees to provide the same warranty for the substitution as for the specified product.
  - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
  - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
  - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
  - 1. Note explicitly any non-compliant characteristics.
- C. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
  - 1. Forms included in the Project Manual are adequate for this purpose, and must be used.
- D. Limit each request to a single proposed substitution item.
  - 1. Submit an electronic document, combining the request form with supporting data into single document.

**3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT**

- A. Substitution Request Form: TMP Substitution Request Form must be completed and provided at the beginning of each substitution request.
  - 1. Refer to Section 01 2500.01 - TMP Substitution Request Form.
  - 2. Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.
- B. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period.

**3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION**

- A. Substitution Request Form: TMP Substitution Request Form must be completed and provided at the beginning of each substitution request.
  - 1. Refer to Section 01 2500.01 - TMP Substitution Request Form.

2. Submittals without a completed TMP Substitution Request Form will not be acknowledged, reviewed, or returned. Use only this form; other forms of submission are unacceptable.
- B. Submit request for Substitution for Cause immediately upon discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- C. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
  1. In addition to meeting general documentation requirements, document how the requested substitution benefits the Owner through cost savings, time savings, greater energy conservation, or in other specific ways.
  2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
  3. Bear the costs engendered by proposed substitution of:
    - a. Owner's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
    - b. Other unanticipated project considerations.
- D. Substitutions will not be considered under one or more of the following circumstances:
  1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
  2. Without a separate written request.

#### **3.04 RESOLUTION**

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
  1. During construction, Architect's decision following review of proposed substitution will be noted on the submitted form.
  2. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.

#### **3.05 ACCEPTANCE**

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

#### **3.06 CLOSEOUT ACTIVITIES**

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.

#### **END OF SECTION**

SECTION 01 2500.01 - TMP SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST NUMBER: \_\_\_\_\_ DATE SUBMITTED: \_\_\_\_\_  
TMP PROJECT NUMBER \_\_\_\_\_ PROJECT NAME: \_\_\_\_\_

SPECIFIED ITEM

SPECIFICATION TITLE: \_\_\_\_\_  
SPECIFICATION SECTION \_\_\_\_\_ SPECIFICATION ARTICLE/PARAGRAPH: \_\_\_\_\_  
SPECIFIED PRODUCT / DESCRIPTION: \_\_\_\_\_  
SPECIFIED MANUFACTURER: \_\_\_\_\_  
SPECIFIED PRODUCT / MODEL: \_\_\_\_\_  
REASON SPECIFIED ITEM CANNOT BE PROVIDED: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PROPOSED SUBSTITUTION

DESCRIPTION OF PROPOSED SUBSTITUTION: \_\_\_\_\_  
\_\_\_\_\_  
PROPOSED MANUFACTURER: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
WEBSITE: \_\_\_\_\_  
PRODUCT / MODEL: \_\_\_\_\_  
YEARS PRODUCT/MODEL HAS BEEN MANUFACTURED: \_\_\_\_\_  
DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED ITEM: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

WILL PROPOSED SUBSTITUTION AFFECT OTHER PARTS OF WORK?  NO  YES  
IF YES, EXPLAIN HOW: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

HOW WILL SUBSTITUTION BENEFIT THE OWNER:  COST SAVINGS  TIME SAVINGS  OTHER  
PROVIDE SPECIFIC DETAILS: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

THE FOLLOWING INFORMATION IS REQUIRED; CHECK TO INDICATE INFORMATION IS ATTACHED. (REQUEST WILL BE REJECTED WITHOUT REQUIRED DATA)

32.01

- A.  List of references where proposed product has been installed; include address, owner, architect, and date installed.
- B.  Product data sheets.
- C.  Applicable certificates and test reports.

- D.  Comparative Data: Provide point-by-point, side-by-side comparison of specified product and proposed substitution addressing essential attributes specified.

**INDICATE WHICH OF THE FOLLOWING VOLUNTARY INFORMATION IS ATTACHED, IF ANY:**

- DRAWINGS.
- SAMPLES.
- OTHER ITEMS: \_\_\_\_\_

**SIGNATURE**

**THE UNDERSIGNED CERTIFIES:**

- The proposed substitution meets or exceeds the quality level of the specified product, equipment, assembly, or system.
- To provide the same warranty for the substitution as for the specified product.
- Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
- Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
- The proposed substitution will have no adverse effects on other work.
- The proposed substitution will not affect project schedule.
- Waives claims for additional costs or time extension that may subsequently become apparent.

**CONTRACTOR / COMPANY:** \_\_\_\_\_

**SIGNED BY:** \_\_\_\_\_ **PRINTED NAME:** \_\_\_\_\_

**TITLE:** \_\_\_\_\_

**ADDRESS:** \_\_\_\_\_

**EMAIL:** \_\_\_\_\_ **PHONE:** \_\_\_\_\_

**ARCHITECT'S RESPONSE**

- A. During bidding, Architect will approve substitution requests by issuing an Addendum. Substitutions not approved by addendum are rejected.
- B. During construction, Architect will notify Contractor in writing (see below) of decision to accept or reject request, and incorporate the substitution into the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments as provided for in the Conditions of the Contract.

- SUBSTITUTION APPROVED - PROVIDE SUBMITTALS PER SECTION 01 3000 AND RESPECTIVE SECTION FOR WHICH SUBSTITUTION WAS MADE.**
- SUBSTITUTION REJECTED - PROVIDE SPECIFIED MATERIALS.**

**SIGNED BY:** \_\_\_\_\_ **PRINTED NAME:** \_\_\_\_\_

**ARCHITECT'S COMMENTS:** \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**END OF SECTION**

**SECTION 01 3000 - ADMINISTRATIVE REQUIREMENTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Submittals for review, information, and project closeout.
- B. Number of copies of submittals.
- C. Requests for Interpretation (RFI) procedures.
- D. Submittal procedures.

**1.02 RELATED REQUIREMENTS**

- A. Section 01 3000.01 - TMP Submittal and Sample Transmittal Form.

**1.03 REFERENCE STANDARDS**

- A. AIA G716 - Request for Information 2004.
- B. CSI/CSC Form 13.2A - Request for Information Current Edition.

**PART 2 PRODUCTS - NOT USED****PART 3 EXECUTION****3.01 REQUESTS FOR INTERPRETATION (RFI)**

- A. Definition: A request seeking one of the following:
  - 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
  - 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
  - 1. Prepare a separate RFI for each specific item.
    - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
    - b. Do not forward requests which solely require internal coordination between subcontractors.
  - 2. Prepare in a format and with content acceptable to Architect. Use one of the following:
    - a. Use AIA G716 - Request for Information .
    - b. Use CSI/CSC Form 13.2A - Request for Interpretation.
    - c. Other format acceptable to Architect.
  - 3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- C. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
  - 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
  - 2. Improper RFIs: Requests not prepared in conformance to requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response and may include an explanatory notation.
  - 3. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, the Contract Documents, with no additional input required to clarify the question. They will be returned without a response and may include an explanatory notation.
    - a. The Owner reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- D. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.

1. Official Project name and number, and any additional required identifiers established in Contract Documents.
  2. Discrete and consecutive RFI number, and descriptive subject/title.
  3. Issue date, and requested reply date.
  4. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
  5. Annotations: Field dimensions and/or description of conditions which have engendered the request.
  6. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
- E. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- F. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
1. Indicate current status of every RFI. Update log promptly and on a regular basis.
  2. Note dates of when each request is made, and when a response is received.
  3. Identify and include improper or frivolous RFIs.
- G. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 3:00 PM will be considered as having been received on the following regular working day.
1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- H. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to Owner.
1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
  2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
  3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
  4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

### **3.02 SUBMITTAL SCHEDULE**

- A. Submit to Architect for review a schedule for submittals in tabular format.
1. Submit at the same time as the preliminary schedule.
  2. Coordinate with Contractor's construction schedule and schedule of values.
  3. Format schedule to allow tracking of status of submittals throughout duration of construction.
  4. Arrange information to include scheduled date for initial submittal, specification number and title, description of item of work covered, and role and name of subcontractor.
  5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.

- a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.

### **3.03 SUBMITTALS FOR REVIEW**

- A. When the following are specified in individual sections, submit them for review:
  1. Product data.
  2. Shop drawings.
  3. Samples for selection.
  4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.
- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 7800 - Closeout Submittals.

### **3.04 SUBMITTALS FOR INFORMATION**

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

### **3.05 SUBMITTALS FOR PROJECT CLOSEOUT**

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

### **3.06 NUMBER OF COPIES OF SUBMITTALS**

- A. Electronic Documents: Submit one electronic copy.
- B. Samples: Submit the number specified in individual specification sections, but not less than 3; one (minimum) of which will be retained by Architect.
  1. After review, produce duplicates.
  2. Retained samples will not be returned to Contractor unless specifically so stated.

### **3.07 SUBMITTAL PROCEDURES**

- A. Transmittal Form: TMP Submittal and Sample Transmittal Form must be completed and provided at the beginning of each submittal.
  1. Refer to Section 01 3000.01 - TMP Submittal and Sample Transmittal Form.
  2. Submittals without a completed TMP Submittal and Sample Transmittal Form will not be acknowledged, reviewed, or returned.
- B. Submittals shall be submitted in electronic form.
  1. Exceptions: Physical samples.

- a. Physical Samples must be accompanied by an electronic copy and a hard/physical copy of the completed TMP Submittal and Sample Transmittal Form.
- C. Electronic Submittals: Comply with the following:
1. Submittal process shall be through a data management system (i.e. Submittal Exchange) or other approved method agreed to by the Architect and Owner.
  2. File Format: Portable Document Format (PDF).
  3. File Naming: File naming shall be in the following format:
    - a. Specification section number, followed by a hyphen, and a consecutive number indicating sequential submittals for that section; followed by a general description of the submittal contents.
      - 1) Examples:
        - (a) Section 07 9200; first submittal:
          - (1) 07 9200-01 Joint Sealants
        - (b) Section 07 9200; second submittal:
          - (1) 07 9200-02 Joint Sealant Color
      - b. Resubmittals. For revised resubmittals use original number and a sequential combination numerical and alphabetical suffix; hyphen followed by "R" and a two-digit consecutive number indicating sequential resubmittals for that particular submittal.
        - 1) Examples:
          - (a) Section 07 9200; resubmittal of first submittal of section:
            - (1) 07 9200-01-R01 Joint Sealants.
          - (b) Section 07 9200; second resubmittal of first submittal of section:
            - (1) 07 9200-01-R02 Joint Sealants
          - (c) Section 07 9200; first resubmittal of second submittal of section:
            - (1) 07 9200-02-R01 Joint Sealant Color
    4. Each Submittal shall be one file, complete with all attachments.
      - a. Multi-file submittal will not be acknowledged, reviewed, or returned.

D. General Requirements:

    1. Use a single transmittal for related items.
      - a. Each transmittal shall be for one specification section only; do not submit items for multiple sections under the same transmittal.
        - 1) Multi-section submittals will be acknowledged and returned; stamped "X - Not Approved - Resubmit".
    2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
    3. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
      - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
    4. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
    5. Schedule submittals to expedite the Project, and coordinate submission of related items.
      - a. For each submittal for review, allow 14 calendar days excluding delivery time to and from the Contractor.
      - b. For sequential reviews involving Architect's consultants, Owner, or another affected party, allow an additional 7 calendar days.
    6. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
    7. When revised for resubmission, identify all changes made since previous submission.
    8. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
    9. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.



10. Submittals not requested will be recognized and returned; stamped "NA - No Action Taken - Not Reviewed"
- E. Product Data Procedures:
  1. Submit only information required by individual specification sections.
  2. Collect required information into a single submittal.
  3. Submit concurrently with related shop drawing submittal.
  4. Do not submit (Material) Safety Data Sheets for materials or products unless specifically called for in individual sections.
- F. Shop Drawing Procedures:
  1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
  2. Do not reproduce Contract Documents to create shop drawings.
  3. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
  4. Non-complying submittals will be acknowledged and returned; stamped "X - Not Approved - Resubmit".
- G. Samples Procedures:
  1. Transmit related items together as single package.
  2. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
  3. Submit actual physical samples.
  4. Electronic submittals will not be accepted unless prior approval is received from the Architect. Electronic samples without prior approval will be acknowledged and returned; stamped "X - Not Approved - Resubmit."

### 3.08 SUBMITTAL REVIEW

- A. General: Submittals that do not conform to the requirements of this section will not be acknowledged, reviewed, or returned.
- B. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- C. Submittals for Information: Architect will acknowledge and may review. See below for actions to be taken.
- D. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
  1. Where more than one action has been indicated, each shall apply to that portion of the submittal for which the action is indicated.
- E. Architect's review shall not indicate approval of dimensions, quantities or fabrication processes unless specific notations are made by the Architect regarding same.
- F. Architect's and consultants' actions on items submitted for review:
  1. Authorizing purchasing, fabrication, delivery, and installation:
    - a. "Reviewed - No Exceptions Taken", "Approved", or language with same legal meaning.
    - b. "Reviewed with Corrections Noted", "Approved as Noted, Resubmission not required", or language with same legal meaning.
      - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
    - c. "Approved as Noted, Resubmit for Record", or language with same legal meaning.
      - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
  2. Not Authorizing fabrication, delivery, and installation:
    - a. "Not Approved - Resubmit", "Revise and Resubmit", or language with the same legal meaning.
      - 1) Resubmit revised item, with review notations acknowledged and incorporated.

G. Architect's and consultants' actions on items submitted for information:

1. Items for which no action was taken:
  - a. "No Action Taken - Not Reviewed" or "Received" - to notify the Contractor that the submittal has been received for record only.

**END OF SECTION**



# SUBMITTAL AND SAMPLE TRANSMITTAL FORM

01 1300.01

CONST. MANAGER / CONTRACTOR		PROJECT	TMP PROJECT NO.	DATE SUBMITTED	SUBMITTAL NO.						
Name and Address:		Title:									
			<b>* ACTION CODES</b>		Initial Submittal	<input type="checkbox"/>					
			R	Reviewed – No Exceptions Taken	Resubmittal	<input type="checkbox"/>					
			RN	Reviewed with Corrections Noted							
Email:		Location:	RR	Revise and Resubmit	<b>REVIEWED BY</b>						
			X	Not Approved – Resubmit	TMP	<input type="checkbox"/>					
Phone:			NA	No Action Taken – Not Reviewed	Consultant	<input type="checkbox"/>					
							Reviewer:				
SPECIFICATION SECTION NO.	SUBCONTRACTOR / MANUFACTURER	ITEM DESCRIPTION	NO. OF SAMPLES	NO. OF SAMPLES RETURNED	ACTION CODE *	DATE REVIEWED	DATE RETURNED				
Transmittal shall be for one specification section only; do not submit items from multiple sections under the same transmittal. Multi-section submittals will be returned; stamped "X - Not Approved - Resubmit"											
Submittal Stamps may be placed on subsequent blank page.											
CONTRACTOR COMMENTS		ARCHITECT COMMENTS		The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with the Contract Documents except as otherwise noted. NOTE: Approval of items submitted does not relieve Contractor from complying with all requirements of the Contract Documents.							
								<b>CONTRACTOR NAME</b>			
								<b>SIGNATURE</b>			

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**SECTION 01 4000 - QUALITY REQUIREMENTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Submittals.
- B. Quality assurance.
- C. Testing and inspection agencies and services.
- D. Contractor's design-related professional design services.
- E. Control of installation.
- F. Mock-ups.
- G. Tolerances.
- H. Manufacturers' field services.
- I. Defect Assessment.

**1.02 DEFINITIONS**

- A. Contractor's Professional Design Services: Design of some aspect or portion of the project by party other than the design professional of record. Provide these services as part of the Contract for Construction.
  - 1. Design Services Types Required:
    - a. Design-Related: Design services explicitly required to be performed by another design professional due to highly-technical and/or specialized nature of a portion of the project. Services primarily involve engineering analysis, calculations, and design, and are not intended to alter the aesthetic aspects of the design.
- B. Design Data: Design-related, signed and sealed drawings, calculations, specifications, certifications, shop drawings and other submittals provided by Contractor, and prepared directly by, or under direct supervision of, appropriately licensed design professional.

**1.03 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES**

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
  - 1. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
  - 2. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- C. Test Reports: After each test/inspection, promptly submit 1 copies of report to Architect and to Contractor.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test/inspection.
    - h. Date of test/inspection.

- i. Results of test/inspection.
  - j. Compliance with Contract Documents.
  - k. When requested by Architect, provide interpretation of results.
- 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for Owner's information.
- D. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
  - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
  - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- E. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the Owner's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- F. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for Owner.
  - 1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.

#### **1.05 QUALITY ASSURANCE**

- A. Testing Agency Qualifications:
  - 1. Prior to start of Work, submit agency name, address, and telephone number, and names of full time specialist and responsible officer.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

#### **1.06 REFERENCES AND STANDARDS**

- A. Obtain copies of standards where required by product specification sections.
- B. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

#### **1.07 TESTING AND INSPECTION AGENCIES AND SERVICES**

- A. As indicated in individual specification sections, Owner or Contractor shall employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- C. Contractor Employed Agency:
  - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, and ASTM E699.
  - 2. Inspection agency: Comply with requirements of ASTM E329.
  - 3. Laboratory Staff: Maintain a full time specialist on staff to review services.

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION**

#### **3.01 CONTROL OF INSTALLATION**

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.

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

### **3.02 MOCK-UPS**

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Integrated Exterior Mock-ups: Construct integrated exterior mock-up as indicated on drawings. Coordinate installation of exterior envelope materials and products as required in individual Specification Sections. Provide adequate supporting structure for mock-up materials as necessary.
- D. Notify Architect 5 working days in advance of dates and times when mock-ups will be constructed.
- E. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- F. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- G. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- H. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
  - 1. Make corrections as necessary until Architect's approval is issued.
- I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.

### **3.03 TOLERANCES**

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

### **3.04 TESTING AND INSPECTION**

- A. See individual specification sections for testing and inspection required.
- B. Testing Agency Duties:
  - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
  - 2. Perform specified sampling and testing of products in accordance with specified standards.
  - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.

4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
  5. Perform additional tests and inspections required by Architect.
  6. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  2. Agency may not approve or accept any portion of the Work.
  3. Agency may not assume any duties of Contractor.
  4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
  2. Cooperate with laboratory personnel, and provide access to the Work.
  3. Provide incidental labor and facilities:
    - a. To provide access to Work to be tested/inspected.
    - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
    - c. To facilitate tests/inspections.
    - d. To provide storage and curing of test samples.
  4. Notify Architect and laboratory 48 hours prior to expected time for operations requiring testing/inspection services.
  5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
  6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

### **3.05 MANUFACTURERS' FIELD SERVICES**

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

### **3.06 DEFECT ASSESSMENT**

- A. Replace Work or portions of the Work not complying with specified requirements.
- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.

**END OF SECTION**



**SECTION 01 4100 - REGULATORY REQUIREMENTS****PART 1 GENERAL****1.01 SUMMARY OF REFERENCE STANDARDS**

- A. Regulatory requirements applicable to this project are the following:
1. Barrier Free Code: Comply with the following:
    - a. Michigan Building Code; 2015.
    - b. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2009.
  2. School Fire Safety Rules: Michigan School Fire Safety Rules; 2016.
    - a. Includes NFPA 101-2012 - Life Safety Code; 2012, plus amendments.
  3. Building Code: Michigan Building Code; 2015.
  4. Plumbing Code: Michigan Plumbing Code; 2015.
  5. Mechanical Code: Michigan Mechanical Code; 2015.
  6. Electrical Code: NFPA 70 - National Electric Code; 2017.
    - a. Includes 2017 Michigan Construction Code - Part 8 Electrical Code Rules.
  7. Elevator Code: Comply with the following:
    - a. ASME A17.1 - Safety Code for Elevators and Escalators; 2010.
    - b. ASME A18.1- Safety Standard for Platform Lifts and Stairway Chairlifts; 2011.
    - c. Michigan Elevator Safety Board General Rules.
  8. Boiler Code: Michigan Boiler Code.
    - a. Includes the following:
      - 1) ASME Boiler and Pressure Vessel Codes; 2010, plus 2011 addenda.
      - 2) National Board Inspection Code; 2011.
      - 3) PA 407 Skilled Trades Regulation Act; 2016.
  9. Energy Code: Michigan Energy Code; 2015.
    - a. Includes ASHRAE Std 90.1 I-P-2013- Energy Standard for Buildings Except Low-Rise Residential Buildings; 2013.
  10. Existing Building Code: Michigan Rehabilitation Code; 2015.
- B. Where specification sections reference more current standards or codes, comply with the more restrictive requirements unless notified in writing by Architect.

**PART 2 PRODUCTS - NOT USED****PART 3 EXECUTION - NOT USED****END OF SECTION**



**SECTION 01 4216 - DEFINITIONS**

**PART 1 GENERAL**

**1.01 SUMMARY**

- A. This section supplements the definitions contained in the General Conditions.
- B. Other definitions are included in individual specification sections.

**1.02 DEFINITIONS**

- A. Furnish: To supply, deliver, unload, and inspect for damage.
- B. Install: To unpack, assemble, erect, apply, place, finish, cure, protect, clean, start up, and make ready for use.
- C. Product: Material, machinery, components, equipment, fixtures, and systems forming the work result. Not materials or equipment used for preparation, fabrication, conveying, or erection and not incorporated into the work result. Products may be new, never before used, or re-used materials or equipment.
- D. Project Manual: The book-sized volume that includes the procurement requirements (if any), the contracting requirements, and the specifications.
- E. Provide: To furnish and install.
- F. Supply: Same as Furnish.

**PART 2 PRODUCTS - NOT USED**

**PART 3 EXECUTION - NOT USED**

**END OF SECTION**



**SECTION 01 4219 - REFERENCE STANDARDS**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements relating to referenced standards.

**1.02 QUALITY ASSURANCE**

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Comply with the reference standard of date of issue specified in this section, except where a specific date is established by applicable code.
- C. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- D. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

**PART 2 PRODUCTS -- NOT USED**

**PART 3 EXECUTION -- NOT USED**

**END OF SECTION**



**SECTION 01 4533 - CODE-REQUIRED SPECIAL INSPECTIONS AND PROCEDURES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Code-required special inspections.
- B. Submittals.

**1.02 ABBREVIATIONS AND ACRONYMS**

- A. AHJ: Authority having jurisdiction.
- B. NIST: National Institute of Standards and Technology.

**1.03 DEFINITIONS**

- A. Code or Building Code: Michigan Building Code; 2015, specifically Chapter 17 - Special Inspections and Tests.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located.
- C. Special Inspection:
  - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the AHJ that also require special expertise to ensure compliance with the approved Contract Documents and the referenced standards.
  - 2. Special inspections are separate from and independent of tests and inspections conducted by Owner or Contractor for the purposes of quality assurance and contract administration.

**1.04 REFERENCE STANDARDS**

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection 2020.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:
  - 1. Submit agency name, address, and telephone number, names of full time specialist and responsible officer.
  - 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
  - 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to the AHJ.
  - 1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of Special Inspector.
    - d. Date and time of special inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of special inspection.
    - h. Date of special inspection.
    - i. Results of special inspection.
    - j. Compliance with Contract Documents.

2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
- D. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one to AHJ.
  1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of Special Inspector.
    - d. Date and time of special inspection.
    - e. Identification of fabricated item and specification section.
    - f. Location in the Project.
    - g. Results of special inspection.
    - h. Verification of fabrication and quality control procedures.
    - i. Compliance with Contract Documents.
    - j. Compliance with referenced standard(s).
- E. Test Reports: After each test or inspection, promptly submit at least two copies of report; one to Architect and one to AHJ.
  1. Include:
    - a. Date issued.
    - b. Project title and number.
    - c. Name of inspector.
    - d. Date and time of sampling or inspection.
    - e. Identification of product and specifications section.
    - f. Location in the Project.
    - g. Type of test or inspection.
    - h. Date of test or inspection.
    - i. Results of test or inspection.
    - j. Compliance with Contract Documents.

#### **1.06 SPECIAL INSPECTION AGENCY**

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

#### **1.07 QUALITY ASSURANCE**

- A. Special Inspection Agency Qualifications:
  1. Independent firm specializing in performing testing and inspections of the type specified in this section.

### **PART 2 PRODUCTS - NOT USED**

### **PART 3 EXECUTION**

#### **3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL**

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



**3.02 SPECIAL INSPECTIONS**

- A. Special inspections and testing shall be for materials, installation, fabrication, erection or placement of components and connections as indicated on Drawings, but not less than that required by the building code.

**END OF SECTION**



**SECTION 01 6000 - PRODUCT REQUIREMENTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

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

**1.02 SUBMITTALS**

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

**PART 2 PRODUCTS****2.01 EXISTING PRODUCTS**

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the Owner; notify Owner promptly upon discovery; protect, remove, handle, and store as directed by Owner.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the Owner, or otherwise indicated as to remain the property of the Owner, become the property of the Contractor; remove from site.
- D. Specific Products to be Reused: The reuse of certain materials and equipment already existing on the project site is required.
  - 1. Refer to Drawings and Section 02 4100 - Demolition.

**2.02 NEW PRODUCTS**

- A. Provide new products unless specifically required or permitted by Contract Documents.

**2.03 PRODUCT OPTIONS**

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.
- D. Available Products: Products specified by naming one or more Manufacturers as an Available Product indicates that these Manufacturers' products may be provided but other comparable products and Manufacturers not named may also be provided without submitting a request for substitution.

**2.04 MAINTENANCE MATERIALS**

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

**PART 3 EXECUTION****3.01 SUBSTITUTION LIMITATIONS**

- A. See Section 01 2500 - Substitution Procedures.

**3.02 OWNER-SUPPLIED PRODUCTS**

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

**3.03 TRANSPORTATION AND HANDLING**

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- F. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- G. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

**3.04 STORAGE AND PROTECTION**

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Provide off-site storage and protection when site does not permit on-site storage or protection.
- G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- H. Comply with manufacturer's warranty conditions, if any.

- I. Do not store products directly on the ground.
- J. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- K. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Prevent contact with material that may cause corrosion, discoloration, or staining.
- M. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- N. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**END OF SECTION**



**SECTION 01 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

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

**1.02 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2019.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  - 1. Structural integrity of any element of Project.
  - 2. Integrity of weather exposed or moisture resistant element.
  - 3. Efficiency, maintenance, or safety of any operational element.
  - 4. Visual qualities of sight exposed elements.
  - 5. Work of Owner or separate Contractor.
  - 6. Include in request:
    - a. Identification of Project.
    - b. Location and description of affected work.
    - c. Necessity for cutting or alteration.
    - d. Description of proposed work and products to be used.
    - e. Effect on work of Owner or separate Contractor.
- C. Project Record Documents: Accurately record actual locations of capped and active utilities.
- D. Warranties: For each affected material under warranty, submit written verification, signed by manufacturer of existing materials, stating that the Owner's full warranty will remain in effect after cutting and patching operations have been completed

**1.04 QUALIFICATIONS**

- A. For surveying work, employ a land surveyor registered in the State in which the Project is located and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,

**1.05 PROJECT CONDITIONS**

- A. Use of explosives is not permitted.
- B. Grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- C. Protect site from puddling or running water. Provide water barriers as required to protect site from soil erosion.
- D. Perform dewatering activities, as required, for the duration of the project.

- E. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- F. Dust Control: Execute work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into atmosphere and over adjacent property.
  - 1. Provide dust-proof enclosures to prevent entry of dust generated outdoors.
  - 2. Provide dust-proof barriers between construction areas and areas continuing to be occupied by Owner.
- G. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
  - 1. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- H. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
  - 1. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
  - 2. Indoors: Limit conduct of especially noisy interior work to the hours of 6 pm to 7 am.
- I. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- J. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. Comply with federal, state, and local regulations.

#### **1.06 COORDINATION**

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

#### **1.07 WARRANTIES**

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

### **PART 2 PRODUCTS**

#### **2.01 PATCHING MATERIALS**

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.



- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 6000 - Product Requirements.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

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

#### **3.02 PREPARATION**

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

#### **3.03 PREINSTALLATION MEETINGS**

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect 5 calendar days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
  - 1. Review conditions of examination, preparation and installation procedures.
  - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with 1 copies to Architect, Owner, participants, and those affected by decisions made.

#### **3.04 LAYING OUT THE WORK**

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Contractor shall locate and protect survey control and reference points.
- D. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- E. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- F. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- G. Utilize recognized engineering survey practices.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
  2. Grid or axis for structures.
  3. Building foundation, column locations, ground floor elevations.
  4. Controlling lines and levels required for mechanical and electrical trades.
- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

### **3.05 GENERAL INSTALLATION REQUIREMENTS**

- A. In addition to compliance with regulatory requirements, conduct construction operations in compliance with NFPA 241, including applicable recommendations in Appendix A.
- B. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- C. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- D. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- E. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- F. Make neat transitions between different surfaces, maintaining texture and appearance.

### **3.06 ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation only.
1. Verify that construction and utility arrangements are as indicated.
  2. Report discrepancies to Architect before disturbing existing installation.
  3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Keep areas in which alterations are being conducted separated from other areas that are still occupied.
1. Provide, erect, and maintain temporary dustproof partitions.
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
  2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- D. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
  2. Relocate items indicated on drawings.
  3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
  4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
  2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
  3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.

- a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
- b. Provide temporary connections as required to maintain existing systems in service.
4. Verify that abandoned services serve only abandoned facilities.
5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- F. Protect existing work to remain.
  1. Prevent movement of structure; provide shoring and bracing if necessary.
  2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  3. Repair adjacent construction and finishes damaged during removal work.
- G. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
  1. Where removal of partitions or walls results in adjacent spaces becoming one, rework floors, walls, and ceilings to a smooth plane without breaks, steps, or bulkheads.
- H. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- I. Refinish existing surfaces as indicated:
  1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
  2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.
- J. Clean existing systems and equipment.
- K. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- L. Do not begin new construction in alterations areas before demolition is complete.
- M. Comply with all other applicable requirements of this section.

### **3.07 CUTTING AND PATCHING**

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

- I. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400, to full thickness of the penetrated element.
- J. Patching:
  - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
    - a. This includes painted surfaces.
    - b. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
  - 2. Match color, texture, and appearance.
  - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

### **3.08 PROGRESS CLEANING**

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

### **3.09 PROTECTION OF INSTALLED WORK**

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

### **3.10 SYSTEM STARTUP**

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Notify Architect and Owner 7 calendar days prior to start-up of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- D. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

- H. Submit a written report that equipment or system has been properly installed and is functioning correctly.

### **3.11 DEMONSTRATION AND INSTRUCTION**

- A. See Section 01 7900 - Demonstration and Training.
- B. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- C. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Provide a qualified person who is knowledgeable about the Project to perform demonstration and instruction of Owner's personnel.
- F. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

### **3.12 ADJUSTING**

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

### **3.13 FINAL CLEANING**

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

### **3.14 CLOSEOUT PROCEDURES**

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

- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

**3.15 MAINTENANCE**

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

**END OF SECTION**

**SECTION 01 7329 - CUTTING AND PATCHING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Cutting and patching.

**1.02 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2013.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
  1. Structural integrity of any element of Project.
  2. Integrity of weather exposed or moisture resistant element.
  3. Efficiency, maintenance, or safety of any operational element.
  4. Visual qualities of sight exposed elements.
  5. Work of Owner or separate Contractor.
  6. Include in request:
    - a. Location and description of affected work.
    - b. Necessity for cutting or alteration.
    - c. Description of proposed work and products to be used.
    - d. Effect on work of Owner or separate Contractor.
- C. Warranties: For each affected material under warranty, submit written verification, signed by manufacturer of existing materials, stating that the Owner's full warranty will remain in effect after cutting and patching operations have been completed.

**1.04 WARRANTIES**

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.
  1. Materials that are still under warranty include, but are not limited to, the following:
    - a. .
    - b. .
    - c. .

**PART 2 PRODUCTS****2.01 PATCHING MATERIALS**

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

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.
- B. Prior to Patching: Before patching, verify compatibility and suitability of substrates, including compatibility with existing finishes or primers. Beginning of patching means acceptance of existing conditions.

**3.02 PREPARATION**

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.
- D. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.
  - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
- E. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

**3.03 CUTTING AND PATCHING**

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. Perform whatever cutting and patching is necessary to:
  - 1. Complete the work.
  - 2. Fit products together to integrate with other work.
  - 3. Provide openings for penetration of mechanical, electrical, and other services.
  - 4. Match work that has been cut to adjacent work.
  - 5. Repair areas adjacent to cuts to required condition.
  - 6. Repair new work damaged by subsequent work.
  - 7. Remove samples of installed work for testing when requested.
  - 8. Remove and replace defective and non-conforming work.
- C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- D. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- E. Cutting:
  - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces.
  - 2. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
  - 3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
- F. Restore work with new products in accordance with requirements of Contract Documents.
- G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 8400 - Firestopping, to full thickness of the penetrated element.
- I. Patching:
  - 1. Repair adjacent construction and finishes damaged during removal work and cutting work.
  - 2. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
    - a. This includes painted surfaces.
    - b. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
  - 3. Match color, texture, and appearance.



4. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

**END OF SECTION**



**SECTION 02 4100 - DEMOLITION****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Selective demolition of building elements for alteration purposes.
- B. Abandonment and removal of existing utilities and utility structures.
- C. Salvaged items.
- D. Removed and reinstalled items.

**1.02 RELATED REQUIREMENTS**

- A. Section 04 2000 - Unit Masonry: Salvaging existing brick.

**1.03 REFERENCE STANDARDS**

- A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2019.
- B. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings 2011.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

**1.05 QUALITY ASSURANCE**

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
  - 1. Minimum of 5 years of documented experience.

**PART 2 PRODUCTS - NOT USED**

- A. Fill Material: As specified in Division 31.

**PART 3 EXECUTION****3.01 SCOPE**

- A. Remove portions of existing building as indicated on Drawings including, but not limited to, the following:
  - 1. Remove indicated foundation walls and footings completely.
  - 2. Remove concrete slabs on grade as indicated on drawings.
  - 3. Remove other items indicated, for salvage and relocation.
  - 4. Unless otherwise indicated, fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Division 31.

**3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS**

- A. Comply with other requirements specified in Section 01 7000.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
  - 1. Obtain required permits.
  - 2. Comply with applicable requirements of NFPA 241.
  - 3. Prior to start of demolition operations, perform an engineering survey of building condition to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures.
  - 4. Use of explosives is not permitted.
  - 5. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
  - 6. Provide, erect, and maintain temporary barriers and security devices.
  - 7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
  - 8. Do not close or obstruct roadways or sidewalks without permit.

9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
  10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
  - D. Do not begin removal until built elements to be salvaged or relocated have been removed.
  - E. Protect existing structures and other elements that are not to be removed.
    1. Provide bracing and shoring.
    2. Prevent movement or settlement of adjacent structures.
    3. Stop work immediately if adjacent structures appear to be in danger.
  - F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
  - G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
  - H. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

### **3.03 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS**

- A. 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.
  1. Where concrete cannot be cut full depth, cut concrete to a depth of at least 3/4 inch. 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. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
  1. Refer to Section 04 2000 - Unit Masonry for salvaging brick.
- C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI (RWP). Do not use methods requiring solvent-based adhesive strippers.
- E. Carpet: Remove carpet and adhesive according to industry standard and below. Do not use methods requiring solvent-based adhesive strippers.
  1. Remove carpet in manageable sections and dispose.
  2. Using a floor scrapper, scrape residual of carpet and adhesive from concrete.
  3. Sand the floor by mechanical means starting with a heavy grit to remove the bulk of the left adhesive and then a finer grit (approx 300) for the finish sand to allow new finish to be applied.

### **3.04 EXISTING UTILITIES**

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

### **3.05 SELECTIVE DEMOLITION FOR ALTERATIONS**

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
  - 1. Verify that construction and utility arrangements are as indicated.
  - 2. Report discrepancies to Architect before disturbing existing installation.
  - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Separate areas in which demolition is being conducted from other areas that are still occupied.
  - 1. Provide, erect, and maintain temporary dustproof partitions of construction as specified and/or indicated on Drawings .
- C. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- D. Remove existing work as indicated and as required to accomplish new work.
  - 1. Remove items indicated on Drawings.
- E. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
  - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
  - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
  - 3. Verify that abandoned services serve only abandoned facilities before removal.
  - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- F. Protect existing work to remain.
  - 1. Prevent movement of structure; provide shoring and bracing if necessary.
  - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
  - 3. Repair adjacent construction and finishes damaged during removal work.
  - 4. Patch as specified for patching new work.

### **3.06 SALVAGED ITEMS**

- A. Clean salvaged items.
- B. Pack or crate items after cleaning. Identify contents of containers.
- C. Store items in a secure area until delivery to Owner.
- D. Transport items to Owner's storage area on-site.
- E. Protect items from damage during transport and storage.

### **3.07 REMOVED AND REINSTALLED ITEMS**

- A. Clean and repair items to functional condition adequate for intended reuse.
- B. Pack or crate items after cleaning and repairing. Identify contents of containers.
- C. Protect items from damage during transport and storage.

- D. 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.

**3.08 EXISTING ITEMS TO REMAIN**

- A. 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

**3.09 DEBRIS AND WASTE REMOVAL**

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

**END OF SECTION**

## SECTION 03 3000 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.

#### 1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- B. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

#### 1.05 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

#### 1.06 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.

### **1.07 FIELD CONDITIONS**

- A. Cold-Weather Placement: Comply with ACI 306.1.
  - 1. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301.

## **PART 2 - PRODUCTS**

### **2.01 CONCRETE, GENERAL**

- A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301.
  - 2. ACI 117.

### **2.02 FORM-FACING MATERIALS**

- A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
- 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.

### **2.03 STEEL REINFORCEMENT**

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
- D. 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."

### **2.04 CONCRETE MATERIALS**

- A. Cementitious Materials:
  - 1. Portland Cement: ASTM C 150/C 150M, Type I, gray.



2. Fly Ash: ASTM C 618, Class F or C.
  3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
1. Maximum Coarse-Aggregate Size: 1 inch nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Air-Entraining Admixture: ASTM C 260/C 260M.
- D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do 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.
- E. Water: ASTM C 94/C 94M and potable.

## 2.05 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation; Admixture Systems.
    - b. Dayton Superior.
    - c. Euclid Chemical Company (The); an RPM company.
    - d. L&M Construction Chemicals, Inc.
    - e. Sika Corporation.
    - f. W. R. Meadows, Inc.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BASF Corporation; Admixture Systems.
    - b. ChemMasters, Inc.
    - c. Dayton Superior.
    - d. Euclid Chemical Company (The); an RPM company.
    - e. L&M Construction Chemicals, Inc.
    - f. W. R. Meadows, Inc.

## **2.06 RELATED MATERIALS**

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

## **2.07 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.
- B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing admixture in concrete, as required, for placement and workability.

## **2.08 CONCRETE MIXTURES FOR BUILDING ELEMENTS**

- A. Refer to structural general notes.

## **2.09 FABRICATING REINFORCEMENT**

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## **2.010 CONCRETE MIXING**

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
  - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

## **PART 3 - EXECUTION**

### **3.01 FORMWORK INSTALLATION**

- 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. Chamfer exterior corners and edges of permanently exposed concrete.

### **3.02 EMBEDDED ITEM INSTALLATION**

- 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.

### **3.03 VAPOR-RETARDER INSTALLATION**

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

### **3.04 STEEL REINFORCEMENT INSTALLATION**

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
  - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

### **3.05 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.
- 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. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool 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 when cutting action does 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.

### **3.06 CONCRETE PLACEMENT**

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

- B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

### **3.07 FINISHING FORMED SURFACES**

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
  - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
  - 2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  - 3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.
- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

### **3.08 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 in one 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 to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
  - 1. Apply a trowel finish to surfaces 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 and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.
- 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 thinnest 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, 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.

### **3.09 CONCRETE PROTECTING AND CURING**

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h 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 remainder of curing period.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
  - 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. Cure for not less than seven days. 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.
    - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.
  - 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

### **3.010 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.

### **3.011 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

**END OF SECTION 03 3000**

## SECTION 04 2000 - UNIT MASONRY ASSEMBLIES

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. The provisions and guidelines indicated in ACI 530.1/ASCE 6/TMS 602 Specification for Masonry Structures (referred to hereinafter as the MSJC Code), current at the time of project bidding shall constitute the masonry standard and shall apply to this Section.

#### 1.2 DESCRIPTION OF WORK

- A. Extent of each type of masonry work is indicated on drawings and schedule.
- B. Types of masonry work required include:
- C. Concrete Unit Masonry.
- D. Reinforced masonry
- E. Mortar and grout.
- F. Steel reinforcing bars.
- G. Masonry-joint reinforcement.
- H. Ties and anchors.
- I. Embedded flashing.
- J. Miscellaneous masonry accessories.
- K. Products installed but not furnished under this Section include the following:
- L. Division 05 Section "Metal Fabrication" for steel lintels in unit masonry.
- M. Division 06 Section "Rough Carpentry" for wood nailers and blocking built into unit masonry.
- N. Division 07 Section "Sheet Metal Flashing and Trim" for reglets in masonry joints for metal flashing.
- O. Division 07 Section "Firestop Joint Systems" for head-of-wall joints.
- P. Division 08 Section "Standard Steel Doors and Frames" for hollow metal frames in unit masonry openings.
- Q. Division 09 Section "Painting" for field applied sealer at all exposed concrete masonry units.
- R. Related Requirements:
- S. Division 07 Section "Sheet Metal Flashing and Trim" for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.

- T. Division 07 Section "Firestop Joint Systems" for head-of-wall joints.
- U. Division 08 Section "Standard Steel Doors and Frames" for hollow metal frames in unit masonry openings.
- V. Division 09 Section "Painting" for field-applied sealer at all exposed concrete masonry units.

1.3 PREINSTALLATION MEETINGS

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

1.4 QUALITY ASSURANCE

- A. Testing Agency Services

The Construction Manager/Owner will secure and pay for the services of a qualified, independent materials engineer to perform quality assurance testing of mortar and grout materials, to confirm rebar and anchorage placement, to verify compliance of materials with specified requirements, to observe and document compliance with hot and cold weather construction methods, and to perform required field and laboratory testing. Testing Agency shall be acceptable to the architect and the owner and shall be licensed to practice in the state in which the project is located.

- B. Masonry Inspection Requirements:

Testing Frequency for Non-Essential Facilities - Level B Quality Assurance:

- a. Assurance level to be in accordance with Table 4 of the MSJC Specification for Masonry Structures.
- b. Frequency level for Category I, II or III buildings to be in accordance with Table 1704.5.1 Level 1 Special Inspections of the Michigan Building Code.

For this project, the testing and inspecting agency will be hired by the Owner or the Owner's representative.

Contractor may retain a qualified consultant to review procedures and construction methods to comply with this specification, industry standards and construction codes.

- C. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- D. Masonry Standard: Comply with the MSJC Code unless modified by requirements in the Contract Documents.
- E. Single source responsibility for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one manufacturer for each different product required for each continuous surface or visually related surfaces.
- F. Single source responsibility for Mortar Materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.5 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops indicated net-area compressive strengths (f'm) at 28 days.



- B. Determine net-area compressive strength ( $f'm$ ) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in Section 1.4 of the MSJC Code. Provide  $f'm$  for concrete masonry construction according to the following:

Use	Compressive Strength, $f'm$ (psi)	Unit Strength (psi)	Grout Strength (psi)	Mortar Type
Typical, unless noted otherwise	2000 min.	2800 min.	2000 min.	S

## 1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements.

- B. Shop Drawings: Show fabrication and installation details for the following:

Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

- C. Samples for Verification: For each type and color of the following:

Pigmented mortar. Make Samples using same sand and mortar ingredients to be used on Project.

Weep hole inserts.

Accessories embedded in masonry.

- D. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

Each type of masonry unit required.

- a. Include size-variation data for brick, verifying that actual range of sizes falls within specified tolerances.
- b. Include test data, measurements, and calculations establishing net-area compressive strength of masonry units.

Each cement product required for mortar and grout, including name of manufacturer, brand, type, and weight slips at time of delivery.

For each combination of masonry unit type and mortar type, include a written statement identifying the following:

- c. Net-area compressive strength of masonry units.
- d. Mortar type.

- e. Net-area compressive strength of the completed masonry system determined according to Tables 1 and 2 in Section 1.4 of the MSJC Code.

Each combination of masonry unit type and mortar type specified to be manufactured with integral water repellent.

Each material and grade indicated for reinforcing bars.

Each type and size of joint reinforcement.

Each type and size of anchor, tie, and metal accessory.

- E. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

Include test reports from past projects which were performed in accordance with ASTM C 780, for mortar mixes intended for this project required to comply with property specification.

Include test reports from past projects which were performed in accordance with ASTM C 1019, for grout mixes intended for this project required to comply with compressive strength requirement.

- F. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in Section 1.4 of the MSJC Code.

- G. Cold-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with hot-weather requirements.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver masonry materials to project in undamaged condition.
- B. Store and handle masonry units to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion or other causes.

Limit moisture absorption of concrete masonry units during delivery and until time of installation to the maximum percentage specified for Type I units for the average annual relative humidity as reported by the U.S. Weather Bureau Station nearest project site.

- C. Store cementitious materials off the ground, under cover and in dry location.
- D. Store aggregates where grading and other required characteristics can be maintained.
- E. Store masonry accessories including metal items to prevent deterioration by corrosion and accumulation of dirt.

#### 1.8 PROJECT CONDITIONS

- A. Protection of work: During erection, cover top of walls with waterproof sheeting at end of each day's work. Cover partially completed structures when work is not in progress.

- B. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
- C. Do not apply uniform floor or roof loading for at least 3 days after building masonry walls or columns.
- D. Staining: Prevent grout or mortar or soil from staining the face of masonry to be left exposed or painted. Remove immediately grout or mortar in contact with such masonry.
- E. Protect base of walls from rain-splashed mud and mortar splatter by means of covering spread on ground and over wall surfaces.
- F. Protect sills, ledges and projections from droppings of mortar.

#### 1.9 COLD WEATHER PROTECTION

- A. Do not lay masonry units which are wet or frozen.
- B. Remove any ice or snow formed on masonry bed by carefully applying heat until top surface is dry to the touch.
- C. Remove masonry damaged by freezing conditions.
- D. For clay masonry units with initial rates of absorption (suction) which require them to be wetted before laying, comply with the following requirements.

For units with surface temperatures above 32°F (0°C), wet with water heated to above 70°F (21°C).

For units with surface temperatures below 32°F (0°C), wet with water heated to above 130°F (54°C).

- E. Perform the following construction procedures while masonry work is progressing. Temperature ranges indicated below apply to air temperatures existing at time of installation except for grout.
- F. For grout, temperature ranges apply to anticipated minimum night temperatures. In heating mortar and grout materials, maintain mixing temperature selected with 10°F (6°C).

40°F (4°C) to 32°F (0°C):

- a. Mortar: Heat mixing water to produce mortar temperature between 40°F (4°C) and 120°F (49°C).
- b. Grout: Follow normal masonry procedures.

32°F (0°C) to 25°F (-4°C):

- c. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.
- d. Grout: Heat grout materials to 90°F (32°C) to produce in-place grout temperature of 70°F (21°C) at end of work day.

25°F (-4°C) to 20°F (-7°C):

- e. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C); maintain temperature of mortar on boards above freezing.

- f. Grout: Heat grout materials to 90°F (32°C) to produce in-place grout temperature of 70°F (21°C) at end of work day.
- g. Heat both sides of walls under construction using salamanders or other heat sources.
- h. Use windbreaks or enclosures when wind is in excess of 15 mph.

20°F (-7°C) and below:

- i. Mortar: Heat mixing water and sand to produce mortar temperatures between 40°F (4°C) and 120°F (49°C).
- j. Grout: Heat grout materials to 90°F (32°C) to produce in-place grout temperature of 70°F (21°C) at end of work day.
- k. Masonry Units: Heat masonry units so that they are above 20°F (-7°C) at time of laying.
- l. Provide enclosure and auxiliary heat to maintain an air temperature of at least 40°F (4°C) for 24 hours after laying units.

Do not heat water for mortar and grout to above 160°F (71°C).

- G. Protect completed masonry and masonry not being worked on in the following manner. Temperature ranges indicated apply to mean daily air temperatures except for grouted masonry. For grouted masonry, temperature ranges apply to anticipated minimum night temperatures.

40°F (4°C) to 32°F (0°C):

- a. Protect masonry from rain or snow for at least 24 hours by covering with weather-resistant membrane.

32°F (0°C) to 25°F (-4°C):

- b. Completely cover masonry with weather-resistant membrane for at least 24 hours.

25°F (-4°C) to 20°F (-7°C):

- c. Completely cover masonry with weather-resistant insulating blankets or similar protection for at least 24 hours, 48 hours for grouted masonry.

20°F (-7°C) and below:

- d. Except as otherwise indicated, maintain masonry temperature above 32°F (0°C) for 24 hours using enclosures and supplementary heat, electric heating blankets, infrared lamps or other methods proven to be satisfactory. For grouted masonry maintain heated enclosure to 40°F (4°C) for 48 hours.

## PART 2 - PRODUCTS

### 2.1 CONCRETE MASONRY UNITS

- A. General: Comply with referenced standards and other requirements indicated below applicable to each form of concrete masonry unit required.

Provide special shapes where required for lintels, corners, jambs, sash, control joints, headers, bonding and other special conditions.

- a. Provide bullnose units for outside corners unless otherwise indicated.
- b. Provide units with vertical center score where indicated.
- c. Provide CMU Bond Beam units where indicated. Where center score units are scheduled for walls surrounding the bond beam, provide units matching said walls.
- d. Supply standard open-end units and open-end bond beam units to facilitate placement of vertical reinforcement. Units shall comply with the material specification of adjacent construction.

Water-Repellent Admixture: All concrete masonry exposed to the exterior shall be manufactured with a liquid water-repellent block admixture intended for use with concrete masonry.

- e. Products: Dry-Block Block Admixture as manufactured by Grace Construction Products, a unit of W. R. Grace & Co. or approved equal.

- B. Concrete block: Provide units complying with characteristics indicated below for Grade, Type, face size, exposed face and, under each form of block included, for weight classification.

Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

- a. Regular (Standard) Concrete Masonry Units using standard aggregate:
  - 1) Manufacturers: Subject to compliance with requirements provide products from one of the following:
    - a) Best Block Company
    - b) Fendt Builder's Supply, Inc.
    - c) National Block Company
    - d) Grand Blanc Cement Products

Grade N.

- b. Grade N except Grade S may be used above grade in exterior walls with weather protective coatings and in walls not exposed to weather.

Size: Manufacturer's standard units with nominal face dimensions of 16" long x 8" high (15-5/8" x 7-5/8" actual) x thicknesses indicated.

- c. Provide special shape concrete blocks as indicated on drawings.

Hollow Load bearing or Non-load bearing Block: ASTM C 90 and as follows:

- d. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified under the Performance Requirements of Article 1.4.B above.
- e. Exterior Walls: Normal or Medium weight – Cavity/Veneer Walls Only
- f. Exterior Walls: Normal weight – Singly Wythe Walls
- g. Interior Load or Non-Load Bearing Walls: Normal weight.

Solid Load bearing or Non-load bearing Block: ASTM C 145 and as follows:

- h. Unit Compressive Strength: Provide units with minimum average net-area compressive strength specified under the Performance Requirements of Article 1.4.B above.
- i. Exterior Walls: Normal or Medium weight – Cavity/Veneer Walls Only
- j. Exterior Walls: Normal weight – Singly Wythe Walls
- k. Interior Load or Non-Load Bearing Walls: Normal weight.

## 2.2 BRICK UNITS

- A. Refer To requirements for Salvaged Brick elsewhere in this section

## 2.3 CONCRETE AND MASONRY LINTELS

General: Provide either concrete or masonry lintels, at Contractor's option, complying with requirements below.

- A. Concrete Lintels: Formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete" with the same reinforcing as scheduled Masonry Lintels. Use in hidden or un-exposed conditions only. Temporarily support built-in-place lintels until cured.
- B. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

## 2.4 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C 150, Type I, except Type III may be used for cold weather construction. Provide natural color or white cement as required to produce required mortar color.
- B. Masonry Cement: ASTM C 91.

For colored pigmented mortar use premixed colored masonry cements of formulation required to produce color(s) indicated. Subject to compliance with requirements provide products of Solomon Grind-Chem Services, Inc.

- a. Color: Architect shall select up to two (2) colors from manufacturer's standards.
- C. Hydrated Lime: ASTM C 207, Type S.

- D. Aggregate for Mortar: ASTM C 144, except for joints less than 1/4" use aggregate graded with 100% passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C 404.
- F. Water: Clean and potable.
- G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units.

Products: Dry-Block Mortar Admixture as manufactured by Grace Construction Products, a unit of W. R. Grace & Co. or approved equal.

## 2.5 JOINT REINFORCEMENT, TIES AND ANCHORING DEVICES

- A. Materials: Comply with requirements indicated below for basic materials and with requirements indicated under each form of joint reinforcement, tie and anchor for size and other characteristics:

Hot-Dip Galvanized Steel Wire: ASTM A 82 for uncoated wire and with ASTM A 153, Class B-2 (1.5 oz. per sq. ft. of wire surface) for zinc coating applied after prefabrication into units.

- B. Joint Reinforcement: Provide welded-wire units prefabricated with deformed continuous side rods and plain cross rods into straight lengths of not less than 10', with prefabricated corner and tee units, and complying with requirements indicated below:

Width: Fabricate joint reinforcement in units with widths of approximately 2" less than nominal width of walls and partitions as required to provide mortar coverage of not less than 5/8" on joint faces exposed to exterior and 1/2" elsewhere.

Wire Size for Side Rods: 0.1483" diameter.

Wire Size for Cross Rods: 0.1483" diameter.

For single-wythe masonry provide type as follows with single pair of side rods:

- a. Ladder design with perpendicular cross rods spaced not more than 16" o.c.

For multi-wythe masonry provide type as follows:

- b. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch (1.5 mm) and maximum vertical adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.
- c. Number of side rods for Composite Construction: One side rod for each face shell of concrete masonry back-up and one rod for brick wythe.
- d. Use units with adjustable 2-piece rectangular ties where horizontal joints of facing wythe do not align with those of back-up.

- 1) Products: Subject to compliance with requirements, provide the following:

- a) "Series 800 Hook and Eye"; Wire Bond.
- b) "AA525" Adjustable Econo-Eye-Lok", AA Wire Products.
- c) "Ladur-Eye"; Dur-O-Wal, Inc.
- d) "Lox-All Adjustable Eye-Wire"; Hohman & Barnard, Inc.

C. Flexible Anchors: Where flexible anchors are indicated for connecting masonry to structural framework, provide 2-piece anchors as described below which permit vertical or horizontal differential movement between wall and framework parallel to, but resist tension and compression forces perpendicular to, plane of wall.

For anchorage to steel framework provide manufacturer's standard anchors which fasten thru exterior sheathing and extent thru rigid insulation.

- a. Wire Size: 0.1875" diameter.
- b. Products: Subject to compliance with requirements, provide the following:
  - 1) "HCL-911", Wire-Bond as distributed by Masonpro. Phone No. 800-659-4731
  - 2) RAP-TIE, Fero Corporation as distributed by Masonpro Phone No. 800-659-4731

Joint Stabilizing Anchors: Single-piece assembly with sliding rods held in receiver which allows vertical and horizontal movement but resists tension and compression forces perpendicular to plane of wall.

- c. Receiver Section: Fabricated with stainless steel 1/32 inch sheet steel sleeves, one side embedded in masonry, the other connected to the steel frame with self tapping screws for full capacity of the anchor assembly.
- d. Tie Section: Two 8 gauge stainless wires encased in plastic sleeves held in the receiver section.
  - 1) Dur-O-Wal # D/A 2200 or approved equal.

D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- (6.4-mm-) diameter, hot-dip galvanized steel.

Tie Section for Steel Frame : Triangular-shaped wire tie, sized to extend within 1 inch (25 mm) of masonry face, made from 0.188-inch- (4.8-mm-) diameter, hot-dip galvanized steel.

E. Masonry Veneer Anchors (Interior use only): Not less than 22 gauge and not less than 7/8 inch wide and 7 inches long, with one end crimped for attachment to substrate. Size to extend within 3/4" of face of masonry veneer.

F. Galvanized steel channel slot anchors for anchoring new masonry to existing.

Provide Heckmann No. 133/133-P continuous channel and mounting plate, with standard triangular type wire tie.

G. Rigid Anchors: Provide straps of form and length indicated, fabricated from metal strips 1-1/2 inches wide x 1/4 inch thick (12 inches long) unless other sizes indicated.



- H. Un-coated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

## 2.6 INTERSECTING WALL ANCHORS

Exterior Walls and Interior Bearing Walls: Fabricate steel bars as follows:

- a. 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins.
- b. Finish: Hot-dip galvanized to comply with ASTM A 153.
- c. Lay-up in alternate courses between adjacent intersection walls which are not interlocked or at control joint locations.

Interior Non-Bearing Walls and Interior Partitions:

- d. Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units.

## 2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch (0.40 mm) thick.

Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.

Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.

Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

Fabricate metal drip edges and sealant stops for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam sheds water.

Fabricate metal drip edges from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.

Fabricate metal expansion-joint strips from stainless steel copper to shapes indicated.

Solder metal items at corners.

- B. Flexible Flashing: Use the following unless otherwise indicated:

Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

a. Manufacturers:

- 1) Grace Construction Products
- 2) W.R Meadows, Inc

- b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

C. Application: Unless otherwise indicated, use the following:

Where flashing is indicated to receive counterflashing, use metal flashing.

Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.

Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing or flexible flashing with a metal drip edge.

Where flashing is fully concealed, use flexible flashing.

- D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.
- E. Termination Bars for Flexible Flashing: Stainless-steel sheet 0.019 inch by 1-1/2 inches (0.48 mm by 38 mm) with a 3/8 inch (10-mm) sealant flange at top.
- F. Solder and Sealants for Sheet Metal Flashings: As specified in Division 7 Section "Sheet Metal Flashing and Trim."
- G. Bituthene Sheet Flashing (Rubberized Asphalt): Flexible sheet flashing especially formulated from modified bituthene flexible and waterproof in concealed masonry applications, black in color and of thickness indicated below:

Thickness: 40 mils.

Manufacturer: W.R. Grace & Co.

Provide stainless steel drip under flexible sheet flashing at lintels and where indicated.

Form end dams at lintel ends.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Reinforcing Bars: Deformed steel, ASTM A 615, Grade 60 for bars No. 3 to No. 18.
- B. Control Joint Strips: Premolded, flexible cellular neoprene rubber filler strips complying with ASTM D 1056, Grade RE41E1, capable of compression up to 35%, of width and thickness indicated.
- C. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Steel Column Isolation Material: 1/2 inch thickness asphalt impregnated fiberboard.

E. Weep/Cavity Vent Products: Use one of the following unless otherwise indicated:

Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.

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

- 1) Advanced Building Products.
- 2) Mortar Net USA, Ltd.

Cavity Drainage Material: Free-draining mesh

F. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

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

- a. MortarNet, Mortar Net Solutions.
- b. Mortar Maze, Advanced Building Products.

Configuration: Provide one of the following:

Strips, not less than 1-1/2 inches (38 mm) thick and 10 inches (250 mm) high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

- G. Compressible Joint Fillers: For use between the top of unrated masonry walls and the underside of structural steel or roof deck: Closed cell neoprene conforming to the requirements of ASTM D 1056, Grade SCE-42, board stock of sufficient thickness to be under compression when in the joint.
- H. Column Wrap: Wrap steel columns with "Boxboard" 1/4 inch corrugated, asphalt impregnated, cardboard as manufactured by Williams Products.
- I. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.187-inch steel wire, hot-dip galvanized after fabrication.

Provide self-positioning units with either two loops or four loops as needed for number of bars indicated recessed downward into core a minimum of 1-1/4".

Reinforcing Bar Positioners Manufacturer:

Wire-Bond: Core-Lock Seated Rebar Positioner.

## 2.9 INSULATION

- A. Extruded Polystyrene Board Insulation: Rigid cellular polystyrene thermo insulation with closed cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578, Type IV; 5-year aged r-value of 5 Btu/(hr x sf x °F) at 75°F (24°C); in manufacturer's standard lengths and widths; thicknesses as indicated.

Available Products: Subject to compliance with requirements, products which may be incorporated in the work include, but are not limited to, the following:

- a. Styrofoam Cavitymate Plus"; Dow Chemical USA.
- b. "Foamular 250"; UC Industries
- c. "Certifoam", Minnesota Diversified Products, Inc.

Tape: Type recommended by insulation board manufacturer for application indicated.

Adhesive: Type recommended by insulation board manufacturer for application indicated.

## 2.10 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.

Available Products: Subject to compliance with requirements, a product which may be used to clean unit masonry surfaces includes, but is not limited to, the following:

- a. "Sure Klean" No. 600 Detergent; ProSoCo, Inc..

## 2.11 MORTAR AND GROUT MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

Do not use calcium chloride in mortar or grout.

Use portland cement-lime mortar unless otherwise indicated.

- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

Provide Spec Mix/Quikrete factory pre-blended mortar mix, colored mortar mix, and integral water repellent mortar mix as manufactured instead of field prepared mortars NO SUBSTITUTION Pre-blended mortar shall include manufacturer's standard silo system for mixing and delivery of mortar mixes.

Pre-blended mortar and grout mixes shall be mixed with potable water in strict compliance with manufacturer's standard silo system for mixing and delivery system of mortar mixes or 80lb bags of pre-blended as governed.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

Use Type M mortar for masonry below grade and in contact with earth, and where indicated.

Use Type M or S mortar for reinforced masonry and where indicated.

For interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

For interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

- D. Pigmented Mortar: Use colored cement product.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
- F. Grout for Unit Masonry: Comply with ASTM C 476.

Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.

Proportion grout in accordance with ASTM C 476, or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).

Provide grout with a slump of 8 to 11 inches (200 to 280 mm) as measured according to ASTM C 143/C 143M.

### PART 3 – EXECUTION

#### 3.1 SALVAGING BRICKS

- A. General: Comply with Section 02 4100-Demolition.
- B. Where indicated, remove and salvage existing brick.

Carefully remove brick by hand. Cut out full units from joint to joint.

- a. If required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

Salvage as many whole, undamaged bricks as needed for new construction.

Salvage damaged brick that may be cut and used where cut units are required.

Take care not to chip, crack or otherwise damage surrounding masonry.

- C. Remove mortar, loose particles and soil from salvaged brick by cleaning with hand chisels, brushes and water. Store brick for reuse.
- D. Clean remaining masonry at edges of removal areas by removing mortar, dust, and loose debris in preparation for new construction.
- E. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

#### 3.2 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

Verify that foundations are within tolerances specified.

Verify that reinforcing dowels are properly placed.

Verify that substrates are free of substances that impair mortar bond.

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.

### 3.3 INSTALLATION, GENERAL

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

Verify that foundations are within tolerances specified.

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.

D. Do not wet concrete masonry units.

E. Cleaning Reinforcing: Before placing, remove loose rust, ice and other coatings from reinforcing.

F. Thickness: Build cavity and composite walls, floors and other masonry construction to the full thickness shown. Build single-wythe walls (if any) to the actual thickness of the masonry units, using units of nominal thickness indicated.

G. Build chases and recesses as shown or required for the work of other trades. Provide not less than 8" of masonry between chase or recess and jamb of openings, and between adjacent chases and recesses.

H. Leave openings for equipment to be installed before completion of masonry work. After installation of equipment, complete masonry work to match work immediately adjacent to the opening.

I. Cut masonry units using motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use full-size units without cutting where possible.

Use dry cutting saws to cut concrete masonry units.

- J. Matching Existing Masonry Work: Match coursing, bonding, color and texture of new masonry work with existing work. Tooth masonry infill into existing masonry coursing.
- K. Bond Break: Provide a continuous bond breaker strip in all mortar joints between clay masonry and concrete masonry.
- L. Sealer: Apply two (2) coats of sealer complying with requirements in Division 9 Section "Painting" at the following locations:

At all exposed interior and exterior Decorative (Special) Concrete Masonry Units unless otherwise indicated.

At all exposed exterior Regular (Standard) Concrete Masonry Units unless otherwise indicated.

At all exposed interior Regular (Standard) Concrete Masonry Units that are not scheduled to be otherwise painted.

### 3.4 CONSTRUCTION TOLERANCES

- A. Variation From Plumb: For vertical lines and surfaces of columns, walls and arises do not exceed 1/4" in 10', or 3/8" in a story height not to exceed 20', nor 1/2" in 40' or more. For external corners, expansion joints, control joints and other conspicuous lines, do not exceed 1/4" in any story or 20' maximum, nor 1/2" in 40' or more. For vertical alignment of head joints do not exceed plus or minus 1/4" in 10', 1/2" maximum.
- B. Variation From Level: For bed joints and lines of exposed lintels, sills, parapets, horizontal grooves and other conspicuous lines, do not exceed 1/4" in any bay or 20' maximum, nor 1/2" in 40' or more. For top surface of bearing walls do not exceed 1/8" between adjacent floor elements in 10' or 1/16" within width of a single unit.
- C. Variation of Linear Building Line: For position shown in plan and related portion of columns, walls and partitions, do not exceed 1/2" in any bay or 20' maximum, nor 3/4" in 40' or more.
- D. Variation in Cross-Sectional Dimensions: For columns and thickness of walls, from dimensions shown, do not exceed minus 1/4" nor plus 1/2".
- E. Variation in Mortar Joint Thickness: Do not exceed bed joint thickness indicated by more than plus or minus 1/8", with a maximum thickness limited to 1/2". Do not exceed head joint thickness indicated by more than plus or minus 1/8".

### 3.5 LAYING MASONRY WALLS:

- A. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to accurately locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half-size units at corners, jambs and wherever possible at other locations.
- B. Lay-up walls to comply with specified construction tolerances, with courses accurately spaced and coordinated with other work.
- C. Pattern Bond: Lay exposed masonry in the bond pattern shown or, if not shown, lay in running bond with vertical joint in each course centered on units in courses above and below. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2". Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4" horizontal face dimensions at corners or jambs.

Grind miter internal corner to match intersection of bullnose.

- D. Stopping and Resuming Work: Rack back 1/2-unit length in each course; do not tooth. Clean exposed surfaces of set masonry, wet units lightly (if required) and remove loose masonry units and mortar prior to laying fresh masonry.
- E. Built-in Work: As the work progresses, build-in items specified under this and other sections of these specifications. Fill in solidly with masonry around built-in items.

Fill space between hollow metal frames and masonry solidly with mortar, unless otherwise indicated.

Column Wrap: Wrap steel columns with corrugated, asphalt impregnated, cardboard prior to grouting or building into masonry surrounds.

Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

Fill cores in hollow concrete masonry units with grout 3 courses (24") under bearing plates, beams, lintels, posts and similar items, unless otherwise indicated.

- F. Masonry walls indicated to extend to the roof deck shall terminate 1" below the underside of the deck and resulting space shall be filled with a firestop joint assembly suitable for permanent placement and complying with Division 7 Section "Firestop Joint Systems". Provide a 4 x 4 x 12 gauge x 8" long angle at 5'-0" (+ or -) o.c. at each face of wall.

Where run of wall is parallel to deck flutes, provide a supplemental 12 gauge plate to link both opposing angles. Width of plate and angles is to be 8".

Where run of wall is perpendicular to the deck flutes, the supplemental plate can be omitted and length of angle sized to bridge two flutes. Secure assembly to metal deck with two #12 tech screws per side. Do not weld.

### 3.6 MORTAR BEDDING AND JOINTING

- A. Lay solid brick size masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
- B. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on footings and in all courses of piers, columns and pilasters, and where adjacent to cells or cavities to be reinforced or filled with concrete or grout. For starting course on footings where cells are not grouted, spread out full mortar bed including areas under cells.
- C. Maintain joint widths shown, except for minor variations required to maintain bond alignment. If not shown, lay walls with 3/8" joints.
- D. Cut joints flush for masonry walls which are to be concealed or to be covered by other materials, unless otherwise indicated.
- E. Tool exposed joints slightly concave for brick and slightly concave for block including scored joint using a jointer larger than joint thickness, unless otherwise indicated.



- F. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners or jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.
- G. Set stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.

Allow cleaned surfaces to dry before setting.

- 3. Wet joint surfaces thoroughly before applying mortar.
- 4. Rake out mortar joints for pointing with sealant.

### 3.7 STRUCTURAL BONDING OF MULTI-WYTHE MASONRY

- A. Use continuous horizontal joint reinforcement installed in horizontal mortar joints for bond tie between wythes. Install at not more than 16" o.c. vertically.

For horizontally reinforced masonry, provide continuity at corners with prefabricated "L" units, in addition to masonry bonding.

- B. Exterior Walls and Intersecting or Abutting Interior Bearing Walls: Unless vertical expansion or control joints are shown at juncture:

Provide rigid metal anchors not more than 24 inches o.c. If used with hollow masonry units, embed ends in mortar-filled cores.

Lay-up in alternate courses between adjacent intersection walls which are not interlocked or at control joint locations.

- C. Intersecting or Abutting Interior, Non-Bearing Walls and Interior Partitions:

Provide continuity with masonry joint reinforcement by using prefabricated T-shaped units laid up in alternate courses.

### 3.8 CAVITY WALLS

- A. Bond wythes of cavity walls together using one of the following methods:

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 36 inches (914 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 openings and space not more than 36 inches (915 mm) apart around perimeter of openings. 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-type (two-piece-type) ties.
- b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable-type (two-piece-type) ties to allow for differential movement regardless of whether bed joints align.

Masonry-Joint Reinforcement: Installed in horizontal mortar joints.

- c. Where bed joints of wythes do not align, use adjustable-type (two-piece-type) reinforcement.

Header Bonding: Provide masonry unit headers extending not less than 3 inches (76 mm) into each wythe. Space headers not more than 8 inches (203 mm) clear horizontally and 16 inches (406 mm) clear vertically.

Masonry-Veneer Anchors: Comply with requirements for anchoring masonry veneers.

- B. Bond wythes of cavity walls together using bonding system indicated on Drawings.
- C. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.
- D. Installing Cavity Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches (300 mm) o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

### 3.9 CAVITY WALL INSULATION

- A. On units of polystyrene insulation, install small pads of adhesive spaced approximately 1'-0" o.c. both ways on inside face. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

Tape all joints.

Fill all cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

### 3.10 HORIZONTAL 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).

Space reinforcement not more than 16 inches (406 mm) o.c.

Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.

Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings 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.

3.11 ANCHORING MASONRY WORK:

- A. General: Provide anchor devices of type specified.

Anchor masonry to structural members where masonry abuts or faces structural members.

3.12 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

- B. Placing Reinforcement: Comply with requirements in **the MSJC Code**.

Install reinforcing bar positioners in locations coordinated with the vertical reinforcement spacing. Positioners shall be located accurately to install reinforcement bars in the center of the unit core or offset as specified on the Drawings.

- a. Based on the size of the vertical wall reinforcement, do not exceed the following maximum vertical spacing of positioners:

- 1) #3 Bar: 6'-3"
- 2) #4 Bar: 8'-4"
- 3) #5 Bar: 10'-0"
- 4) #6 Bar: 12'-6"
- 5) #7 Bar: 14'-7"
- 6) #8 Bar: 16'-8"

- C. At lap splices, the upper reinforcement bar shall be held within the positioner adjacent to the lower bar being spliced. Reinforcement Splices:

The following lap splice requirements shall supersede the MSJC Code requirements. Specified wall heights refer to the distance from the top of foundation or slab support to the upper joist or beam bearing or slab/deck tie-in elevation. For wall heights which equal the specified limit, the lesser provision may apply. As a minimum, reinforcing bars shall be lapped according to the following:

Wall Configuration	#4 Bar	#5 Bar	#6 Bar	#7 Bar	#8 Bar
8" Walls (single reinforcement)	24"	30"	36"	--	--
8" Walls (double reinforcement)	24"	30"	58"	--	--
12" Walls (single reinforcement)	24"	30"	36"	42"	48"

12" Walls (double reinforcement)	24"	30"	58"	80"	--
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D. Grouting:

Grouting may not proceed until the grout cavity is inspected, vertical reinforcement spacing and position and lap dimensions are confirmed, and anchor size, spacing and position are confirmed.

Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

General: Grout the cores of all masonry at all locations of reinforcement, bond beams, bearing plates, anchors and embedded items.

Comply with requirements in the MSJC Code for cleanouts and for grout placement, including minimum grout space, maximum lift and pour height, vibration and consolidation.

Unless previously approved, limit height of vertical grout lifts to not more than 60 inches.

Stop grout placement 1.5 inches lower than top of masonry to form a grout key between successive lifts.

3.13 CONTROL AND EXPANSION JOINTS:

A. General: Install control and expansion joints in unit masonry where indicated in Drawings but not spaced more than 20'-0" apart. Build-in related items as masonry progresses. Do not form a continuous span through movement joints. Verify control joint locations with Architect.

B. Form control joints in concrete masonry as follows using one of the following methods:

Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

Install preformed control-joint gaskets designed to fit standard sash block.

Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.

Location and spacing of control joints shall comply with industry standards.

Interrupt joint reinforcing each side of joint.

C. Form expansion joints in brick made from clay or shale as follows:

Build flanges of factory-fabricated, expansion-joint units into masonry.

Form open joint of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."

D. Build in horizontal, pressure-relieving joints where required and indicated; construct joints by either leaving an air space or inserting a compressible filler of width required."

Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry veneer and attached to structure behind masonry veneer.

3.14 LINTELS:

- A. Provide steel lintels where shown and wherever openings of more than 1'-0" for brick size units and 2'-0" for block size units are shown without structural steel or other supporting lintels. Refer to Metal Fabrications specification section additional information.
- B. Provide minimum bearing of 8" at each jamb, unless otherwise indicated.
- C. One end of lintel shall remain un-connected to allow for movement. The choice of which end to remain free is arbitrary, but if possible, it end should be located adjacent to the nearest control joint.

3.15 FLASHING, WEEP HOLES, AND CAVITY VENTS:

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install cavity vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.
- B. Install flashing as follows unless otherwise indicated:

Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and through inner wythe to within 1/2 inch (13 mm) of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches (50 mm) on interior face.

At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches (200 mm), and 1-1/2 inches (38 mm) into the inner wythe. Form 1/4-inch (6-mm) hook in edge of flashing embedded in inner wythe.

At masonry-veneer walls, extend flashing through veneer, across airspace behind veneer, and up face of sheathing at least 8 inches (200 mm); with upper edge tucked under air barrier, lapping at least 4 inches (100 mm). Fasten upper edge of flexible flashing to sheathing through termination bar.

At lintels and shelf angles, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

Install metal drip edges and sealant stops with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.

Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.

Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.

Cut flexible flashing off flush with face of wall after masonry wall construction is completed.

- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.
- D. Install weep holes in exterior wythes and veneers in head joints of first course of masonry immediately above embedded flashing.

Use specified weep/cavity vent products to form weep holes.

Space weep holes 24 inches (600 mm)o.c. unless otherwise indicated.

- E. Place cavity drainage material in airspace behind veneers to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.
- F. Install cavity vents in head joints in exterior wythes at spacing indicated. Use specified weep/cavity vent products to form cavity vents.
- G. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

### 3.16 FIELD QUALITY CONTROL

- A. Inspectors: Construction Manager/Owner will engage a qualified, independent agency to perform field inspections and prepare inspection reports.
- B. Testing: Construction Manager/Owner will engage a qualified, independent agency to perform field tests indicated below and prepare test reports.
- C. Quality Assurance Level and Frequency:

Testing Frequency for Non-Essential Facilities - Level B Quality Assurance:

- a. Assurance level to be in accordance with Table 4 of the MSJC Specification for Masonry Structures.
- b. Frequency level for Category I, II or III buildings to be in accordance with Table 1704.5.1 Level 1 Special Inspections of the Michigan Building Code.
- c. Note: The MSJC and Michigan Building Codes require inspectors to observe all grouting operations continuously. Communication with inspector is the contractor's responsibility. Grouting shall not proceed until the inspector is onsite and has made the required pre-grouting observations.
- d. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

- e. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, locations and position of reinforcement.
- D. Clay Masonry Unit Test: For each type of unit provided, per ASTM C 67.
- E. Concrete Masonry Unit Test: For each type of unit provided, per ASTM C 140.
- F. Mortar Test (Property Specification): For each mix provided, per ASTM C 780.
- G. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.
- H. Testing agency will report results of tests and inspections promptly, in detail and in writing to Contractor, Architect and authorities having jurisdiction.
- I. Remove and replace work that does not comply with specified requirements.
- J. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

3.17 REPAIR, POINTING AND CLEANING:

- A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar. Point-up all joints including corners, openings and adjacent work to provide a neat, uniform appearance, prepared for application of sealants.
- C. Final cleaning: After mortar is thoroughly set and cured, clean masonry as follows:

Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.

Test cleaning methods on sample wall panel; leave 1/2 panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

Saturate wall surfaces with water prior to application of cleaners; remove cleaners promptly by rinsing thoroughly with clear water.

- a. Detergent.
- b. Acidic Cleaner; apply in compliance with directions of cleaner manufacturer.

Clean concrete unit masonry to comply with masonry manufacturer's directions and applicable NCMA "Tek" bulletins.

Clean stone trim to comply with stone supplier's written instructions.

- c. Clean limestone units to comply with recommendations in ILI's "Indiana Limestone Handbook."
- D. Protection: Provide final protection and maintain conditions in a manner acceptable to Installer, which ensures unit masonry work being without damage and deterioration at time of substantial completion.

END OF SECTION 042000



## **SECTION 05 1200 - STRUCTURAL STEEL FRAMING**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Structural steel.
  - 2. Grout.
- B. Related Requirements:
  - 1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.

#### **1.2 DEFINITIONS**

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

#### **1.3 PREINSTALLATION MEETINGS**

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

#### **1.4 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
- C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data.

#### **1.5 INFORMATIONAL SUBMITTALS**

- A. Qualification Data: For Installer and fabricator.
- B. Welding certificates.
- C. Mill test reports for structural steel, including chemical and physical properties.
- D. Source quality-control reports.
- E. Field quality-control and special inspection reports.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
  - 2. AISC 360.
  - 3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. 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.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
  - 1. Select and complete connections using schematic details indicated and AISC 360.
- B. Moment Connections: Fully restrained.
- C. Construction: Combined system of moment frame, braced frame, and shear walls.

## **2.2 STRUCTURAL-STEEL MATERIALS**

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

## **2.3 BOLTS, CONNECTORS, AND ANCHORS**

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
  - 1. Finish: Plain.
- C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
  - 1. Finish: Plain.
- E. Threaded Rods: ASTM A 36/A 36M.
  - 1. Finish: Plain.

## **2.4 PRIMER**

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

## **2.5 GROUT**

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## **2.6 FABRICATION**

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
- B. 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/D1.1M and manufacturer's written instructions.

## **2.7 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/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## **2.8 SHOP PRIMING**

- A. Shop prime steel surfaces except the following:
  - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  - 2. Surfaces to be field welded.
  - 3. Surfaces of high-strength bolted, slip-critical connections.
  - 4. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
  - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

## **2.9 SOURCE QUALITY CONTROL**

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
  3. Ultrasonic Inspection: ASTM E 164.
  4. Radiographic Inspection: ASTM E 94.
- D. Prepare test and inspection reports.

### **PART 3 - EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.2 ERECTION**

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of baseplate.
  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 plate before packing with grout.
  4. Promptly pack grout solidly between bearing surfaces and 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 303, "Code of Standard Practice for Steel Buildings and Bridges."

### **3.3 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/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

### **3.4 FIELD QUALITY CONTROL**

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Verify structural-steel materials and inspect steel frame joint details.
  - 2. Verify weld materials and inspect welds.
  - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M 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 are not accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.

**END OF SECTION**

## **SECTION 05 4000 - COLD-FORMED METAL FRAMING**

### **PART 1 - GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Types of cold-formed metal framing units include the following:
  - 1. Non loading-bearing punched channel studs (exterior wall framing.)

#### **1.03 SUBMITTALS**

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data and installation instructions for each item of cold-formed metal framing and accessories.
- C. Shop drawings showing layout, spacings, sizes, thickness, and types of cold-formed metal framing, fabrication, fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of work.
  - 1. Include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

#### **1.04 QUALITY ASSURANCE**

- A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."
- B. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."
- C. Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.
  - 1. Coordinate with provisions of Division 1 Section "Project Meetings."

## **PART 2 - PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
1. ClarkDietrich Building Systems; [www.clarkdietrich.com](http://www.clarkdietrich.com).
  2. Jaimes Industries Inc. ; [www.jaimesind.com](http://www.jaimesind.com).
  3. MarinoWARE; [www.marinoware.com](http://www.marinoware.com).
  4. State Building Products; [www.statebp.com](http://www.statebp.com).
  5. Steel Stud Solutions, LLC; [www.steelstudsolutions.com](http://www.steelstudsolutions.com).
  6. Telling Industries; [www.buildstrong.com](http://www.buildstrong.com).

### **2.02 METAL FRAMING**

- A. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
1. Design framing systems to withstand wind load per current BOCA without deflections greater than  $l/600$  of the wall height.
  2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 120 Deg F (67 Deg C).
  3. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
  4. Design exterior framing to accommodate lateral deflection without regard to contribution of sheathing materials.
  5. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.
  6. Provide Cee studs of depth indicated at maximum 16" on center, 20-gage minimum.
  7. Provide deep leg slip track connection as required under structural steel framing.
- B. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 50,000 psi; ASTM A 446, A 570, or A 611.
- C. For 18-gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.
- D. Provide galvanized finish on metal framing components complying with ASTM A525 for minimum G 60 coating.
1. Finish of installation accessories to match that of main framing components, unless otherwise indicated.
- E. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.
- F. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.
- G. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.



## **2.03 FABRICATION**

- A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.
- B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
- C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.
- D. Wire tying of framing components is not permitted.
- E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.
- C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.
- D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
- F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
- H. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- I. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c. Weld at each intersection.

- J. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
  - 1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.
- K. Field Painting: Touch-up damaged shop-applied protective coatings. Use compatible primer for prime-coated surfaces; use galvanizing repair system for galvanized surfaces.

**END OF SECTION**

**SECTION 05 5000 - METAL FABRICATIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Shop fabricated steel items, including:
  - 1. Loose steel lintels.

**1.02 REFERENCE STANDARDS**

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements 2018.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
- C. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements 2018.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2014, with Editorial Revision (2017).
- F. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2017.
- G. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
  - 2. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Designer's Qualification Statement.
- E. Fabricator's Qualification Statement.

**1.04 QUALITY ASSURANCE**

- A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Fabricator: Company specializing in performing the work of this section with minimum 5 years of documented experience.

**PART 2 PRODUCTS****2.01 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A500/A500M, Grade B, cold-formed or ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.
- E. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- G. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.

- H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

**2.02 FABRICATION - GENERAL**

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

**2.03 LOOSE STEEL LINTELS**

- A. General:
  - 1. Fabricate loose steel lintels from steel angles, plates, and other shapes as indicated.
    - a. Weld adjoining members together to form a single unit.
  - 2. Size loose steel lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
  - 3. Galvanize loose steel lintels located in exterior walls.
  - 4. Prime loose steel lintels located in interior walls.
- B. Fabricate loose steel lintels in accordance with the following schedule, unless otherwise indicated:

<i>CLEAR SPAN (Feet)</i>	<i>WALL WIDTH (Inches)</i>	<i>ANGLE SIZE (LLV)</i>	<i>BEAM SIZE</i>	<i>VERTICAL PLATES (Inches)</i>	<i>HORIZONTAL PLATE SIZE (Inches)</i>
0 to 4	0 to 4	4x4x3/8	-	-	--
	4+ to 8	-	-	4x1/4	Wall Width minus 1 x 3/8
	8+ to 12	-	-	(2) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
	12+ to 16	-	-	(3) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
4+ to 6	0 to 4	4x4x3/8	-	-	-
	4+ to 8	-	-	4x1/4	Wall Width minus 1 x 3/8
	8+ to 12	-	-	(2) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
	12+ to 16	-	-	(3) 4x1/4, 4 oc	Wall Width minus 1 x 3/8
6+ to 8	0 to 4	6x4x3/8	-	-	-
	4+ to 8	-	-	5x3/8	Wall Width minus 1 x 3/8
	8+ to 12	-	-	(2) 5x3/8, 4 oc	Wall Width minus 1 x 3/8
	12+ to 16	-	-	(3) 5x3/8, 4 oc	Wall Width minus 1 x 3/8
8+ to 12	4+ to 8	-	W8x10	-	Wall Width minus 1 x 3/8

<i>CLEAR SPAN (Feet)</i>	<i>WALL WIDTH (Inches)</i>	<i>ANGLE SIZE (LLV)</i>	<i>BEAM SIZE</i>	<i>VERTICAL PLATES (Inches)</i>	<i>HORIZONTAL PLATE SIZE (Inches)</i>
	8+ to 12	-	W8x10	-	Wall Width minus 1 x 3/8
	12+ to 16	-	W8x13	-	Wall Width minus 1 x 3/8
Refer to Drawings for conditions other than those listed in chart above.					

**2.04 MISCELLANEOUS**

- A. Protective Coating: Zinc molybdate alkyd.
- B. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

**2.05 FINISHES - STEEL**

- A. Prepare surfaces to be primed in accordance with SSPC-SP2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Prime Painting: One coat.
  - 1. Provide at all fabrications except at galvanized locations and where otherwise indicated.
- D. Where indicated, galvanizing of Structural Steel Members: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
  - 1. Locations: All exterior locations and elsewhere as indicated.
- E. Where indicated, galvanizing of Non-structural Items: Galvanize after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
  - 1. Locations: All exterior locations and elsewhere as indicated.

**2.06 FABRICATION TOLERANCES**

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

**PART 3 EXECUTION**

**3.01 EXAMINATION**

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

**3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

**3.03 INSTALLATION - GENERAL**

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

**3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

**END OF SECTION**

**SECTION 05 5213 - PIPE AND TUBE RAILINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Steel pipe and tube railings.
- B. Includes:
  - 1. Wall mounted handrails.

**1.02 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures 2006.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2020.
- F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2009 (Reapproved 2015).
- G. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2017.
- H. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings 2013, with Editorial Revision.
- I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2012.
- J. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer 1999 (Ed. 2004).

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordination: Coordinate installation of the following:
  - 1. Placement of anchors in concrete and masonry.
  - 2. Placement of backing plates in stud wall construction.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, material descriptions, finishes, dimensions and details for the following:
  - 1. Gate hardware.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
  - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
  - 2. Include the design engineer's seal and signature on each sheet of shop drawings.
- D. Samples:
  - 1. Railings: Submit 3 samples 12 inches long for each material and finish selected.
  - 2. Miscellaneous: Submit 3 samples, full size, of each elbow, wall bracket, and end stop.
- E. Designer's Qualification Statement.
- F. Fabricator's Qualification Statement.

**1.05 QUALITY ASSURANCE**

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.

- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. Fabricator Qualifications:
  - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
  - 2. A company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

## **PART 2 PRODUCTS**

### **2.01 RAILINGS - GENERAL REQUIREMENTS**

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Railing Configurations and Layout: As indicated.
- C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- E. Allow for expansion and contraction of members and building movement without damage to connections or members.
- F. Dimensions: See drawings for configurations and heights.
  - 1. Top Rails and Wall Rails: 1-1/2 inches diameter, round, unless otherwise indicated.
  - 2. Intermediate Rails: 1-1/2 inches diameter, round, unless otherwise indicated.
  - 3. Posts: 1-1/2 inches diameter, round, unless otherwise indicated.
  - 4. Balusters: 1/2 inch round solid bar, unless otherwise indicated.
- G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- H. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

### **2.02 STEEL RAILING SYSTEM**

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.
- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: No exposed bolts or screws.
- E. Galvanizing: In accordance with requirements of ASTM A123/A123M.
  - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type II - Organic.
  - 2. Locations: All exterior locations and elsewhere as indicated.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
  - 1. Locations: All locations except where galvanizing is required.

### **2.03 MISCELLANEOUS MATERIALS**

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.



- B. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- C. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; minimum 0.015 inch dry film thickness per coat.

#### **2.04 FABRICATION**

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured.
- D. Welded Joints:
  - 1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
  - 2. Interior Components: Continuously seal joined pieces by continuous welds.
  - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

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

#### **3.02 PREPARATION**

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Weld connections that cannot be shop welded due to size limitations.
  - 1. Weld in accordance with AWS D1.1/D1.1M.
  - 2. Match shop welding and bolting.
  - 3. Clean welds, bolted connections and abraded areas.
  - 4. Touch up shop primer and factory applied finishes.
  - 5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.
- F. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.
- G. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

#### **3.04 TOLERANCES**

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

#### **3.05 PROTECTION**

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.

1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

**END OF SECTION**

**SECTION 06 1000 - ROUGH CARPENTRY****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Structural dimension lumber framing.
- B. Nonstructural dimension lumber framing.
- C. Sheathing.
- D. Subflooring.
- E. Preservative treated wood materials.
- F. Fire retardant treated wood materials.
- G. Miscellaneous framing and sheathing.
- H. Concealed wood blocking, nailers, and supports.
- I. Miscellaneous wood nailers, furring, and grounds.

**1.02 REFERENCE STANDARDS**

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing 2003 (Reapproved 2017).
- C. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010 (Reapproved 2017).
- D. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing 2019a.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
- G. PS 1 - Structural Plywood 2009.
- H. PS 20 - American Softwood Lumber Standard 2020.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

**PART 2 PRODUCTS****2.01 GENERAL REQUIREMENTS**

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
  - 1. Species: Unless otherwise indicated, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
  - 2. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at [www.alsc.org](http://www.alsc.org), and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

**2.02 DIMENSION LUMBER**

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: Kiln-dry or MC15.
- C. Stud Framing (2 by 2 through 2 by 6 ):
  - 1. Species: Southern Pine.
  - 2. Grade: No. 2.
- D. Stud Framing Framing (2 by 6 through 4 by 16 ):
  - 1. Species: Southern Pine.
  - 2. Grade: No. 2.
- E. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
  - 1. Lumber: S4S, No. 2 or Standard Grade.
  - 2. Boards: Grade No. 2.

**2.03 CONSTRUCTION PANELS**

- A. Subfloor: Plywood, PS 1, Grade C-C, Touch-sanded.
  - 1. Panel Grade: APA Rated; Sturd-I-Floor Sheathing.
  - 2. Span Rating: 48/24.
  - 3. Bond Classification: Exposure 1.
  - 4. Performance Category: 3/4.
  - 5. Thickness: 3/4 inch unless otherwise indicated.
  - 6. Tongue-and-groove edges.
- B. Other Applications:
  - 1. Plywood Concealed From View But Located Within Exterior Enclosure: PS 1, C-C Plugged or better, Exterior grade.
  - 2. Concealed Plywood in Other Locations: PS 1, C-D Plugged or better.

**2.04 ACCESSORIES**

- A. Fasteners and Anchors:
  - 1. Metal and Finish: Stainless steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
  - 2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
  - 3. Anchors:
    - a. Toggle bolt type for anchorage to hollow masonry.
    - b. Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
    - c. Bolt or ballistic fastener for anchorages to steel
- B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
  - 1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
  - 2. Manufacturers:
    - a. MiTek Industries, Inc.: [www.mitek-us.com](http://www.mitek-us.com).
    - b. Nu-Vue Industries, Inc.: [www.nu-vueindustries.com](http://www.nu-vueindustries.com).
    - c. Simpson Strong-Tie Company Inc.: [www.strongtie.com](http://www.strongtie.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
- C. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
  - 1. Products:
    - a. Owens Corning Insulating Systems, LLC; ProPink ComfortSeal Sill Gasket: [www.owenscorning.com](http://www.owenscorning.com).
    - b. Dupont/Dow; Sill Seal Foam Gasket: [www.dupont.com](http://www.dupont.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.
- D. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.
  - 1. Manufacturers:

- a. Franklin International, Inc; Titebond GREENchoice Weatherproof Subfloor Adhesive: [www.titebond.com](http://www.titebond.com).
  - b. Liquid Nails, a brand of PPG Industries, Inc.; LN-902 Subfloor & Deck Construction Adhesive (Low VOC): [www.liquidnails.com](http://www.liquidnails.com).
  - c. Substitutions: See Section 01 6000 - Product Requirements.
- E. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.
1. Manufacturers:
    - a. Franklin International, Inc; Titebond GREENchoice Heavy Duty Construction Adhesive: [www.titebond.com](http://www.titebond.com).
    - b. Liquid Nails, a brand of PPG Industries, Inc.; LN-903 Heavy Duty Construction Adhesive (Low VOC): [www.liquidnails.com](http://www.liquidnails.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

## 2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
  2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWWA standards.
- B. Fire Retardant Treatment:
1. Manufacturers:
    - a. Lonza Group: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Hoover Treated Wood Products, Inc: [www.frtw.com](http://www.frtw.com).
    - c. Koppers, Inc: [www.koppersperformancechemicals.com](http://www.koppersperformancechemicals.com).
    - d. Viance, LLC: [www.treatedwood.com](http://www.treatedwood.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Exterior Type: AWWA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Treat lumber in locations as indicated
  3. Interior Type A: AWWA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
    - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
    - b. Interior rough carpentry items are to be fire retardant treated.
- C. Preservative Treatment:
1. Manufacturers:
    - a. Lonza Group: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Hoover Treated Wood Products, Inc: [www.frtw.com](http://www.frtw.com).
    - c. Koppers Performance Chemicals, Inc: [www.koppersperformancechemicals.com](http://www.koppersperformancechemicals.com).
    - d. Viance, LLC: [www.treatedwood.com](http://www.treatedwood.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Preservative Pressure Treatment of Lumber Above Grade: AWWA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.

- a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
  - b. Treat lumber exposed to weather.
  - c. Treat lumber in contact with roofing, flashing, or waterproofing.
    - 1) At Contractor's option, roof nailers may be non-preservative treated.
  - d. Treat lumber in contact with masonry or concrete.
  - e. Treat lumber less than 18 inches above grade.
  - f. Treat lumber in other locations as indicated.
3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
    - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
    - b. Treat plywood in contact with roofing, flashing, or waterproofing.
    - c. Treat plywood in contact with masonry or concrete.
    - d. Treat plywood less than 18 inches above grade.
    - e. Treat plywood in other locations as indicated.
  4. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
  5. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

#### **3.02 INSTALLATION - GENERAL**

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

#### **3.03 FRAMING INSTALLATION**

- A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
- B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
- C. Install structural members full length without splices.
- D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
- E. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.
- F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
- G. Provide bridging at framing in excess of 8 feet span at mid-span and as detailed. Fit solid blocking at ends of members.
- H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

#### **3.04 MISCELLANEOUS FRAMING**

- A. Install miscellaneous framing level, plumb, and true to line.

- B. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
- C. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.

### **3.05 BLOCKING, NAILERS, AND SUPPORTS**

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- C. Provide the following specific nonstructural framing and blocking:
  - 1. Cabinets and shelf supports.
  - 2. Wall brackets.
  - 3. Handrails.
  - 4. Grab bars.
  - 5. Towel and bath accessories.
  - 6. Other locations as indicated.

### **3.06 INSTALLATION OF CONSTRUCTION PANELS**

- A. Subflooring: Glue and screw to framing; staples are not permitted.

### **3.07 TOLERANCES**

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

### **3.08 CLEANING**

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

### **END OF SECTION**





**SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Standing and running trim.
- B. Cabinets and millwork - specially fabricated.
  - 1. Plastic-laminate clad cabinets and millwork.
- C. Countertops.
  - 1. Solid surfacing countertops.
- D. Miscellaneous items including:
  - 1. Window stools
  - 2. Closet and utility shelving.
  - 3. Other items as indicated on Drawings.

**1.02 REFERENCE STANDARDS**

- A. ANSI A208.1 - American National Standard for Particleboard 2016.
- B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use 2016.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).
- E. AWPA U1 - Use Category System: User Specification for Treated Wood 2018.
- F. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- H. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- I. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII 2016.
- J. NEMA LD 3 - High-Pressure Decorative Laminates 2005.
- K. PS 1 - Structural Plywood 2009.
- L. UL (DIR) - Online Certifications Directory Current Edition.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for the following:
  - 1. Anchors and fasteners.
  - 2. Adhesives.
  - 3. Shop finishing materials.
  - 4. Fire retardant treatment.
  - 5. Wood preservative treatment.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories. Include the following:
  - 1. Information required by AWI/AWMAC/WI (AWS).
  - 2. Dimensioned plans, elevations, and sections.
  - 3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
  - 4. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.
- D. Samples: Three samples of each of the following:
  - 1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish.
  - 2. Transparent Wood Finishes:

- a. Standing and Running Trim: 4 inches by 12 inches for each species, cut, and finish; finish on one side and one edge.
- b. Door Frames and Borrowed Lite Frames: 4 inches by 12 inches for each species, cut, and finish; finish on one side and one edge.
- c. Wood Cabinets and Millwork: 12 by 12 inches sample for each species, cut, and finish.
- 3. Solid Surfacing: 4 by 4 inches, for each type, color, pattern, and finish.
- 4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.
- 5. Wood Veneer Panel Products: 12 by 12 inches sample for each type and finish.
- 6. Lumber and Panel Products for Field-applied Opaque Finish: 4 inches wide by 12 inches long for lumber and 12 by 12 inches for panels.
  - a. Unfinished.

#### **1.05 QUALITY ASSURANCE**

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
- B. Single Source Responsibility: Provide and install interior architectural woodwork from single fabricator.

#### **1.06 MOCK-UP**

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Mockups: When requested by Architect, build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Comply with AWI/AWMAC/WI (AWS).
- B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.
- C. Store woodwork in installation areas or in areas with the same environmental conditions; temperature and humidity conditions in storage areas shall be at the same levels planned for occupancy.
- D. Protect units from moisture damage.

#### **1.08 FIELD CONDITIONS**

- A. During and after installation of architectural woodwork, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

### **PART 2 PRODUCTS**

#### **2.01 WOOD-BASED COMPONENTS**

- A. Wood fabricated from old growth timber is not permitted.
- B. Particle Board: ANSI A208.1, Grade M-2.
- C. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.
- D. Hardwood Plywood: HPVA HP-1.
- E. Softwood Plywood: PS 1.
- F. Fire Retardant Treatment:
  - 1. Manufacturers:
    - a. Lonza Group: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Hoover Treated Wood Products, Inc: [www.frtw.com](http://www.frtw.com).
    - c. Koppers, Inc: [www.koppersperformancechemicals.com](http://www.koppersperformancechemicals.com).
    - d. Viance, LLC: [www.treatedwood.com](http://www.treatedwood.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.

2. Interior Type A: AWP A U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
  - a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
- G. Preservative Treatment:
  1. Manufacturers:
    - a. Lonza Group: [www.wolmanizedwood.com](http://www.wolmanizedwood.com).
    - b. Hoover Treated Wood Products, Inc: [www.frtw.com](http://www.frtw.com).
    - c. Koppers Performance Chemicals, Inc: [www.koppersperformancechemicals.com](http://www.koppersperformancechemicals.com).
    - d. Viance, LLC: [www.treatedwood.com](http://www.treatedwood.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  2. Preservative Pressure Treatment of Lumber Above Grade: AWP A U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
    - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
    - b. Treat lumber in contact with masonry or concrete.
    - c. Treat lumber in other locations as indicated.
  3. Preservative Pressure Treatment of Plywood Above Grade: AWP A U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
    - a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
    - b. Treat plywood in contact with masonry or concrete.
    - c. Treat plywood at countertop subtops at sinks or other wet locations.
    - d. Treat plywood in other locations as indicated.
  4. Preservative Pressure Treatment of Lumber in Contact with Soil: AWP A U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
  5. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

## 2.02 LAMINATE MATERIALS

- A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as indicated or recommended for specific applications.
  1. Manufacturers:
    - a. Formica Corporation: [www.formica.com](http://www.formica.com).
    - b. Panolam Industries International, Inc. Nevamar: [www.nevamar.com](http://www.nevamar.com).
    - c. Panolam Industries International, Inc. Pionite: [www.pionitelaminates.com](http://www.pionitelaminates.com).
    - d. Wilsonart: [www.wilsonart.com](http://www.wilsonart.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
  2. Colors, Patterns, and Finishes:
    - a. Architect shall select up to two (2) colors/patterns, from standard and premium laminates, from all manufacturers listed in Section 2.01.A.1.
- B. Low Pressure Decorative Laminate (LPDL): Melamine resin, NEMA LD 3, Type VGL (0.20 inch thick) laminate panels; thermally fused.
  1. Manufacturers:
    - a. Panolam Industries International, Inc.: [www.panolam.com](http://www.panolam.com).
    - b. Wilsonart: [www.wilsonart.com](http://www.wilsonart.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.
  2. Color: White unless otherwise indicated.
- C. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness. Match adjacent laminate in color, pattern, and finish.
  1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.

2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

### 2.03 SOLID SURFACING

- A. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous and non-porous; no surface coating; color and pattern consistent throughout thickness.
  1. Manufacturers:
    - a. E. I. du Pont de Nemours and Company (Dupont); Corian: [www.corian.com](http://www.corian.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
  2. Colors, Patterns, and Finishes:
    - a. Troy High School (13174H): Architect shall select up to two (2) colors from manufacturer's full range, including all price groups.
    - b. Smith Middle School (13172G): Color shall be "Dove."

### 2.04 ACCESSORIES

- A. Support Faming, Grounds, and Concealed Blocking: Refer to Section 06 1000 - Rough Carpentry.
- B. Stain and Finishing Materials: In compliance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- C. Adhesives: Type recommended by fabricator to suit application.
  1. Do not use adhesives that contain urea formaldehyde.
  2. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. Wood Glues: 30 g/L.
    - b. Contact Adhesive: 250 g/L.
- D. Fasteners: Size and type to suit application.
- E. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- F. Concealed Joint Fasteners: Threaded steel.

### 2.05 HARDWARE

- A. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
  1. K & V standards No.85 with coordinating brackets No.185 - 14"
  2. Finish: Anochrome
- B. Countertop Support Brackets:
  1. Tee-Shaped Brackets: Fabricated from 6063-T6 extruded aluminum 2 inch by 3 inch by 3/16 inch Tee.
    - a. Finish: Black.
    - b. Size: 18 inch support unless otherwise indicated.
      - 1) Manufacturers:
        - (a) Rakks Model EH 1818 ; Rangine Corp.: [www.rakks.com](http://www.rakks.com).
        - (b) Or equal by A&M Hardware, Inc.; [www.aandmhardware.com](http://www.aandmhardware.com).
        - (c) Substitutions: See Section 01 6000 - Product Requirements.
    - c. Where concealed flush mount is indicated on Drawings, provide the following:
      - 1) Manufacturers:
        - (a) Rakks Model EH1818-FM; Rangine Corp.: [www.rakks.com](http://www.rakks.com).
        - (b) Or equal by A&M Hardware, Inc.; [www.aandmhardware.com](http://www.aandmhardware.com).
        - (c) Substitutions: See Section 01 6000 - Product Requirements.

**2.06 FABRICATION**

- A. General:
  - 1. Fabricate woodwork to dimensions, profiles, and details indicated.
  - 2. 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.
  - 3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.
    - a. Locate openings accurately and use templates to produce accurately sized and shaped openings.
  - 4. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
  - 5. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
    - a. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
    - b. Cap exposed plastic laminate finish edges with material of same finish and pattern, unless otherwise indicated.
  - 6. Fire Retardant Wood Materials:
    - a. Provide UL (DIR) listed and approved identification on fire retardant treated material.
    - b. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.
- B. Cabinets and Millwork:
  - 1. Assembly: Shop assemble cabinets and millwork for delivery to site in units easily handled and to permit passage through building openings.
  - 2. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Countertops:
  - 1. Fabricate tops in one piece, unless size dictates multiple pieces.
  - 2. Solid-Surface Sinks: Provide undermount sinks integrated at factory with solid surface countertops.

**2.07 STANDING AND RUNNING TRIM**

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. For Transparent Finishes:
  - 1. Wood Species: Red Oak.
  - 2. Cut: Plain sawn.
  - 3. Wood Moisture Content: 5 to 10.
  - 4. Veneer Grade: AA.
- C. For Opaque Finishes:
  - 1. Wood Species: Any closed-grain hardwood.
  - 2. Wood Moisture Content: 5 to 10.
- D. Wood Profiles: As indicated on Drawings.

**2.08 PLASTIC LAMINATE CABINETS AND MILLWORK**

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Casework Construction Type: Frameless.
- C. Door and Drawer Style: Flush Overlay.
- D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
- E. Exposed Surfaces:

1. Horizontal Surfaces: Grade HGL (0.039 inch thick).
  2. Vertical Surfaces: Grade VGS (0.028 inch thick).
  3. Door and Drawer Edges: PVC edge banding, 0.118 inch (3mm) thick, matching laminate in color, pattern, and finish .
  4. Other Edges: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish
  5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- F. Semi-exposed Surfaces:
1. For semiexposed backs of panels with exposed surfaces: Grade VGS (0.028 inch thick).
  2. Surfaces Other Than Drawer Bodies: Low pressure decorative laminate.
    - a. Edges of Low Pressure Decorative Laminate Shelves: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish.
  3. Surfaces of Drawer Subfronts, Backs, and Sides: Low pressure decorative laminate.
  4. Cores of Drawer Subfronts, Backs, and Sides: Hardwood veneer plywood.
  5. Drawer Bottoms: Hardwood veneer plywood.
- G. Concealed Backs of Panels with Exposed or Semi-exposed Surfaces: Grade BKL (0.020 inch thick).
- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Drawer Construction Method: Multiple dovetailed or doweled.
- I. All cabinets and millwork shall be fabricated with balance construction.
- J. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

## 2.09 COUNTERTOPS

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Subtops: plywood.
1. Thickness: 3/4 inch.
  2. Provide preservative treatment for subtops at sink or other wet locations.
- C. Solid Surface Countertops: Solid surfacing over continuous substrate.
1. Flat Sheet Thickness: 1/2 inch, minimum.
  2. Substrate: Particle board, medium density fiberboard (MDF), or plywood.
    - a. Thickness: 3/4 inch.
  3. Other Components Thickness: 1/2 inch, minimum.
  4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
  5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
    - a. Field applied.
  6. Fabricate in accordance with manufacturer's standard requirements.

## 2.10 MISCELLANEOUS ITEMS

- A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
- B. Solid Surface Window Stools: Solid surfacing sheet or plastic resin casting over continuous substrate.
1. Flat Sheet Thickness: 1/2 inch, minimum.
  2. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.

## 2.11 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Field Applied Opaque Finishes:
1. Apply wood filler in exposed nail and screw indentations and sand smooth.
  2. Shop prime with one coat of wood primer as specified in Section 09 9123 - Interior Painting.

3. Refer to Section 09 9100 - Painting for field painting.
- C. Shop Applied Transparent Finishes:
  1. On items to receive transparent finishes, use wood filler matching or blending with surrounding surfaces and of types recommended for applied finishes.
  2. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
    - a. Transparent Finishes:
      - 1) Provide one of the following finishes:
        - (a) System - 5, Varnish, Conversion.
        - (b) System - 9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
        - (c) System - 10, UV Curable, Water-based.
        - (d) System - 11, Polyurethane, Catalyzed.
      - 2) Stain: To match Architect's samples.
      - 3) Sheen: Satin.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

#### **3.02 PREPARATION**

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.
- B. Condition all interior architectural woodwork to temperature and humidity conditions in installation areas for not less than 72 hours prior to installation.
  1. Temperature and humidity conditions shall be same levels planned for occupancy.

#### **3.03 INSTALLATION - GENERAL**

- A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.
- B. Install architectural woodwork level, plumb, true in line, and without distortion.
  1. Shim as required with concealed shims.
  2. Install level and plumb to a tolerance of 1/8 inch in 96 inches
- C. Scribe and cut architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

#### **3.04 STANDING AND RUNNING TRIM INSTALLATION**

- A. Install with minimum number of joints.
  1. Use full-length pieces to greatest extent possible.
- B. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary.
- C. Scarf running joints and stagger in adjacent and related members.
- D. Secure with countersunk, concealed fasteners and blind nailing.
  1. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with architectural woodwork.
  2. For shop-finished items, use filler matching finish of items being installed.
- E. Fill gaps between top of base and wall with latex sealant.
  1. Refer to Section 07 9200 - Joint Sealants for latex sealant.
  2. Paint sealant; refer to Section 09 9123 - Interior Painting.

#### **3.05 CABINET AND MILLWORK INSTALLATION**

- A. Set and secure custom cabinets and millwork in place, assuring that they are rigid, plumb, and level.
- B. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned.

1. Adjust hardware to center doors and drawers in openings and to provide easy and smooth operation.
- C. Use fixture attachments in concealed locations for wall mounted components.
  1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips, or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- E. Secure cabinets to floor using appropriate angles and anchorages.

### **3.06 COUNTERTOP INSTALLATION**

- A. Install countertops level; shim where required.
  1. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum.
  2. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- C. Attach plastic laminate countertops to substrates using concealed screws and fasteners.
- D. Attach solid surfacing countertops to substrates with adhesive according to solid surfacing manufacturer's written instructions.
- E. Joints: Keep to a minimum; seal with manufacturer's recommended joint adhesive.
  1. Joints shall be inconspicuous in appearance, smooth, and without voids.
  2. Use adhesive in color to match countertop; form seams according to manufacturer's written instructions.
- F. Install back and end splashes to countertop and walls with manufacturer's recommended adhesive.
- G. Apply sealant between back and end splashes and wall.
  1. Refer to Section 07 9200 - Joint Sealants for joint sealant.

### **3.07 ADJUSTING**

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

### **3.08 REPAIRING AND CLEANING**

- A. Repair damaged and defective architectural woodwork, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural woodwork.
- B. Clean all architectural woodwork, including, but not limited to, casework, counters, shelves, hardware, fittings, and fixtures.

### **END OF SECTION**



**SECTION 07 9200 - JOINT SEALANTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

**1.02 RELATED REQUIREMENTS**

- A. Section 08 8000 - Glazing: Glazing sealants and accessories.
- B. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

**1.03 REFERENCE STANDARDS**

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer 2015.
- B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.
- C. ASTM C834 - Standard Specification for Latex Sealants 2017.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
- E. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- F. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.
- G. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants 2018.
- H. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015, with Editorial Revision (2017).

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
  - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
  - 2. List of backing materials approved for use with the specific product.
  - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
  - 4. Substrates the product should not be used on.
  - 5. Substrates for which use of primer is required.
  - 6. Sample product warranty.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where custom colors are not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Samples for Verification: For each sealant color, submit at least three physical samples for color verification.
  - 1. Provide 1/2 inch wide joint sealant samples formed between two 4 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.
- F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

- B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
  - 1. Adhesion Testing: In accordance with ASTM C794.
  - 2. Compatibility Testing: In accordance with ASTM C1087.
  - 3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
  - 4. Allow sufficient time for testing to avoid delaying the work.
  - 5. Deliver to manufacturer sufficient samples for testing.
  - 6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
  - 7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- D. Owner may employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
  - 1. Contractor shall cooperate with testing agency and repair failures discovered.

#### **1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

### **PART 2 PRODUCTS**

#### **2.01 JOINT SEALANT APPLICATIONS**

- A. Scope:
  - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
    - a. Wall expansion and control joints.
    - b. Joints between door, window, and other frames and adjacent construction.
    - c. Joints between different exposed materials.
    - d. Openings below ledge angles in masonry.
    - e. Other joints as indicated.
  - 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
    - a. Joints between door, window, and other frames and adjacent construction.
    - b. Other joints as indicated.
  - 3. Do not seal the following types of joints.
    - a. Intentional weepholes in masonry.
    - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
    - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
    - d. Joints where installation of sealant is specified in another section.
    - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.
- C. Interior Joints: Use non-sag acrylic emulsion latex sealant, unless otherwise indicated.
  - 1. Interior Sides of Aluminum Framing in Exterior Walls: Use non-sag non-staining silicone sealant, unless otherwise indicated.
    - a. Includes, but is not limited to, curtain walls, storefronts, and metal-framed skylights.

2. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
  3. Joints between countertops and walls: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
- D. Interior Wet Areas: Includes, but is not limited to, toilet rooms, showering areas, locker rooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

## 2.02 NONSAG JOINT SEALANTS

1. Hardness Range: Comply with one of the following:
    - a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
    - b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
  2. Color: Custom color(s) to match Architect's sample(s).
  3. Cure Type: Single-component, neutral moisture curing.
  4. Service Temperature Range: Minus 40 to 250 degrees F.
  5. Products:
    - a. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: [www.siliconeforbuilding.com](http://www.siliconeforbuilding.com).
    - b. Pecora Corporation; 890NST: [www.pecora.com](http://www.pecora.com).
    - c. Sika Corporation; Sikasil WS-295 FPS: [www.usa.sika.com](http://www.usa.sika.com).
    - d. Tremco, Inc.; Spectrem 3: [www.tremcosealants.com](http://www.tremcosealants.com).
    - e. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: [consumer.dow.com/en-us/industry/ind-building-construction.html/#sle](http://consumer.dow.com/en-us/industry/ind-building-construction.html/#sle).
    - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use. Siliconized.
1. Color: To be selected by Architect from manufacturer's full range.
  2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
  3. Products:
    - a. Franklin International Inc; Titebond Painter's Plus Caulk: [www.titebond.com](http://www.titebond.com).
    - b. Pecora Corporation; AC-20 +Silicone: [www.pecora.com](http://www.pecora.com).
    - c. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: [www.sherwin-williams.com](http://www.sherwin-williams.com).
    - d. Tremco, Inc.; Tremflex 834: [www.tremcosealants.com](http://www.tremcosealants.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.

## 2.03 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
  2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
  3. Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.

- C. Verify that backer rods are of the correct size.

### **3.02 PREPARATION**

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

### **3.03 INSTALLATION**

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

### **3.04 FIELD QUALITY CONTROL**

- A. Owner may employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
- B. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

### **END OF SECTION**

**SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Hollow metal borrowed lites glazing frames.

**1.02 ABBREVIATIONS AND ACRONYMS**

- A. ANSI: American National Standards Institute.
- B. BHMA - Builders Hardware Manufacturers Association.
- C. NFPA: National Fire Protection Association.
- D. SDI: Steel Door Institute.
- E. UL: Underwriters Laboratories.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames. 2003.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2017.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2020.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete 2020.
- J. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- K. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2016.
- L. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- M. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2014.
- N. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2019.
- O. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
  - 1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
- D. Manufacturer's Qualification Statement.

- E. Installer's Qualification Statement.

### 1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

### 1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ANSI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

### 1.07 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer warranty for doors and frames to be free from material or workmanship defects and within commercial tolerances within a 1 year period after Date of Substantial Completion.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
  - 1. Ceco Door, an Assa Abloy Group company: [www.cecodoor.com](http://www.cecodoor.com).
  - 2. Curries, an Assa Abloy Group company: [www.curries.com](http://www.curries.com).
  - 3. De La Fontaine: [www.delafontaine.com](http://www.delafontaine.com).
  - 4. Mesker/Mesker Openings Group, a Dormakaba Group company: [www.meskeropeningsgroup.com](http://www.meskeropeningsgroup.com).
  - 5. Pioneer Industries, an Assa Abloy Group company: [www.pioneerindustries.com](http://www.pioneerindustries.com).
  - 6. Republic Doors, an Allegion brand: [www.republicdoor.com](http://www.republicdoor.com).
  - 7. Steelcraft, an Allegion brand: [www.allegion.com](http://www.allegion.com).
  - 8. Substitutions: See Section 01 6000 - Product Requirements.

### 2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
  - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
  - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
  - 3. Door Edge Profile: Beveled, both sides.
  - 4. Typical Door Face Sheets: Flush.
  - 5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturers standard.
  - 6. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115 and ANSI A250.8 (SDI-100) in accordance with specified requirements and as follows:
    - a. Minimum Hardware reinforcing thicknesses:
      - 1) Mortise Butt Hinges: 0.123 inches (10 gage),
      - 2) Pivot Hinges: 0.167 inches (7 gage)
      - 3) Continuous Hinges: 0.067 inches (14 gage).
      - 4) Exit Devices: 0.067 inches (14 gage)
      - 5) Mortise Locksets and Deadbolts: 0.067 inches (14 gage).
      - 6) Bored Locksets and Deadbolts: 0.067 inches (14 gage).
      - 7) Flush and Surface Bolts: 0.067 inches (14 gage).
      - 8) Closers and Hold Open Arms: 0.067 inches (14 gage).
      - 9) Pull Plates and Push/Pull Bars: 0.067 inches (14 gage).
      - 10) Protection Plates and Push Plates: No reinforcing required.

7. Zinc Coating: Where indicated, provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M.
  - a. Minimum A60/ZF180 (galvannealed) coating unless otherwise indicated.
- B. Hollow Metal In-Fill Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

### 2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Interior Doors, Non-Fire Rated:
  1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
    - a. Level 3 - Extra Heavy-duty.
    - b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
    - c. Model 2 - Seamless.
    - d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
  2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.

### 2.04 HOLLOW METAL FRAMES

- A. Hollow metal frames based on SDI Standards: ANSI A250.8 (SDI-100).
  1. Joints between faces of abutting frame members shall appear seamless; joints shall be securely welded, filled, and finished smooth without visible seams.
- B. Frame Finish: Factory primed and field finished.
- C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
  1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
  2. Includes frames for wood doors.
- D. Borrowed Light Frames: Full profile/continuously welded type.
  1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
  2. Face dimensions to match door frames.
- E. Mullions for Pairs of Doors: Where indicated provide fixed mullions with profile similar to jambs.
  1. Refer to Section 08 7100 - Door Hardware for removable mullions.
- F. Transom Bars: Fixed, of profile same as jamb and head.
- G. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- H. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
- I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
- J. Frame Anchors:
  1. Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
  2. Floor Anchors: Base anchors welded to bottom of frames, designed to attach frame to floor.
  3. Masonry Anchors: Masonry anchors shall be T-strap type, corrugated or perforated.
  4. Stud Anchors: Z-type, welded to back of frames.
  5. In-Place Concrete or Masonry Wall Anchors: Minimum 3/8 inch diameter bolts with expansion shields or inserts, with manufacturer's standard spacer.
    - a. For existing walls or new openings cut into existing walls

**2.05 FINISHES**

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Corrosion Resistant Back-Coating: Automotive undercoating, asphalt emulsion, or other high-build, water-resistant, resilient coating.

**2.06 ACCESSORIES**

- A. Glazing: As specified in Section 08 8000.
- B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Double Doors: Specified in Section 08 7100.
- D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
  - 1. Comply with requirements of Section 04 2000 - Unit Masonry.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- F. Filler: Two-component, non-shrinking resin, autobody filler.
  - 1. Available Products:
    - a. 3M/Bondo; Professional Gold Body Filler: [www.bondo.com](http://www.bondo.com).

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

**3.02 PREPARATION**

- A. Back-Coating of Non-Rated Frames: Field-apply corrosion resistant back-coatings to frames that are to be grouted solid.

**3.03 INSTALLATION**

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install smoke control units in accordance with NFPA 105.
- C. Set frames accurately in position, aligned, plumb, and square.
- D. Fill head and jamb members with mineral fiber insulation prior to installation.
  - 1. Exception: Do not fill frames that are to be grouted solid.
- E. Grout frames solid in masonry and concrete construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
  - 1. Install silencers prior to grouting frames.
  - 2. Do not grout fire-rated frames; instead fill head and jamb members with mineral fiber insulation.
- F. Frame Anchors:
  - 1. Coordinate frame anchor placement with wall construction.
  - 2. Minimum number of anchors:
    - a. Provide 3 jamb anchors per jamb up to 90 inches in height; evenly spaced.
    - b. Provide 4 jamb anchors per jamb from 90 to 144 inches in height; evenly spaced.
    - c. Provide 1 additional anchor per jamb for each 24 inches or fraction thereof more than 144 inches in height.
    - d. Provide 1 floor anchor at the bottom of each jamb or mullion; where a floor anchor is not possible provide one additional jamb anchor.



- 3. In-Place Concrete or Masonry Wall Anchor: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- G. Install doors plumb with uniform clearance at jambs and head; doors shall open and close without binding
- H. Install glass in accordance with Section 08 8000 - Glazing.
- I. Install door hardware as specified in Section 08 7100.
- J. Coordinate installation of electrical connections to electrical hardware items.

**3.04 TOLERANCES**

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

**3.05 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

**END OF SECTION**



**SECTION 08 1612 - FRP-FACED ALUMINUM DOORS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flush aluminum doors with fiberglass reinforced plastic (FRP) face sheets.
  - 1. Includes FRP-faced aluminum doors installed in storefront framing.

**1.02 ABBREVIATIONS**

- A. FRP: Fiberglass reinforced plastic.

**1.03 REFERENCE STANDARDS**

- A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
- C. AAMA 701/702 - Combined Voluntary Specifications for Pile Weatherstrip and Replaceable Fenestration Weatherseals 2011.
- D. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
- J. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2017.
- K. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics 2016.
- L. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates 2016.
- M. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010 (Reapproved 2018).
- N. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films 2007 (Reapproved 2015).
- O. ASTM D570 - Standard Test Method for Water Absorption of Plastics 1998 (Reapproved 2018).
- P. ASTM D638 - Standard Test Method for Tensile Properties of Plastics 2014.
- Q. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials 2017.
- R. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor 2013a.
- S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- T. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

**1.04 SUBMITTALS**

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

- B. Product Data: Manufacturer's descriptive literature for each type of door and frame; include information on fabrication methods, hardware preparation, accessories, installation, and maintenance instructions.
- C. Shop Drawings: Include elevations of each opening type and details at each wall type.
  - 1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
- D. Selection Samples: Complete set of color and finish options, using actual materials, for Architect's selection.
- E. Verification Samples: Three actual pieces of products in each finish specified, not less than 4 inches square or 6 inches long for linear components.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver aluminum components in manufacturer's standard protective packaging, palletted, crated, or banded together.
- B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
- C. Store components in clean, dry, indoor area, under cover in manufacturer's packaging until installation.
- D. Protect materials and finish from damage during handling and installation.

#### **1.07 FIELD CONDITIONS**

- A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

#### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide ten year manufacturer warranty for defects in workmanship and materials.
- C. Provide 25 year warranty on fiberglass reinforced plastic (FRP) face sheets covering delamination, bubbling, and panel corrosion.
- D. Provide 20 year warranty on aluminum finishes 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 D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:
  - 1. Special-Lite, Inc.; SL-17 Door: [www.special-lite.com](http://www.special-lite.com).
  - 2. Substitutions: Not permitted.

**2.02 DESIGN CRITERIA**

- A. Provide door assemblies that have been designed and fabricated in compliance with specified performance requirements.
- B. Factory install door hardware to the greatest extent possible.
- C. Accessibility: Conform to ICC A117.1 and ADA Standards.
- D. Door and Frame Dimensions and Shapes: As indicated on Drawings; dimensions indicated are nominal.
  - 1. Provide the following clearances:
    - a. Hinge and Lock Stiles: 1/8 inch.
    - b. Between Meeting Stiles: 1/4 inch.
    - c. At Top Rail and Bottom Rail: 1/8 inch.

**2.03 MATERIALS**

- A. Aluminum Sheet: ASTM B209 (ASTM B209M), alloy 5005, temper H14, stretcher leveled.
- B. Extruded Aluminum: ASTM B221 (ASTM B221M), alloy 6063, temper T5, or alloy 6463, temper T5.
- C. Fiberglass Reinforced Plastic (FRP) Face Sheet Properties:
  - 1. Ultraviolet stabilized.
  - 2. Surface Burning Characteristics: Flame spread index (FSI) of 76 to 200, Class C, and smoke developed index (SDI) of 450 or less; when tested in accordance with ASTM E84.
  - 3. Izod Impact Resistance: ASTM D256, 12 ft lbf/inch of width, minimum, with notched izod.
  - 4. Tensile Strength at Break: ASTM D638, 13,000 psi, minimum.
  - 5. Water Absorption: ASTM D570, 0.20 percent, maximum, after 24 hours at 74 degrees F.
  - 6. Flexural Strength: ASTM D790, 21,000 psi, minimum.
  - 7. Barcol Hardness: ASTM D2583, minimum of 50 units.
- D. Foam Insulation Fill Material:
  - 1. Manufacturer's standard polystyrene or polyurethane foam.
    - a. Compressive Strength:
      - 1) Polyurethane: 60 psi; ASTM D1621.
    - b. Thermal Resistance:
      - 1) Polyurethane: R-value 6.8 per inch, minimum; ASTM C518.

**2.04 DOORS**

- A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:
  - 1. Overall Door Thickness: 1-3/4 inches.
  - 2. Internal Framing: Extruded aluminum tubing, 1/8 inch minimum thickness, with heavy-duty plated steel through bolts in rails.
    - a. Top and Bottom Rails: 6 inches wide.
    - b. Side Stiles: 2-1/2 inches wide.
  - 3. Provide manufacturer's standard aluminum and steel reinforcements for door hardware; 1/8 inch minimum thickness.
  - 4. Facing: Seamless laminated FRP sheet.
    - a. Sheet Thickness: 0.12 inch, minimum.
    - b. Color: As selected by Architect from manufacturer's standard line.
  - 5. Perimeter Edges: Extruded aluminum caps or returns that capture and secure edges of FRP face sheets.
    - a. Door Edge Profile: Hinged edge square, and lock edge beveled.
  - 6. Core: Foam insulation fill material.
  - 7. Vision Lites: Extruded aluminum framed, gasket glazed.
    - a. Glazing: As specified in Section 08 8000 - Glazing.
  - 8. Aluminum Finish: Class I - Color anodized.
    - a. Color: Dark bronze.
  - 9. Hardware:
    - a. Weatherstripping: Replaceable pile type; at jambs and head of exterior doors.

- b. Bottom Sweep: Manufacturer's concealed adjustable bottom brush.
- c. Door Pulls: Provide recessed flush door pulls, unless otherwise indicated.
  - 1) Products:
    - (a) Special-Lite, Inc.; SL-86: [www.special-lite.com](http://www.special-lite.com).
    - (b) Substitutions: See Section 01 6000 - Product Requirements.
- d. Balance of Hardware: Refer to Section 08 7100 - Door Hardware.

## **2.05 FINISHES FOR ALUMINUM**

- A. Exposed aluminum door components for Smith Middle School Stage Upgrade: Class I Color Anodized Finish: Electrolytically deposited colored anodic coating; AAMA 611AA-M12C22A44, minimum dry film thickness 0.7 mils.
  - 1. Color: Dark bronze.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

## **2.06 ACCESSORIES**

- A. Replaceable Weatherstripping: AAMA 701/702 wool pile.
- B. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
  - 1. Provide concealed fasteners where possible.
  - 2. Exposed fasteners shall match finish of doors and frames.
- C. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.
- D. Laminating Adhesive: Manufacturer's standard low-VOC materials.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
- B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.02 PREPARATION**

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.
- B. Replace components with damage to exposed finishes.
- C. Separate dissimilar metals to prevent electrolytic action between metals.

### **3.03 INSTALLATION**

- A. Install doors in accordance with manufacturer's instructions.
- B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.
- C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
- D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.
- E. Install door hardware as specified in Section 08 7100.
- F. Coordinate installation of electrical connections to electrical hardware items.

**3.04 FIELD QUALITY CONTROL**

- A. Provide services of FRP door manufacturer's field representative to observe for proper installation of system and submit report.

**3.05 TOLERANCES**

- A. Tolerances: Install framing systems in accordance with the following tolerances:
  1. Variation from Plane: Do not exceed 1/8 inch in 12 feet of length or 1/4 inch in any total length.
  2. Offset from Alignment: Maximum offset from true alignment between 2 identical members abutting end to end in line shall not exceed 1/16 inch.
  3. Diagonal Measurements: Maximum difference in diagonal measurements shall not exceed 1/8 inch.
  4. Offset at Corners: Maximum out-of-plane offset of framing at corners shall not exceed 1/32 inch.

**3.06 ADJUSTING**

- A. Adjust for smooth and balanced door movement.

**3.07 CLEANING**

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609 & 610.
- B. Do not use abrasive, caustic, or acid cleaning agents.

**3.08 PROTECTION**

- A. Protect products of this section from damage caused by subsequent construction until Date of Substantial Completion.
- B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

**END OF SECTION**





**SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Aluminum-framed storefront.
- B. Insulated infill panels (including Glazing Type GL-14).
- C. Aluminum doors (for Troy High School Media Center Remodeling).

**1.02 REFERENCE STANDARDS**

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems 2015.
- C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems 2014.
- D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2014 (2015 Errata).
- F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.
- G. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2017a.
- H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- J. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- K. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- L. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.
- M. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
- N. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2019.
- O. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).
- P. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014.
- Q. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors 2002 (Reapproved 2018).
- R. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference 2015.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
  - 1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
- D. Samples:
  - 1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
  - 2. Submit three samples of infill panels for each color and finish, not less than 6 inches square.
- E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
  - 1. Include storefront manufacturer's field representative's field observation reports.
- G. Designer's Qualification Statement.
- H. Manufacturer's Qualification Statement.
- I. Installer's Qualification Statement.
- J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

**1.05 QUALITY ASSURANCE**

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience and approved by manufacturer.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

**1.07 FIELD CONDITIONS**

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

**1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer's warranty for defects in workmanship and materials.
- C. Provide 20 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Thermally Broken Storefront Products:
  - 1. Basis of Design: Kawneer North American, an Arconic company; Trifab 601T Framing System: [www.kawneer.com](http://www.kawneer.com).

2. Other Manufacturers: Provide either the product identified as "Basis of Design" or equivalent products as manufactured by one of the following:
  - a. CMI Architectural; www.cmiarch.com.
  - b. EFCO Corporation, an Apogee Enterprises, Inc. company; www.efcocorp.com.
  - c. Oldcastle Building Envelope; www.obe.com.
  - d. Tubelite Inc, an Apogee Enterprises, Inc. company; www.tubeliteinc.com.
  - e. U. S. Aluminum, part of the C. R. Laurence Family of Companies; www.crl-arch.com.
  - f. YKK AP America, Inc.; www.ykkap.com.
  - g. Substitutions: Refer to Section 01 6000-Product Requirements.
- B. Swing Door Manufacturers:
  1. Any of the manufacturers specified for storefront products.
- C. Source Limitations: Obtain storefront systems, including swing doors, from one manufacturer.

## 2.02 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
  1. Thermal Breaks: Manufacturer's standard pour and debridge system.
  2. Glazing Rabbet: For 1 inch insulating glazing, unless otherwise indicated.
  3. Glazing Rabbet: For 1/4 inch monolithic glazing.
  4. Glazing Position: Centered (front to back).
  5. Framing Face Width: 2 inches.
  6. Framing Depth: 6 inches.
  7. Finish for Smith Middle School Stage Upgrade: Class I color anodized.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
    - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
    - c. Finish Color: Dark bronze.
  8. Finish for Troy High School Media Center Remodeling: High Performance Organic coatings.
    - a. Factory finish all surfaces that will be exposed in completed assemblies.
    - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
    - c. Finish Color: Bone White, to match existing framing
  9. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
  10. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
  11. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
  12. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
  13. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
  14. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. PERFORMANCE REQUIREMENTS
  1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.

- a. Design Wind Loads: Comply with requirements of ASCE 7 and as indicated on Drawings; not less than 25 lbf/ sq ft.
- b. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
3. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.
4. Overall U-value Including Glazing: 0.42 Btu/(hr sq ft deg F), maximum.

### 2.03 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
  1. Framing members for interior applications need not be thermally broken.
  2. Glazing Stops: Flush.
- B. Glazing: As specified in Section 08 8000.
- C. Infill Panels (including Glazing Type GL-14): Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
  1. Overall Thickness: 1 inch.
  2. Face Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
  3. Core: Rigid polystyrene (EPS) insulation core with R-value of 4.
  4. Back Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
  5. Finish: Same as storefront.
  6. Products:
    - a. Citadel Architectural Products; GlazeGuard 1000 WR+; [www.citadelap.com](http://www.citadelap.com).
    - b. Laminators, Inc.; Thermolite; [www.laminatorsinc.com](http://www.laminatorsinc.com).
    - c. Mapes Panels LLC; Corelite; [www.mapespanels.com](http://www.mapespanels.com).
    - d. Substitutions: Refer to Section 01 6000 - Product Requirements.
- D. Swing Doors: Glazed aluminum.
  1. Style: Wide style, refer also to drawings for intermediate rails.
  2. Thickness: 1-3/4 inches.
  3. Top Rail: 5 inches wide.
  4. Vertical Stiles: 5 inches wide.
  5. Bottom Rail: 10 inches wide.
  6. Glazing Stops: Square.
  7. Finish: Same as storefront (as specified for Troy High School Media Center Remodeling).

### 2.04 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.
- D. Fasteners: Stainless steel.
- E. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- F. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.
- G. Glass and Glazing Accessories: As specified in Section 08 8000.

### 2.05 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.

- B. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

## **2.06 HARDWARE**

- A. For each door, include weatherstripping and sill sweep strip.
- B. Other Door Hardware: As specified in Section 08 7100.
- C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.
- D. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

### **3.02 INSTALLATION**

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- I. Install glass and infill panels in accordance with Section 08 8000 - Glazing.
- J. Install door hardware as specified in Section 08 7100 - Door Hardware.
- K. Coordinate installation of electrical connections to electrical hardware items.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

### **3.03 TOLERANCES**

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### **3.04 FIELD QUALITY CONTROL**

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 4000 - Quality Requirements, for general testing and inspection requirements.
- C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
  - 1. Perform a minimum of three tests in each designated area as directed by Architect.
  - 2. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.

- D. Owner may engage an independent inspection agency to perform additional tests and inspections as follows:
1. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
    - a. Perform a minimum of three tests in each designated area as indicated on drawings.
    - b. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.
    - c. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 8 psf.
      - 1) Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
    - d. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.20 psf.
      - 1) Maximum allowable rate of air leakage is 0.09 cfm/sq ft.
- E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

### **3.05 ADJUSTING**

- A. Adjust operating hardware and sash for smooth operation.

### **3.06 CLEANING**

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

### **3.07 PROTECTION**

- A. Protect installed products from damage until Date of Substantial Completion.

### **END OF SECTION**

**SECTION 08 7100 – DOOR HARDWARE****PART 1 – GENERAL****1.01 SUMMARY**

- A. Section includes furnishing, installation and commissioning of mechanical door hardware for doors specified in “Hardware Sets” and required by actual conditions: including screws, bolts, expansion shields, electrified door hardware, and other devices for proper application of hardware.
- B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- C. Related Divisions:
  - 1. Division 03 Concrete
  - 2. Division 06 Rough & Finish Carpentry
  - 3. Division 07 Joint Sealants
  - 4. Division 08 Openings
  - 5. Division 09 Finishes

**1.02 REFERENCES**

- A. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI):
  - 1. ANSI/BHMA A156.1 Butts & Hinges (2016)
  - 2. ANSI/BHMA A156.3 Exit Devices (2014)
  - 3. ANSI/BHMA A156.4 Door Controls – Closers (2013)
  - 4. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks (2014)
  - 5. ANSI/BHMA A156.6 Architectural Door Trim (2015)
  - 6. ANSI/BHMA A156.7 Template Hinge Dimensions (2016)
  - 7. ANSI/BHMA A156.13 Mortise Locks & Latches (2012)
  - 8. ANSI/BHMA A156.18 Materials & Finishes (2016)
  - 9. ANSI/BHMA A156.21 Thresholds (2014)
  - 10. ANSI/BHMA A156.22 Door Gasketing Systems (2012)
  - 11. ANSI/BHMA A156.26 Continuous Hinges (2012)
  - 12. ANSI/BHMA A156.28 Keying Systems (2013)
  - 13. ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames (2014)
  - 14. ANSI/BHMA A156.115W Hardware Preparation in Wood Doors with Wood or Steel Frames (2016)
- B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
  - 1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities 2017.
- C. Underwriters Laboratories, Inc. (UL):
  - 1. UL 10C Positive Pressure Fire Test of Door Assemblies.
  - 2. UL 1784 Air Leakage Test of Door Assemblies.
  - 3. UL 294 Access Control System Units
- D. Door and Hardware Institute (DHI):
  - 1. DHI Publications – Keying Systems and Nomenclature (1989).
  - 2. DHI Publication – Abbreviations and Symbols.
  - 3. DHI Publication – Installation Guide for Doors and Hardware.
  - 4. DHI Publication – Sequence and Format of Hardware Schedule (1996).
- E. National Fire Protection Agency (NFPA):
  - 1. NFPA 70 National Electrical Code 2017.

2. NFPA 80 Standard for Fire Doors and Other Opening Protectives 2016.
3. NFPA 101 Life Safety Code 2018.
4. NFPA 105 Standard for the Installation of Smoke Door Assemblies 2016.

### 1.03 SUBMITTALS

- A. Submit in accordance with Conditions of the Contract and Division 1 Administrative Requirements and Submittal Procedures Section.
- B. Shop Drawings:
  1. Organize hardware schedule in vertical format as illustrated in DHI Publications Sequence and Formatting for the Hardware Schedule. Include abbreviations and symbols page according to DHI Publications Abbreviations and Symbols. Complete nomenclature of items required for each door opening as indicated.
  2. Coordinate final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of hardware.
  3. Architectural Hardware Consultant (AHC), as certified by DHI, who will affix seal attesting to completeness and correctness, including the review of the hardware schedule prior to submittal.
- C. Submit manufacturer's catalog sheet on design, grade, and function of items listed in hardware schedule. Identify specific hardware item per sheet, provide an index, and cover sheet.
- D. Templates:
  1. Upon final approval of the architectural hardware schedules, submit one set of complete templates for each hardware item to the door manufacturers, frame manufacturers, and the installers. Date and index these 8-1/2 inch x 11 inch papers in a three ring binder, including detailed lists of the hardware location requirements for mortised and surface applied hardware within fourteen days of receiving approved door hardware submittals.
- E. Closeout Submittals: Submit to Owner in a three-ring binder or CD if requested.
  1. Warranties.
  2. Maintenance and operating manual.
  3. Maintenance service agreement.
  4. Record documents.
  5. Copy of approved hardware schedule.
  6. Copy of approved keying schedule with bitting list.
  7. Door hardware supplier name, phone number, and fax number.

### 1.04 QUALITY ASSURANCE

- A. Listed and Labeled electrified door hardware as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction.
- B. Hardware supplier will employ an Architectural Hardware Consultant (AHC) as certified by DHI and a member of the seal program who will be available at reasonable times during course of work for Project hardware consultation.
- C. Door hardware conforming to ICC/ANSI A117.1: Handles pulls, latches locks and operating devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.



- 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/or labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C, unless otherwise indicated.
- E. Fire Door Inspection: Prior to receiving certificate of occupancy have fire rated doors inspected by an independent Certified Fire and Egress Door Assembly Inspector (FDAI), as certified by Intertek (ITS), a written report be submitted to Owner and Contractor. Doors failing inspection must be adjusted, replaced or modified to be within appropriate code requirements.
- F. Smoke and Draft Control Door Assemblies: Where smoke and draft control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
- G. Door hardware certified to ANSI/BHMA standards as noted, participate and be listed in BHMA Certified Products Directory.
- H. Substitution request: create a comparison chart that includes the testing information as well as the warranty for both the specified product and the proposed substitution. Include the reason for requesting the substitution, clear catalog copy highlighting the proposed product and options, compliance statement, technical data, product warranty and lead time, to show how the proposed can meet or exceed established level of design, function, and quality. Approval of request is at the discretion of the owner, architect, and their designated consultants and will be addressed via addendum prior to bid date.
  - 1. Items listed with no substitute manufacturers have been requested by the Owner to meet existing standard and will not be reviewed for substitution, unless the product is no longer available.
- I. Meetings: Comply with requirements in Division 1 Section "Project Meetings."
  - 1. Keying Meeting
    - a. Within fourteen days of receipt of approved door hardware submittals, contact Owner with representative from hardware supplier to establish a keying conference. Verify keyway, visual key identification, number of master keys and keys per lock. Provide keying system per Owner's instructions.
  - 2. Pre-installation Meeting
    - a. Convene meeting within fourteen days of receipt of approved door hardware submittals. Participants required to attend: Contractor, installer, material supplier, manufacturer representatives.
    - b. Include in-conference decisions regarding proper installation methods and procedures for receiving and handling hardware.
    - c. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment and facilities needed to make progress and avoid delays.
- J. Installer Qualifications: Specialized in performing installation of this Section and have five years minimum documented experience.
- K. Hardware listed in 3.07 – Hardware Schedule is intended to establish minimum level of design, type, function and grade of hardware to be used.

#### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Provide clean, dry and secure room for hardware delivered to Project but not yet installed. Shelf hardware off of the floor and with larger items of hardware being stored on wooden pallets. Arrange locksets and keyed cylinders by opening number. Organize the balance of hardware by brand, model of hardware, and hardware set number. Leave the door markings of the hardware visible for installers.

- B. Furnish hardware that is not bulk packed with each unit marked and numbered in accordance with approved finish hardware schedule. Include architect's opening number, hardware set number, and item number for each type of hardware. Include keyset symbols and corresponding hardware component for keyed products.
- C. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.
- D. Deliver architectural hardware to the job site according to the phasing agreed upon in the pre-installation meeting. Inventory the delivery with the supplier's assistance. Immediately note shortages and damages on the shipping receipts and bill of lading. Coordinate replacement or repair with the supplier.
- E. Deliver permanent keys, cores, and related accessories directly to Owner via registered mail or overnight package service. Establish the instructions for delivery to Owner at "Keying Conference."
- F. Waste Management and Disposal: Separate waste materials for use or recycling in accordance with Division 1.

#### **1.06 WARRANTY**

- A. General Warranty: Owner may have under provisions of the Contract Documents and be an addition and run concurrently with other warranties made by Contractor under requirements of the Contract documents.
- B. Special Warranty: Warranties specified in this article will not deprive Owner of other rights.
  - 1. Ten years for manual door closers.
  - 2. Five years for mortise, auxiliary and bored locks.
  - 3. Five years for exit devices.
- C. Replace or repair defective products during warranty period in accordance with manufacturer's warranty at no cost to Owner. There is no warranty against defects due to improper installation, abuse, and failure to exercise normal maintenance.
- D. Maintenance Tool and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, removal and replacement of door hardware.

### **PART 2 – PRODUCTS**

#### **2.01 HINGES**

- A. Hinges, electric hinges, and self-closing hinges of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Products to be certified and listed by the following:
  - 1. Butts and Hinges: ANSI/BHMA A156.1.
  - 2. Template Hinge Dimensions: ANSI/BHMA A156.7.
  - 3. Self-Closing Hinges: ANSI/BHMA A156.17.
- C. Butt Hinges:
  - 1. Hinge weight and size unless otherwise indicated in hardware sets:
    - a. Doors up to 36" wide and up to 1-3/4" thick provide hinges with a minimum thickness of .134" and a minimum of 4-1/2" in height.

- b. Doors from 36" wide up to 42" wide and up to 1-3/4" thick provide hinges with a minimum thickness of .145" and a minimum of 4-1/2" in height.
- c. For doors from 42" wide up to 48" wide and up to 1-3/4" thick provide hinges with a minimum thickness of .180" and a minimum of 5" in height.
- d. Doors greater than 1-3/4" thick provide hinges with a minimum thickness of .180" and a minimum of 5" in height.
- e. Width of hinge is to be minimum required to clear surrounding trim.
- 2. Base material unless otherwise indicated in hardware sets:
  - a. Exterior Doors: 304 Stainless Steel, Brass or Bronze material.
  - b. Interior Doors: Steel material.
  - c. Fire Rated Doors: Steel or 304 Stainless Steel materials.
  - d. Stainless Steel ball bearing hinges to have stainless steel ball bearings. Steel ball bearings are unacceptable.
- 3. Quantity of hinges per door unless otherwise stated in hardware sets:
  - a. Doors up to 60" in height provide 2 hinges.
  - b. Doors 60" up to 90" in height provide 3 hinges.
  - c. Doors 90" up to 120" in height provide 4 hinges.
  - d. Doors over 120" in height add 1 additional hinge per each additional 30" in height.
  - e. Dutch doors provide 4 hinges.
- 4. Hinge design and options unless otherwise indicated in hardware sets:
  - a. Hinges are to be of a square corner five-knuckle design, flat button tips and have ball bearings unless otherwise indicated in hardware sets.
  - b. Out-swinging exterior and out-swinging access controlled doors are required to have Non-Removable Pins (NRP) to prevent removal of pin while door is in closed position.
  - c. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
  - d. When shims are necessary to correct frame or door irregularities, provide metal shims only.
- 5. Acceptable Manufacturers:

	Standard Weight	Heavy Weight
Hager	BB1279/BB1191	BB1168/BB1199
Bommer	BB5000/BB5002	BB5004/BB5006
McKinney	TA2714/TA2314	T4A3786/T4A3386

**2.02 CONTINUOUS HINGES**

- A. Continuous hinges of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Products to be certified and listed by ANSI/BHMA A156.26 Grade 1.
- C. Continuous Geared Hinges:
  - 1. Determine model number by door and frame application, door thickness, frequency of use, and fire rating requirements according to manufacturer's recommendations.
    - a. Size length of hinge to equal the actual door height unless otherwise stated in hardware sets.
- D. Material and Design:
  - 1. Base material: Anodized aluminum manufactured from 6063-T6 material, unexposed working metal surfaces be coated with TFE dry lubricant.
  - 2. Bearings:
    - a. Vertical loads be carried on Lubriloy RL bearings for non-fire rated doors.
    - b. Continuous hinges are to have a minimum spacing between bearings of 2-9/16". Typical door from 80" to 84" in height to have a minimum of 32 bearings.
  - 3. Options:

- a. Hinges to have Rounded Back Cover Channel (RBCC).
- b. When full width of opening is required, use hinges that are designed to swing door completely from opening when door is opened to 95 degrees.
- c. At fire rated openings provide hinges that carry a UL certification, up to and including 90-minute applications for wood doors and up to 3-hour applications for metal doors.

E. Acceptable Manufacturers:

	Heavy Duty
Hager	780-112HD/780-224HD
Bommer	FMHD/FMSLFHD
Zero	914A/910A

**2.03 REMOVABLE MULLIONS**

- A. Keyed removable mullions of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Material and Design:
  - 1. For use with rim exit devices on non-fire rated pairs of doors.
  - 2. Mullion 2" x 3" aluminum tube.
- C. Acceptable manufacturers for keyed removable mullions:

	Keyed Non Fire-Rated
Special-Lite	SL-60 x KR

**2.04 LOCKS AND LATCHES**

- A. Locks and latches of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Product to be certified and listed by following:
  - 1. ANSI/BHMA A156.13 Series 1000 Certified to Grade 1 for Operational and Security.
  - 2. UL/cUL Labeled and listed up to 3 hours for single doors up to 48" in width and up to 96" in height.
  - 3. UL10C/UBC 7-2 Positive Pressure Rated.
  - 4. ICC/ANSI A117.1.
- C. Lock and latch function numbers and descriptions of manufacturer's series as listed in hardware sets.
- D. Material and Design:
  - 1. Lock cases from fully wrapped, 12 gauge steel, zinc dichromate for corrosion resistance.
  - 2. Non-handed, field reversible without opening lock case.
  - 3. Break-away spindles to prevent unlocking during forced entry or vandalism.
  - 4. Levers, zinc cast, forged brass or stainless steel and plated to match finish designation in hardware sets.
  - 5. Sectional Roses, solid brass or stainless steel material and have a minimum diameter of 2-7/16".
  - 6. Armor fronts, self-adjusting to accommodate a square edge door or a standard 1/8" beveled edge door.
- E. Latch and Strike:
  - 1. Stainless steel latch bolt with minimum of 3/4" throw and deadlocking for keyed and exterior functions.

2. Strike is to fit a standard ANSI A115 prep measuring 1-1/4" x 4-7/8" with proper lip length to protect surrounding trim.
3. Deadbolts to be 1-3/4" total length with a minimum of a 1" throw and 3/4" internal engagement when fully extended and made of stainless steel material.

F. Options:

1. Provide knurled levers on entry side of doors that are potentially dangerous to visually impaired persons.

G. Acceptable Manufacturers:

Hager	3800 Series
Schlage	L9000 Series

**2.05 EXIT DEVICES**

- A. Exit Devices of one manufacturer as listed for continuity of design and consideration of warranty. Touchpad type, finish to match balance of door hardware.

B. Standards: Manufacturer to be certified and/or listed by the following:

1. BHMA Certified ANSI A156.3 Grade 1.
2. UL/cUL Listed for up to 3 hours for "A" labeled doors.
3. UL10C/UBC 7-2 Positive Pressure Rated.
4. UL10B Neutral Pressure Rated.
5. UL 305 Listed for Panic Hardware.
6. 2007 Florida Building Code Certification Number: FL9481.1.
7. ANSI/BHMA A250.13 Severe Windstorm Resistant Component.

C. Material and Design:

1. Provide exit devices with actuators that extend a minimum of one-half of door width.
2. Where trim is indicated in hardware sets provide the lever design to match design of lock levers.
3. Exit device to mount flush with door.
4. Latchbolts:
  - a. Rim device – 3/4" throw, Pullman type with automatic dead-latching, stainless steel
  - b. Surface vertical rod device – Top 1/2" throw, Pullman type with automatic dead-latching, stainless steel. Bottom 1/2" throw, Pullman type, held retracted during door swing, stainless steel.
5. Fasteners: Wood screws, machine screws, and thru-bolts.

- D. Lock and Latch Functions: Function numbers and descriptions of manufacturer's series and lever styles indicated in door hardware sets.

E. Acceptable Manufactures:

Hager	4500 Series	4600 Series
Von Duprin	99 Series	33 Series

**2.06 CYLINDERS AND KEYING**

- A. Cylinders of one manufacturer as listed for continuity of design and consideration of warranty.

B. Products to be certified and listed by the following:

1. Auxiliary Locks: ANSI/BHMA A156.5

C. Cylinders:

1. Provide cylinders matched to the types required for hardware that has a locking function and for keyed electronic functions. Furnish with appropriate collars, cams, and tailpieces to fit and operate associated hardware. Stacking collars is not acceptable, a single collar of proper size is required.
2. Provide concealed key control (CKC) at cylinder by stamping or permanently marking the keyset symbol in a location on the cylinder that is concealed when installed.

D. Keying:

1. Key into Owner's existing KABA Peaks key system.
2. Provide a bitting list to Owner of combinations as established, and expand to twenty-five percent for future use or as directed by Owner.
  - a. Include all of the keysets and bittings of the original key system creating one clean version of the entire key system.
3. Keys to be shipped directly to the Owner's Representative as established during the keying conference.
  - a. Package the keys in individual envelopes, grouped by keyset symbol, and label envelopes with project name, factory registry number, and keyset symbol.
4. Stamp large bow key blanks with visual key control (keyset symbol) and "Do Not Duplicate".

E. Acceptable Manufacturers:

KABA Peaks by ILCO
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**2.07 PUSH/PULL PLATES AND BARS**

- A. Push/Pull plates and bars of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer to be certified by the following:
  1. Architectural Door Trim: ANSI/BHMA A156.6.
  2. Americans with Disabilities Act Accessibility Guidelines (ADAAG).
- C. Pull Bar Sets: 1" round bar stock with 2 -1/2" clearances from face of door.

D. Acceptable Manufacturers:

Hager	H12J
Rockwood	
Trimco	

**2.08 CLOSERS**

- A. Closers of one manufacturer as listed for continuity of design and consideration of warranty, unless otherwise indicated on hardware schedule, comply with manufacturer's recommendations for size of closer, depending on width of door, frequency of use, atmospheric pressure, ADAAG requirement, and fire rating.
- B. Standards: Manufacturer to be certified and or listed by the following:
  1. BHMA Certified ANSI A156.4 Grade 1.
  2. ADA Complaint ANSI A117.1.
  3. UL/cUL Listed up to 3 hours.
  4. UL10C Positive Pressure Rated.
  5. UL10B Neutral Pressure Rated.
- C. Material and Design:
  1. Provide cast iron non-handed bodies with full plastic covers.

2. Closers will have separated staked adjustable valve screws for latch speed, sweep speed, and backcheck.
3. Provide Tri-Pack arms and brackets for regular arm, top jamb, and parallel arm mounting.
4. One-piece seamless steel spring tube sealed in hydraulic fluid.
5. Double heat-treated steel tempered springs.
6. Precision-machined heat-treated steel piston.
7. Triple heat-treated steel spindle.
8. Full rack and pinion operation.

D. Mounting:

1. Out-swing doors use surface parallel arm mount closers except where noted on hardware schedule.
2. In-swing doors use surface regular arm mount closers except where noted on hardware schedule.
3. Provide brackets and shoe supports for aluminum doors and frames to mount fifth screw.
4. Furnish drop plates where top rail conditions on door do not allow for mounting of closer and where backside of closer is exposed through glass.

E. Size closers in compliance with requirements for accessibility (ADAAG). Comply with following maximum opening force requirements.

1. Interior hinged openings: 5.0 lbs.
2. Fire-rated and exterior openings use minimum opening force allowable by authority having jurisdiction.

F. Fasteners: Provide self-reaming, self-tapping wood and machine screws, and sex nuts and bolts for each closer.

G. Acceptable manufacturers:

Hager	5100 Series
LCN	4040XP Series

**2.09 PROTECTIVE TRIM**

A. Protective trim of one manufacturer as listed for continuity of design and consideration of warranty.

B. Size of protection plate: single doors, size two inches less door width (LDW) on push side of door, and one inch less door width on pull side of door. For pairs of doors, size one inch less door width (LDW) on push side of door, and 1/2 inch on pull side of door. Adjust sizes to accommodate accompanying hardware, such as, edge guards, astragals and others.

1. Kick Plates 10" high or sized to door bottom rail height.
2. Mop Plates 4" high.
3. Armor Plates 36" high.

C. Products to be certified and listed by the following:

1. Architectural Door Trim: ANSI/BHMA A156.6.
2. UL.

D. Material and Design:

1. 0.050" gage stainless steel.
2. Corners square, polishing lines or dominant direction of surface pattern so they run across door width of plate.
3. Bevel top, bottom, and sides uniformly leaving no sharp edges.

- 4. Countersink holes for screws. Space screw holes so they are no more than eight inches CTC, along a centerline not over 1/2" in from edge around plate. End screws maximum of 0.53" from corners.
- E. UL label stamp required on protection plates when top of plate is more than 16 inches above bottom of door on fire rated openings. Verify door manufacturer's UL listing for maximum height and width of protection plate to be used.
- F. Acceptable Manufacturers:

Hager	190S
Trimco	
Burns	

**2.10 STOPS AND HOLDERS**

- A. Stops and holders of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Wall Stops: Provide door stops wherever necessary to prevent door or hardware from striking an adjacent partition or obstruction. Provide wall stops when possible. Door stops and holders mounted in concrete floor or masonry walls have stainless steel machine screws and lead expansion shields.
- C. Products to be certified and listed by the following:
  - 1. Auxiliary Hardware: ANSI/BHMA A156.16.
- D. Acceptable Manufacturers:

	Convex	Concave
Hager	232W	236W
Rockwood		
Burns		

**2.11 THRESHOLDS**

- A. Thresholds of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Set thresholds for exterior and acoustical openings in full bed of sealant with lead expansion shields and stainless steel machine screws complying with requirements specified in Division 7 Section "Joint Sealants: Notched in field to fit frame by hardware installer. Refer to Drawings for special details.
- C. Standards: Manufacturer to be certified by the following:
  - 1. Thresholds: ANSI/BHMA A156.21.
  - 2. American with Disabilities Act Accessibility Guidelines (ADAAG).
- D. Acceptable Manufacturers:

Hager	413S/520S
K.N. Crowder	
Reese	

**2.12 DOOR GASKETING AND WEATHERSTRIP**

- A. Door gasketing and weatherstrip of one manufacturer as listed for continuity of design and consideration of warranty.



- B. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing where indicated on hardware schedule. Provide noncorrosive fasteners for exterior applications.
  - 1. Perimeter gasketing: Apply to head and jamb, forming seal between door and frame.
  - 2. Meeting stile gasketing: Fasten to meeting stiles, forming seal when doors are in closed position.
  - 3. Door bottoms: Apply to bottom of door, forming seal with threshold or floor when door is in closed position.
  - 4. Sound Gasketing: Cutting or notching for stop mounted hardware not permitted.
  - 5. Drip Guard: Apply to exterior face of frame header. Lip length to extend 4" beyond width of door.
- C. Products to be certified and listed by the following:
  - 1. Door Gasketing and Edge Seal Systems: ANSI/BHMA A156.22.
  - 2. BHMA certified for door sweeps, automatic door bottoms, and adhesive applied gasketing.
- D. Smoke-Labeled Gasketing: Comply with NFPA 105 listed, labeled, and acceptable to Authorities Having Jurisdiction, for smoke control indicated.
  - 1. Provide smoke-labeled gasketing on 20 minute rated doors and on smoke rated doors.
- E. Fire-Rated Gasketing: Comply with NFPA 80 listed, labeled, and acceptable to Authorities Having Jurisdiction, for fire ratings indicated.
- F. Refer to Section 08 1416 Wood Doors for Category A or Category B. Comply with UBC 7-2 and UL10C positive pressure where frame applied intumescent seals are required.

G. Acceptable Manufacturers:

1. Door Bottom Sweeps:

Special-Lite	SL-301
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2. Overhead Drip Guard

Hager	810S
K.N. Crowder	
Reese	

**2.13 SILENCERS**

- A. Where smoke, light, or weather seal are not required, provide three silencers per single door frame, two per double door frame and four per Dutch door frame.
- B. Products to be certified and listed by the following:
  - 1. Auxiliary Hardware: ANSI/BHMA A156.16

C. Acceptable Manufacturers:

	Hollow Metal Frame	Wood Frame
Hager	307D	308D
Rockwood		
Trimco		

## 2.14 FINISHES

- A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if within 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 range of approved samples.
- B. Comply with base material and finish requirements indicated by ANSI/BHMA A156.18 designations in hardware schedule.

## PART 3 – EXECUTION

### 3.01 EXAMINATION

- A. Examine doors and frames, with Installers present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Notify Architect via a prepared written report and endorsed by Installer of any discrepancies between the door schedule, door types, drawings and scheduled hardware. Report will have a list of conditions detrimental to application, to the proper and timely completion of the work and performance of the hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

### 3.02 INSTALLATION

- A. Install hardware using manufactures recommended fasteners and installation instructions, at height locations and clearance tolerances that comply with:
  - 1. NFPA 80
  - 2. NFPA 105
  - 3. ICC/ANSI A117.1
  - 4. ANSI/BHMA A156.115 Hardware Preparation in Steel Doors and Steel Frames
  - 5. ANSI/BHMA A156.115W hardware Preparation in Wood Doors with Wood or Steel Frames
  - 6. DHI Publication – Installation Guide for Doors and Hardware
  - 7. Approved shop drawings
  - 8. Approved finish hardware schedule
- B. Install soffit mounted gaskets prior other soffit mounted hardware to provide a continuous seal around the perimeter of the opening without cutting or notching.
- C. Install door closers so they are on the interior of the room side of the door. Stairwell doors will have closers mounted on the stair side and exterior doors will be mounted on the interior side of the building.
- D. In drywall applications provide blocking material of sufficient type and size for hardware items that mount directly to the wall.
- E. Locate wall mounted bumper to contact the trim of the operating trim.
- F. Mount mop and kick plates flush with the bottom of the door and centered horizontally on the door.
- G. Set thresholds for exterior, and acoustical doors at sound control openings in full bed of sealant complying with requirements specified in Division 07 Section “Joint Sealants” forming a tight seal between threshold and surface to which set.

- H. Anchor all components firmly into position and use anchoring devices furnished with the hardware item, unless otherwise specified.
- I. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

### **3.03 FIELD QUALITY CONTROL**

- A. Material supplier to schedule final walk through to inspect hardware installation ten (10) business days before final acceptance of Owner. Material supplier will provide a written report detailing discrepancies of each opening to General Contractor within seven (7) calendar days of walk through.

### **3.04 ADJUSTMENT, CLEANING, AND DEMONSTRATING**

- A. Adjustment: Adjust and check each opening to ensure proper operation of each item of finish hardware. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application at no cost to Owner.
- B. Cleaning: Clean adjacent surfaces soiled by hardware installation. Clean finish hardware per manufacturer's instructions after final adjustments have been made. Replace items that cannot be cleaned to manufacturer's level of finish quality at no cost to Owner.
- C. Conduct a training class for building maintenance personnel demonstrating the adjustment, operation of mechanical and electrical hardware. Special tools for finish hardware to be turned over and explained usage at the meeting. Record all training and provide to the Owner for future reference.

### **3.05 PROTECTION**

- A. Leave manufacturer's protective film intact and provide proper protection for all other finish hardware items that do not have protective material from the manufacture until Owner accepts project as complete.

### **3.06 HARDWARE SET SCHEDULE**

- A. Intent of Hardware Groups
  1. Should items of hardware not specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
  2. Where items of hardware aren't correctly specified and are required for completion of the Work, a written statement of such omission, error, or other discrepancy is required to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.
- B. Guide: Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, performance, exposure, and like characteristics of door hardware, and may not be complete. Provide door hardware required to make each set complete and operational.
- C. Hardware schedule does not reflect handing, backset, method of fastening, and like characteristics of door hardware and door operation.

- D. Review door hardware sets with door types, frames, sizes and details on drawings. Verify suitability and adaptability of items specified in relation to details and surrounding conditions.

**3.07 HARDWARE SCHEDULE**

**Troy High School Media Center Remodeling**

**SET #1.00**

Doors: D219

1	Continuous Hinge	780-112HD x LAR	CLR	HA
1	Exit Device	4501 RIM	US26D	HA
1	Rim Cylinder	(MATCH EXISTING)		
1	Door Pull	H 12J	US32D	HA
1	Closer	5100 HDCS	ALM	HA
1	Drop Plate	5110	ALM	HA
1	Blade Stop Spacer	5113	ALM	HA
1	Threshold	520S S x LAR	MIL	HA
1	Door Bottom	SL-301 X LAR	MIL	SPCL
1	Gasketing	BY THE FRAME MFGR		BYOT

**SET #2.00**

Doors: D217A, D217B

2	Continuous Hinge	780-112HD x LAR	CLR	HA
1	Mullion	SL-60 X KR X LAR	CL	SPCL
2	Exit Device	4501 RIM	US26D	HA
1	Mortise Cylinder	(MATCH EXISTING)		
1	Rim Cylinder	(MATCH EXISTING)		
2	Door Pull	H 12J	US32D	HA
2	Drop Plate	5110	ALM	HA
2	Closer	5100 HDCS	ALM	HA
2	Blade Stop Spacer	5113	ALM	HA
1	Gasketing	BY THE FRAME MFGR		BYOT

**Smith Middle School Stage Upgrade****SET #3.00**

Doors: D109, D116

1	Continuous Hinge	780-224HD x LAR	CLR	HA
1	Lockset	3880 SECT ARC Less Cyl	US26D	HA
1	Mortise Cylinder	MORTISE (MATCH EXISTING)		
1	Closer	5100 HDCS	DBZ	HA
1	Threshold	520S S x LAR	MIL	HA
1	Door Bottom	SL-301 X LAR	MIL	SPCL
1	Gasketing	BY THE FRAME MFGR		BYOT

**SET #4.00**

Doors: D101, D105

2	Continuous Hinge	780-224HD x LAR	CLR	HA
1	Mullion	SL-60 X KR X LAR	CL	SPCL
2	Exit Device	4501 RIM	US26D	HA
2	Door Pull	SL-86	CL	SPCL
1	Mortise Cylinder	MORTISE (MATCH EXISTING)	KABA	
1	Rim Cylinder	(MATCH EXISTING)		
2	Closer	5100 HDCS	DBZ	HA
2	Blade Stop Spacer	5113	DBZ	HA
1	Threshold	520S S x 72"	MIL	HA
2	Door Bottom	SL-301 X LAR	MIL	SPCL
1	Gasketing	BY THE FRAME MFGR		BYOT

**SET #5.00**

Doors: D127

3	Hinge(s)	BB1279 4 1/2 X 4 1/2	US26D	HA
1	Exit Device	4501 RIM	US26D	HA
1	Exit Device Trim	45CE ARC	US26D	HA
1	Mortise Cylinder	MORTISE (MATCH EXISTING)		
1	Closer	5100 HDCS	DBZ	HA
1	Kick Plate	190S 10" x 2" LDW CSK	US32D	HA
3	Door Silencer(s)	307D	GREY	HA

**END OF SECTION**



**SECTION 08 8000 - GLAZING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Monolithic glazing.
- B. Insulating glass..
- C. Glazing compounds and accessories.

**1.02 REFERENCE STANDARDS**

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.
- C. ASTM C1311 - Standard Specification for Solvent Release Sealants 2014.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- E. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- F. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass 2014.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2015.
- I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
- J. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
- K. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
- L. GANA (SM) - GANA Sealant Manual 2008.
- M. ICC (IBC) - International Building Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- N. NFPA 251 - Standard Methods of Tests of Fire Resistance of Building Construction and Materials - 2006.
- O. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.
- P. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies 2017.
- Q. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2017.
- R. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014, with Errata (2017).
- S. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2017.
- T. UL 9 - Standard for Fire Tests of Window Assemblies Current Edition, Including All Revisions.
- U. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.
- W. UL 263 - Standard for Fire Tests of Building Construction and Materials Current Edition, Including All Revisions.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

**1.04 SUBMITTALS**

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

- B. Product Data on Glazing. Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit three samples 12 by 12 inch in size for each glass type.
  - 1. Non-insulated types may be 4 by 4 inches in size.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
- F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

#### **1.05 QUALITY ASSURANCE**

- A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), IGMA TM-3000, and IGMA TB-3001 for glazing installation methods.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years documented experience.

#### **1.06 FIELD CONDITIONS**

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Laminated Glass: Provide a ten (10) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.
- D. Coated Glass: Provide a ten (10) year manufacturer warranty to include coverage for peeling, cracking, and other indications of deterioration in coating, including providing products to replace failed units.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Float Glass Manufacturers:
  - 1. Guardian Glass, LLC: [www.guardianglass.com](http://www.guardianglass.com).
  - 2. Pilkington North America Inc: [www.pilkington.com](http://www.pilkington.com).
  - 3. Viracon, Inc: [www.viracon.com](http://www.viracon.com).
  - 4. Vitro Architectural Glass (formerly PPG Industries, Inc.): [www.vitroglazings.com](http://www.vitroglazings.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Laminated Glass Manufacturers:
  - 1. Clear Laminated Glass: Any of the manufacturers specified for float glass.
- C. Insulating Glass Manufacturers:
  - 1. Any of the manufacturers specified for float glass.

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. Exterior Glazing Assemblies:
  - 1. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.
    - a. Design Pressure: Calculated in accordance with ASCE 7 applicable codes, and as indicated on Drawings..



- b. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
  - 1) 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 the short side length or 1 inch, whichever is less.
- c. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
- d. Glass thicknesses listed are minimum.
2. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
  - a. In conjunction with vapor retarder and joint sealer materials described in other Division 7 sections.
3. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
  - a. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  - b. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
  - c. Solar Optical Properties: Comply with NFRC 300 test method.
- B. Probability of Breakage: Design glass for a probability of breakage not greater than 0.008 (8 lites per 1000) for glass not more than 15 degrees from vertical.
- C. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
- D. Insulating Glass:
  1. Insulating Glass Certification Program: Provide insulating glass units that are certified by the Insulating Glass Certification Council (IGCC).
    - a. Provide permanent markings with appropriate certification label of IGCC on either the spacer or one lite of each insulated unit.
- E. Safety Glazing:
  1. Complies with ANSI Z97.1 and 16 CFR 1201; test requirements for Class A/Category II.
  2. Markings for Safety Rated Glazing: Provide permanent markings on safety-rated glazing in compliance with applicable safety glazing standards, ICC (IBC), local building code, and authorities having jurisdiction.
- F. Glass Thickness: Indicated glass thicknesses are minimums. Provide glass that complies with performance requirements and load designs, and is not less than the thickness indicated.
- G. Glass Strength:
  1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with performance requirements.
  2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with performance requirements.
- H. Glass Distortion Tolerances:
  1. Roller Wave: Maximum 0.003 (0.076 mm) from peak to valley within the main body of the sheet and maximum 0.008 (0.2 mm) within 10.5 inches of a leading or trailing edge.
  2. Localized Warp: Maximum 0.03 inch (0.8 mm) over any 12 inch (305 mm) span, but limited to 0.31 inch (8 mm).

### **2.03 FLOAT GLASS**

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
  1. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
  2. Kind FT - Fully Tempered Type: Complies with ASTM C1048.

3. Tinted Coated Fully Tempered Type Kind FT Type: ASTM C1048, with color and performance characteristics as indicated.
  - a. Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; [ Solarban 60] Solargray, or a comparable product from any of the manufacturers specified for float glass.

#### 2.04 LAMINATED GLASS

- A. Laminated Glass: Heat-strengthened float glass laminated in accordance with ASTM C1172.
  1. Unless otherwise indicated clear laminated glass shall consist of two plies of clear heat-strengthened float glass with a polyvinyl butyral interlayer.
    - a. Minimum Thickness of Each Glass Ply: 1/8 inch (3 mm), unless otherwise indicated.
    - b. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum, unless otherwise indicated.
      - 1) Clear Laminated Glass Interlayer Color: Clear.
      - 2) Translucent Laminated Glass Interlayer Color: Translucent White.

#### 2.05 INSULATING GLASS

- A. General: Unless otherwise noted, Insulating Glass Unit Types shall comply with the following:
  1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
  2. Tinted Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO.
    - a. Low-E Coating, Tinted, Safety Glazing:
      - 1) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Solarban 60, Solargray, fully-tempered float glass or a comparable product from any of the manufacturers specified for float glass.
  3. Perimeter Spacer: Warm-edge spacer.
    - a. Manufacturer's standard low conductivity polymer, stainless steel, or hybrid material.
      - 1) Spacer Color: Gray.
      - 2) Spacer Width: As required for specified insulating glass unit.
      - 3) Products:
        - (a) Quanex IG Systems, Inc; Super Spacer Premium Enhanced: [www.quanex.com](http://www.quanex.com).
        - (b) Technoform Glass Insulation; TGI-Spacer: [www.glassinsulation.us](http://www.glassinsulation.us).
        - (c) Viracon, Inc; ExtremEdge: [www.viracon.com](http://www.viracon.com).
        - (d) Vitro Architectural Glass (Formerly PPG); Intercept Spacer System: [www.vitroglazings.com](http://www.vitroglazings.com).
        - (e) Substitutions: Refer to Section 01 6000 - Product Requirements.
  4. Edge Seal:
    - a. Dual-Sealed System: Provide polyisobutylene or acrylic adhesive or spacer manufacturer's standard sealant as primary seal applied between spacer and glass panes, and butyl sealant as secondary seal applied around perimeter.
    - b. Color: Black.
  5. Purge interpane space with dry air, hermetically sealed.

#### 2.06 GLAZING COMPOUNDS

- A. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, butyl sealant.
  1. Product:
    - a. Pecora Corp.; BC-158: [www.pecora.com](http://www.pecora.com).
    - b. Tremco, Inc.; Butyl Sealant: [www.tremcosealants.com](http://www.tremcosealants.com).
    - c. Substitutions: Refer to Section 01 6000 - Product Requirements.
- B. General Glazing Silicone Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25 or 50, Use NT.
  1. Products:
    - a. Dow Corning Corporation; 899 Silicone Glazing Sealant: [www.dowcorning.com](http://www.dowcorning.com).

- b. GE/Momentive Performance Materials, Inc: SCS2800 SilGlaz II:  
www.siliconeforbuilding.com
- c. Pecora Corporation: 896: www.pecora.com.
- d. Tremco, Inc.: Spectrem 2: www.tremcosealants.com.
- e. Substitutions: Refer to Section 01 6000 - Product Requirements.

2. Color: Black.

## **2.07 ACCESSORIES**

- A. Setting Blocks: EPDM or neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: EPDM or neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
  - 1. Width: As required for application.
  - 2. Thickness: As required for application.
- D. Glazing Gaskets and Splines: Resilient EPDM or polyvinyl chloride extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.

## **PART 3 EXECUTION**

### **3.01 VERIFICATION OF CONDITIONS**

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- C. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

### **3.03 INSTALLATION, GENERAL**

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Use one or more of the specified glazing methods as recommended by GANA, glass manufacturer, and installer, and as required to comply with performance requirements.
- C. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- D. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- E. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- F. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

- G. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

### **3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)**

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

### **3.05 CLEANING**

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

### **3.06 PROTECTION**

- A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

### **3.07 GLASS SCHEDULE**

- A. GL-1 and GL-2: NOT USED
- B. GL-3: Clear heat-strengthened laminated glass.
  - 1. Clear heat-strengthened laminated safety glass.
  - 2. PVB Interlayer Color: Clear.
  - 3. Minimum Overall Thickness: 1/4 inch (6 mm).
  - 4. Safety glazing required.
- C. GL-4: Translucent heat-strengthened laminated safety glass.
  - 1. Clear heat-strengthened laminated safety glass.
  - 2. PVB Interlayer Color: Translucent White.
  - 3. Minimum Overall Thickness: 1/4 inch (6 mm).
  - 4. Safety glazing required.
- D. GL-5 through GL-9: NOT USED
- E. GL-10: Clear Tempered insulating safety glass.
  - 1. Overall Unit Thickness: 1 inch.
  - 2. Outdoor Lite: Clear tempered safety glass.
    - a. Minimum Thickness: 1/4 inch (6 mm).
    - b. Safety glazing required.
  - 3. Airspace:
    - a. Width: 1/2 inch.
    - b. Interspace Content: Air.
  - 4. Indoor Lite: Clear tempered safety glass.
    - a. Minimum Overall Thickness: 1/4 inch (6 mm).
    - b. Safety glazing required.
- F. GL-11: Tinted Coated Tempered insulating safety glass:
  - 1. Overall Unit Thickness: 1 inch.
  - 2. Outdoor Lite: Tinted Coated tempered safety glass.
    - a. Minimum Thickness: 1/4 inch (6 mm).
    - b. Color: Vitro Solarban 60 Solargray.

- c. Low-E Coating: On 2nd surface.
- d. Safety glazing required.
- 3. Airspace:
  - a. Width: 1/2 inch.
  - b. Interspace Content: Air.
- 4. Indoor Lite: Clear tempered safety glass.
  - a. Minimum Overall Thickness: 1/4 inch (6 mm).
  - b. Safety glazing required.
- 5. Performance:
  - a. Winter Nighttime U-Factor: 0.29 maximum.
  - b. Visible Light Transmittance: 35 percent minimum.
  - c. Solar Heat Gain Coefficient: 0.25 maximum.
- G. GL12 and GL-13: NOT USED
- H. GL-14: 1" Metal Glazing Panel: Refer to Section 08 4313.

**END OF SECTION**



**SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Metal non-load-bearing interior partition, ceiling, and soffit framing.
- B. Suspension systems for interior ceilings and soffits.
- C. Framing accessories.

**1.02 REFERENCE STANDARDS**

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members 2012.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2019.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- D. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2018.
- F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2020.
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- H. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members 2018, with Editorial Revision.
- I. ASTM D3575 - Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.
- J. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- L. ASTM E413 - Classification for Rating Sound Insulation 2016.
- M. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric 2016.
- N. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs 2017.
- O. ASTM F594 - Standard Specification for Stainless Steel Nuts 2009 (Reapproved 2020).
- P. GA-216 - Application and Finishing of Gypsum Panel Products 2016.
- Q. GA-600 - Fire Resistance Design Manual 2015.
- R. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements 2015.
- S. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements 2016.
- T. UL (FRD) - Fire Resistance Directory Current Edition.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Shop Drawings:
  - 1. Indicate component details, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, accessories, and items of other related work.
  - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.

- C. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience and approved by manufacturer.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Metal Framing, Shaft Wall Framing, Connectors, and Accessories:
  - 1. ClarkDietrich Building Systems: [www.clarkdietrich.com](http://www.clarkdietrich.com).
  - 2. Jaimes Industries Inc.: [www.jaimesind.com](http://www.jaimesind.com).
  - 3. MarinoWARE: [www.marinoware.com](http://www.marinoware.com).
  - 4. MBA Building Supplies, Inc.: [www.mbastuds.com](http://www.mbastuds.com).
  - 5. State Building Products; [www.statebp.com](http://www.statebp.com).
  - 6. The Steel Network, Inc: [www.SteelNetwork.com](http://www.SteelNetwork.com).
  - 7. Steel Stud Solutions, LLC; [www.steelstudsolutions.com](http://www.steelstudsolutions.com).
  - 8. Telling Industries; [www.buildstrong.com](http://www.buildstrong.com).
  - 9. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Rated Assemblies: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 and as follows:
  - 1. Provide construction equivalent to one of the following:
    - a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
    - b. Gypsum Association File Numbers: Provide construction complying with requirements of GA-600 for the particular assembly.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Horizontal Deflection: For wall assemblies, limit maximum deflection of wall framing to L/240 at 5 psf .
  - 1. Exception: Limit deflection of walls to receive hard tile surfaces to L/360 at 5 psf.
- E. Protective Coatings: Equivalent (EQ) coatings are not acceptable; products shall be hot-dip galvanized as indicated.
- F. Embossed (equivalent thickness) steel framing products are not acceptable; products shall be in steel thicknesses indicated.

#### **2.03 FRAMING MATERIALS**

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated.
  - 1. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
  - 2. Minimum Metal Thickness: 0.0329 inch (20 gage).
  - 3. Framing Depths: As indicated.



4. Profiles:
  - a. Studs: C shaped with flat or formed webs.
  - b. Runners: U shaped, sized to match studs.
    - 1) Where indicated or required, provide slip-type head joints using slotted deflection track.
  - c. Ceiling Channels: C shaped.
  - d. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- B. Slotted Deflection Track: Provide galvanized sheet steel track with slotted holes in flanges for mechanical anchorage of studs that accommodate deflection; provide screws and anti-friction bushings. Slotted connections prevent stud rotation without use of lateral bracing and maintains structural performance of partition.
  1. Provide at partition heads to structure connections.
  2. Shall prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above
  3. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
  4. Comply with ASTM C645 and ASTM C754.
  5. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
  6. Minimum Metal Thickness: Same material thickness as studs.
  7. Track Depth: Matching studs.
  8. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
    - a. At Contractor's option, provide the following:
      - 1) Slotted Deflection and Firestop Track: Similar to standard slotted deflection track specified, but includes intumescent strip factory-applied to track flanges or web that expands when exposed to heat or flames to provide a perimeter joint seal.
        - (a) Products:
          - (1) ClarkDietrich Building Systems; BlazeFrame Firestop Deflection Track : [www.clarkdietrich.com](http://www.clarkdietrich.com).
          - (2) MarinoWARE; FAS Track 1000: [www.marinoware.com](http://www.marinoware.com).
          - (3) Substitutions: See Section 01 6000 - Product Requirements.
- C. Preformed Top Track Firestop Seal: Pre-formed firestop device field-applied to head of top track that expands when exposed to heat or flames to provide a perimeter joint seal.
  1. At Contractor's option provide preformed top track firestop seals instead of traditional perimeter joint seals.
  2. Provide components UL-listed for use in UL-listed fire-resistance-rated head of partition joint systems indicated on drawings.
  3. Products:
    - a. Hilti, Inc; Top Track Seal CFS TTS: [www.us.hilti.com](http://www.us.hilti.com).
    - b. Substitutions: See Section 01 6000 - Product Requirements.
- D. Resilient Furring Channels: Galvanized sheet steel, single leg, asymmetrical channel, 1/2 inch deep with a 1-1/4 inch screw flange; complying with ASTM C645.
  1. Exception: At ceilings provide double leg, symmetrical channels.
  2. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
  3. Minimum Metal Thickness: 0.0179 inch (25 gage).
- E. Z-shaped Furring: Galvanized sheet steel z-shaped furring, 2 inches deep, unless otherwise indicated; complying with ASTM C645.
  1. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
  2. Minimum Metal Thickness: 0.0312 inch (20 gage).

#### **2.04 FRAMING ACCESSORIES**

- A. Bridging and Bracing Members: Of same material as studs; thickness to suit purpose; complying with applicable requirements of ASTM C754.

1. Steel, 0.0538-inch (1.37mm) minimum base-metal thickness, with a minimum 1/2-inch (13mm) wide flanges.
  - a. Basis-of-Design Product: Subject to compliance with requirements, provide ClarkDietrich Systems Spazzer 9200 Bridge and Spacing Bar, or equivalent.
- B. Backing Plates: 0.064 inch thick (16 gage), galvanized.
- C. Wood Blocking: Refer to Section 06 1000 - Rough Carpentry.
- D. Anchorage Devices: Powder actuated or Drilled expansion bolts.
- E. Acoustic Sealant: As specified in Section 09 2900 - Gypsum Board.
- F. Isolation Strip: Foam gasket, ASTM D3575, closed-cell vinyl foam strips, 1/8 inch thick, in width to suit steel stud size.
  1. Manufacturer:
    - a. Williams; Everlastic EVA 200; [www.williamsproducts.net](http://www.williamsproducts.net).
    - b. Substitutions: See Section 01 6000 - Product Requirements.

## 2.05 SUSPENSION SYSTEMS

- A. Carrying Channels: ASTM C955; cold-rolled galvanized steel sheet U-channel.
  1. Protective Coating: ASTM A653/A653M, G40, hot-dip galvanized.
  2. Minimum Metal Thickness: 0.064 inch (16 gage).
  3. Depth: 2 inches unless otherwise indicated.
- B. Furring Channels:
  1. Hat-Shaped, Rigid Furring Channels: As specified in "Framing Materials" above.
  2. Resilient Furring Channels: As specified in "Framing Materials" above.
- C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch (16 gage) diameter or double strand of 0.048-inch (18 gage) diameter wire.
- D. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (8 gage) diameter.
- E. Hanger Attachments to Concrete:
  1. Expansion Anchors: Fastener systems with evaluations based on ICC-ES AC193.
  2. Adhesive Anchors: Fastener systems with evaluations based on ICC-ES AC308.
  3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
  4. Material for Exterior Locations and Interior Wet/Humid Locations: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.
- F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
  1. At Contractor's option provide grid suspension system instead of traditional carrying and furring channels.
  2. Not permitted for multi-layer gypsum board systems.
  3. Manufacturers:
    - a. Armstrong World Industries, Inc.; Drywall Grid Suspension System: [www.armstrongceilings.com](http://www.armstrongceilings.com).
    - b. CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: [www.certainteed.com](http://www.certainteed.com).
    - c. Rockfon, Part of the Rockwool Group; Chicago Metallic Drywall Grid: [www.rockfon.com](http://www.rockfon.com).
    - d. USG Corporation: Drywall Suspension System: [www.usg.com](http://www.usg.com)
    - e. Substitutions: See Section 01 6000 - Product Requirements

## 2.06 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. Verify existing conditions before starting work.

**3.02 INSTALLATION OF STUD FRAMING**

- A. Comply with requirements of ASTM C754.
- B. Install framing, shaft wall framing, suspension systems, and related accessories and components in accordance with manufacturer's instructions.
- C. Extend partition framing to structure where indicated and to 4 inches above ceiling in other locations unless otherwise indicated.
- D. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling framing in accordance with details.
- E. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs as indicated.
- F. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- G. Align and secure top and bottom runners at 24 inches on center.
- H. Fire-Resistance-Rated Partitions: Install framing, including shaft wall framing, to comply with fire-resistance-rated assembly indicated.
- I. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
  - 1. At partitions indicated with an acoustic rating:
    - a. Provide components and install as required to produce STC ratings indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
    - b. Place two beads of acoustic sealant between runners and substrate, studs and adjacent construction.
- J. Curved Partitions:
  - 1. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
  - 2. Begin and end each arc with a stud, and space intermediate studs equally along arcs.
- K. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- L. Install studs vertically at 16 inches on center, unless otherwise indicated.
  - 1. Install studs so flanges within framing system point in same direction
- M. Align stud web openings horizontally.
- N. Secure studs to tracks using fastener method. Do not weld.
- O. Stud splicing is not permissible.
- P. Fabricate corners using a minimum of three studs.
- Q. Install double studs at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- R. Brace stud framing system rigid.
- S. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.
- T. Blocking/Backing: Use metal backing plate, wood blocking, or supplementary framing secured to studs. Provide blocking/backing for support of equipment services, plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, and similar construction.
- U. Furring: Install at spacing and locations shown on drawings. Lap splices a minimum of 6 inches.

- V. Do not bridge building control and expansion joints. Frame both sides of joints independently.
  - 1. Install Horizontal stiffeners in stud system, spaced (vertical distance) not more than 4'-6" o.c.
- W. Where studs are installed directly against exterior masonry walls, install isolation strip between studs and exterior wall.

### 3.03 CEILING AND SOFFIT FRAMING

- A. Comply with requirements of ASTM C754.
- B. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- C. Install furring independent of walls, columns, and above-ceiling work.
- D. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated.
  - 1. Space hangers at maximum 48 inches on center.
  - 2. Do not attach hangers to the following:
    - a. Metal deck or rolled-in hanger tabs of composite metal deck.
    - b. Permanent metal forms.
    - c. Ducts, pipes, or conduit.
  - 3. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
  - 4. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 5. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
    - a. Size supplemental suspension members and hangers to support ceiling loads within performance requirements.
- E. Space main carrying channels at maximum 48 inch on center, and not more than 6 inches from wall surfaces. Lap splices securely.
- F. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- G. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.
  - 1. Space furring channels at maximum 24 inches on center.
- H. Laterally brace suspension system.
- I. Grid Suspension Systems:
  - 1. Attach perimeter wall angle where grid suspension systems meet vertical surfaces.
  - 2. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

### 3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.
- C. Maximum variation From Level: 1/8 inch in 10 feet.

### END OF SECTION

**SECTION 09 2900 - GYPSUM BOARD****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Gypsum wallboard.
- B. Tile backing board.
- C. Finishing materials.
- D. Trim accessories.
- E. Acoustic insulation.

**1.02 REFERENCE STANDARDS**

- A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.
- B. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2017.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2017.
- D. ASTM C834 - Standard Specification for Latex Sealants 2017.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2020.
- F. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2018.
- G. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2018.
- H. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2018.
- I. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base 2019.
- J. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel 2018.
- K. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2017.
- L. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels 2019.
- M. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2016.
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- O. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2020.
- P. GA-216 - Application and Finishing of Gypsum Panel Products 2016.
- Q. GA-600 - Fire Resistance Design Manual 2015.
- R. UL (FRD) - Fire Resistance Directory Current Edition.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
  - 1. Include locations of control joints. Coordination drawings for proposed control joint locations may be annotated copies of Construction Documents architectural floor plans, reflected ceiling plans, and interior elevations. Submit prior to commencement of framing installation. Coordinate with requirements specified in Section 09 2216.
- C. Product Data: Provide data on gypsum wallboard, shaft wall liner panels, tile backing panels, finishing materials, trim accessories, acoustical accessories, and fasteners and adhesives.

- D. Samples:
  - 1. Submit three samples of each board type, 4 inches square in size.
  - 2. Submit three samples of each type of special trim, 4 inches in length.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.

#### **1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

#### **1.05 FIELD CONDITIONS**

- A. Ambient Condition (Environmental Limitations): Comply with ASTM C840 and GA-216 requirements or gypsum board manufacturer's written instructions, whichever are more stringent

### **PART 2 PRODUCTS**

#### **2.01 PERFORMANCE REQUIREMENTS**

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire-Rated Assemblies: For fire-resistance-rated assemblies that incorporate gypsum board, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 and as follows:
  - 1. Provide construction equivalent to one of the following:
    - a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
    - b. Gypsum Association File Numbers: Provide construction complying with requirements of GA-600 for the particular assembly.
- C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Horizontal Deflection: For wall assemblies, limit maximum deflection of wall framing to L/240 at 5 psf .
  - 1. Exception: Limit deflection of walls to receive hard tile surfaces to L/360 at 5 psf.

#### **2.02 GYPSUM WALLBOARD**

- A. Gypsum Wallboard: Paper-faced gypsum panels; ASTM C1396/C1396M.
  - 1. Thickness: 1/4 and 1/2 inch.
  - 2. Long Edges: Tapered with paper face wrapping edge.
  - 3. Short Edges: Square cut.
  - 4. Sized to minimize joints.
  - 5. Products:
    - a. CertainTeed Corp.; Regular Gypsum Board: [www.certainteed.com](http://www.certainteed.com).
    - b. Continental Building Products; Regular Drywall: [www.continental-bp.com](http://www.continental-bp.com).
    - c. Georgia-Pacific Gypsum; ToughRock Gypsum Board: [www.gp.com](http://www.gp.com).
    - d. National Gypsum Company; Gold Bond Brand Gypsum Board: [www.nationalgypsum.com](http://www.nationalgypsum.com).
    - e. USG Corporation; Sheetrock Brand Gypsum Panels: [www.usg.com](http://www.usg.com).
    - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Gypsum Wallboard - Type X: Paper-faced gypsum panels with fire-resistant core; ASTM C1396/C1396M.
  - 1. Thickness: 5/8 inch.
  - 2. Long Edges: Tapered with paper face wrapping edge.
  - 3. Short Edges: Square cut.

4. Sized to minimize joints.
5. Type: Fire resistance rated Type X, UL or WH listed.
6. Products:
  - a. CertainTeed Corp.; Type X Gypsum Board: [www.certainteed.com](http://www.certainteed.com).
  - b. Continental Building Products; Firecheck Type X: [www.continental-bp.com](http://www.continental-bp.com).
  - c. Georgia-Pacific Gypsum; ToughRock Fireguard X: [www.gp.com](http://www.gp.com).
  - d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: [www.nationalgypsum.com](http://www.nationalgypsum.com).
  - e. USG Corporation; Sheetrock Brand Firecode X Panels: [www.usg.com](http://www.usg.com).
  - f. Substitutions: See Section 01 6000 - Product Requirements.
- C. Abuse Resistant Gypsum Wallboard: Heavy paper-faced, mold and moisture resistant, gypsum panel with fire-resistant core; ASTM C1396/C1396M.
  1. Thickness: 5/8 inch.
  2. Long Edges: Tapered with paper face wrapping edge.
  3. Short Edges: Square cut.
  4. Sized to minimize joints.
  5. Type: Fire resistance rated Type X, UL or WH listed.
  6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  7. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
  8. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
  9. Soft Body Impact: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
  10. Hard Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
  11. Products:
    - a. CertainTeed Corp.; Extreme Abuse Resistant Gypsum Board: [www.certainteed.com](http://www.certainteed.com).
    - b. Continental Building Products; Protecta AR 100 Type X with Mold Defense: [www.continental-bp.com](http://www.continental-bp.com).
    - c. National Gypsum Company; Gold Bond Brand Hi-Abuse XP Gypsum Board: [www.nationalgypsum.com](http://www.nationalgypsum.com).
    - d. USG Corporation; Sheetrock Brand Mold Tough AR Firecode X Panels: [www.usg.com](http://www.usg.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.

### 2.03 TILE BACKING BOARDS

- A. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
  1. Thickness: 5/8 inch.
  2. Type: Fire resistance rated Type X, UL or WH listed.
  3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
  4. Locations: Non-wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:
    - a. Kitchens.
    - b. Laundry areas.
    - c. Locker rooms.
    - d. Toilet rooms.
  5. Products:
    - a. CertainTeed Corp.; GlasRoc Diamondback Tile Backer: [www.certainteed.com](http://www.certainteed.com).
    - b. Georgia-Pacific Gypsum; DensShield Tile Backer: [www.gp.com](http://www.gp.com).
    - c. National Gypsum Company; Gold Bond Brand eXP Tile Backer: [www.nationalgypsum.com](http://www.nationalgypsum.com).
    - d. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: [www.usg.com](http://www.usg.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.

**2.04 FINISHING MATERIALS**

- A. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
  - 1. Paper Tape: 2 inch wide, creased paper tape for joints and corners.
    - a. Exception: At tile backing board provide the following:
      - 1) Fiberglass Tape: 2 inch, coated glass fiber tape for joints and corners.
    - b. Manufacturers: Provide products from one of the specified gypsum wallboard manufacturers.
  - 2. Joint Compound: Drying and setting types, vinyl-based, ready-mixed or field-mixed.
    - a. Each coat shall be compatible with previously applied coats.
    - b. Manufacturers: Provide products from one of the specified gypsum wallboard manufacturers.

**2.05 TRIM ACCESSORIES**

- A. Trim Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
  - 1. Types: As detailed or required for finished appearance. Including, but not limited to, the following:
    - a. Corner beads.
    - b. Control joints.
    - c. LC or L bead at exposed edges.
  - 2. Products:
    - a. ClarkDietrich Building Systems: [www.clarkdietrich.com](http://www.clarkdietrich.com).
    - b. MarinoWARE: [www.marinoware.com](http://www.marinoware.com).
    - c. Telling Industries; [www.buildstrong.com](http://www.buildstrong.com).
    - d. Phillips Manufacturing Co: [www.phillipsmfg.com](http://www.phillipsmfg.com).
    - e. USG Corporation: [www.usg.com](http://www.usg.com).
    - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Special Trims: Extruded aluminum profiles; ASTM B221 6063 T5 alloy.
  - 1. Manufacturers:
    - a. Fry Reglet Corp.; [www.fryreglet.com](http://www.fryreglet.com).
    - b. Gordon, Inc.; [www.gordon-inc.com](http://www.gordon-inc.com).
    - c. Pittcon Industries; [www.pittconindustries.com](http://www.pittconindustries.com).
    - d. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Shapes and Profiles: As indicated on Drawings, including, but not limited to, the following:
    - a. Reveals: Equal to Fry Reglet Model DRM-625-625.
      - 1) Reveal Size: 5/8 inch wide by 5/8 inch deep
    - b. F-Reveals: Equal to Fry Reglet Model DRMF-625-625.
      - 1) Reveal Size: 5/8 inch wide by 5/8 inch deep
    - c. Wall End Caps: Equal to Fry Reglet DMEC Series.
      - 1) Size to match wall construction.
    - d. Finish: Manufacturer's standard conversion coating or primed finish.

**2.06 ACOUSTICAL ACCESSORIES**

- A. Acoustic Insulation: Provide one of the following types:
  - 1. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.
    - a. Thickness: 3 inches, unless otherwise indicated.
    - b. Density: 2.5 pcf.
    - c. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
    - d. Products:
      - 1) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): [www.jm.com](http://www.jm.com).
      - 2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): [www.owenscorning.com](http://www.owenscorning.com).
      - 3) Rockwool; Safe'n'Sound: [www.rockwool.com](http://www.rockwool.com).



- 4) Substitutions: See Section 01 6000 - Product Requirements.
- B. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Reduces airborne sound transmission through perimeter joints and openings in wall assemblies.
1. Products:
    - a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: [www.titebond.com](http://www.titebond.com).
    - b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: [www.liquidnails.com](http://www.liquidnails.com).
    - c. Pecora Corporation; AC-20 FTR: [www.pecora.com](http://www.pecora.com).
    - d. Pecora Corporation; AIS-919: [www.pecora.com](http://www.pecora.com).
    - e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant: [www.usg.com](http://www.usg.com).
    - f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: [www.usg.com](http://www.usg.com).
    - g. Substitutions: See Section 01 6000 - Product Requirements.

## **2.07 FASTENERS AND ADHESIVES**

- A. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- B. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.
- C. Screws for Fastening of Cementitious Backer Board Products to Steel Studs: Use screws of type and size recommended by panel manufacturer
- D. Anchorage to Other Substrates: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- E. Laminating Adhesive: For directly adhering gypsum-base, face-layer panels to backing-layer panels in multi-layer construction. Provide one of the following types:
  1. Joint Compound: As recommended by gypsum board manufacturer.
  2. Adhesives:
    - a. Franklin International, Inc; Titebond GREENchoice Professional Drywall Adhesive; [www.titebond.com](http://www.titebond.com).
    - b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive: [www.liquidnails.com](http://www.liquidnails.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Control Joint Layout: Prior to commencement of framing and gypsum board installation, submit coordination drawings indicating proposed control joint locations in metal-framed gypsum board-sheathed partitions, walls, ceilings, bulkheads, fasciae, and soffits, for review and acceptance of Architect. Coordinate with requirements of Section 09 2216.

### **3.02 GENERAL INSTALLATION**

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions.

### **3.03 ACOUSTIC ACCESSORIES INSTALLATION**

- A. General: Apply acoustic accessories at all STC-Rated Assemblies and elsewhere as indicated on Drawings.
  1. Apply acoustic sealant at all smoke-tight assemblies.
  2. Fire-Rated Construction: Install acoustic accessories in strict compliance with requirements of assembly listing.

- B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
  - 1. Comply with ASTM C919.
  - 2. Place continuous bead at perimeter of each layer of gypsum board.
  - 3. Seal around all penetrations by conduit, pipe, ducts, rough-in boxes, and similar items, except where firestopping is provided.

### **3.04 BOARD INSTALLATION**

- A. Install to minimize butt end joints, especially in highly visible locations.
  - 1. Use screws for attachment of gypsum board.
  - 2. Use screws for attachment of cementitious backing board.
- B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with long edges occurring over framing.
  - 1. Stagger joints on opposite sides of partitions.
- C. Multi-Layer Non-Rated: Install first layer of gypsum board parallel to framing with long edges occurring over framing. Place second layer parallel to framing with long edges occurring over framing, and joints offset from joints of first layer.
  - 1. Offset face-layer joints at least one stud or furring member from base-layer joints.
  - 2. Stagger joints on opposite sides of partitions.
  - 3. Install additional layers beyond double layers similarly; maintain offset and staggered joints between layers.
  - 4. Apply laminating adhesive between layers of gypsum board for bonding of layers in addition to fasteners.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

### **3.05 INSTALLATION OF TRIM AND ACCESSORIES**

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
  - 1. Not more than 30 feet apart on walls and ceilings, unless otherwise indicated.
  - 2. Submit control joint locations to Architect for approval prior to installation.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Edge Trim (LC or L Beads): Install at locations where gypsum board abuts dissimilar materials and as indicated, using longest practical lengths.
- D. Special Trim: Install at indicated locations, and as follows.
  - 1. Wall End Caps: Provide at all exposed ends of wall assemblies not covered in wallboard and at locations of partition closures.
  - 2. Use longest practical lengths.
- E. Partition Closures: Locate at vertical junctures between end of wall assemblies and windows, glazing, and similar construction, unless otherwise indicated.
  - 1. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.
  - 2. Apply continuous bead of acoustical sealant to the unexposed side of extruded aluminum surface that will be in contact with the wall edge.
  - 3. Place sound barrier partition closure on the vertical surface of the wall partition and loosely install fasteners in the top and bottom slotted holes of the wall end cap.
  - 4. Plumb the partition closure leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.
  - 5. Tighten top and bottom fasteners to secure partition closure.
  - 6. Install additional fasteners at 12 inches on center, minimum.
  - 7. Install snap cover to conceal fasteners.
  - 8. Apply color matched sealant at joints of dissimilar materials.

**3.06 JOINT TREATMENT**

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying or setting type joint compound and finish with drying type joint compound.
- B. Tile Backing Panels: Use fiberglass joint tape, embed and finish with tile setting material.
  - 1. Refer to Section 09 3000 - Hard Tiling for tile setting materials.
- C. Glass Mat Faced Gypsum Board other than Tile Backing Panels: Use fiberglass joint tape, embed and finish with setting type joint compound.
- D. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
  - 1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
  - 2. Level 2: In utility areas, behind cabinetry, and in similar locations that shall not be painted or finished, and at tile backing board to receive tile finish.
  - 3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
    - a. Exception: Fire-Rated Construction shall comply with requirements of assembly listing.
- E. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
  - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
  - 2. Taping, filling and sanding is not required at base layers of multi-layer applications.

**3.07 TOLERANCES**

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

**END OF SECTION**



**SECTION 09 3000 - HARD TILING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Hard tile trim units.
- B. Tile setting materials, grout, sealants, and accessories.
- C. Metal trim.
- D. Waterproofing and crack isolation membranes.

**1.02 REFERENCE STANDARDS**

- A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2017.
- B. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 2017.
- C. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement 1999 (Reaffirmed 2016).
- D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2009 (Revised).
- E. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
- F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2010).
- G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2010).
- H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2010).
- I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 2017.
- J. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
- K. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2016).
- L. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).
- M. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation 2010 (Reaffirmed 2016).
- N. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation 2014.
- O. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).
- P. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation 2014.
- Q. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2019.
- R. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
- D. Samples:
  - 1. Full-size units of each type of tile and each color and finish.
  - 2. Full-size units of each type of trim, threshold and accessory for each color and finish.
    - a. Trim and Threshold Samples: 4 inches long, minimum.
- E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than one box of each type.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.
- C. Provide setting materials, grouts, and waterproofing and crack isolation membrane materials from one manufacturer.

**1.06 MOCK-UP**

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Construct mockups to demonstrate aesthetics and quality of materials and execution.
  - 1. Build mock-up of each type of floor tile and installation method.
  - 2. Build mock-up of each type of wall tile and installation method.
  - 3. Build mock-up of any other specific locations as requested by the Architect.
  - 4. Mockup sizes shall be sized as appropriate to demonstrate complete tile pattern layout; 16 square feet, minimum.
  - 5. Approved mock-ups may remain as part of the Work.

**1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
- B. Storage: Store materials as directed by manufacturer's written instructions.

**1.08 FIELD CONDITIONS**

- A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

**PART 2 PRODUCTS****2.01 PERFORMANCE REQUIREMENTS**

- A. Floor Tile: Floor tile shall comply with the following:
  - 1. Dynamic Coefficient of Friction (DCOF): 0.42 or greater when tested in accordance with DCOF AcuTest per ANSI A137.1.

**2.02 HARD TILE**

- A. CT1 Wall Tile: ANSI A137.1 standard grade.
  - 1. Size: 4-1/4 inch by 12-7/8 inch, nominal.
  - 2. Thickness: 5/16 inch, nominal.
  - 3. Surface Finish: Gloss.
  - 4. Color(s): "Light Smoke" 0042.
  - 5. Trim Units: Refer to Section 2.06, for metal trim.
  - 6. Joint Size: 1/8 inch.
  - 7. Base: Refer to Section 2.06, for metal trim.
  - 8. Installation: Stacked Bond.
  - 9. Products:
    - a. American Olean; Urban Canvas: Website.
    - b. Substitutions: Not permitted.
  - 10. Distributor: Virginia Tile
  - 11. Manufacturer's Representative: Kathleen Black (248) 467-4362.

**2.03 TILE TRIM UNITS**

- A. Trim Units: For tile with coordinating trim units, provide bullnoses, cove bases, and other shapes as required for a complete installation.
  - 1. Shapes: As selected by Architect from manufacturer's standard shapes; coordinate with adjacent flat tile sizes and jointing.
  - 2. Sizes: As selected by Architect from manufacturer's standard sizes; coordinate with adjacent flat tile sizes and jointing.
  - 3. Manufacturers: Same as adjacent flat tile, unless otherwise indicated.

**2.04 SETTING MATERIALS**

- A. Provide setting and grout materials from same manufacturer.
- B. Latex-Portland Cement Thin-Set Mortar Bond Coat: ANSI A118.4 and ANSI A118.11
  - 1. Products:
    - a. Bostik, Inc; Bostik PM: [www.bostik.com](http://www.bostik.com).
    - b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar : [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
    - c. LATICRETE International, Inc; 253 Gold: [www.laticrete.com](http://www.laticrete.com).
    - d. MAPEI Corp.; Porcelain Tile Mortar: [www.mapei.com](http://www.mapei.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.

**2.05 GROUTS**

- A. Provide setting and grout materials from same manufacturer.
- B. High Performance Grout: ANSI A118.7 polymer modified cement grout or other high performance formulation.
  - 1. Glass, Marble, and other Soft Stone Tiles: Follow grout manufacturer's recommendations and verify hard tile compatibility with high performance grout in mock-up before installing.
  - 2. Color(s): As selected by Architect from manufacturer's full line.
  - 3. Products:
    - a. Bostik, Inc; Hydroment Vivid: [www.bostik.com](http://www.bostik.com).
    - b. Custom Building Products; Prism Ultimate Performance Grout: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
    - c. LATICRETE International, Inc; PERMACOLOR Select Grout: [www.laticrete.com](http://www.laticrete.com).
    - d. MAPEI Corp.; Ultracolor Plus FA: [www.mapei.com](http://www.mapei.com).
    - e. TEC, an H.B. Fuller Construction Products Inc; Power Grout: [www.tecspecialty.com/#sle](http://www.tecspecialty.com/#sle).
    - f. Substitutions: See Section 01 6000 - Product Requirements.

**2.06 METAL TRIM**

- A. Metal Trim: Provide metal profiles in heights to match tile and setting-bed thicknesses, designed specifically for hard tile applications.

1. Profiles:
  - a. Angle or L-shaped.
  - b. Cove.
  - c. Other shapes as indicated on Drawings.
2. Material: Brushed stainless steel.
3. Applications and Locations:
  - a. Open edges of wall tile.
  - b. Open edges of floor tile.
  - c. Outside wall corners.
  - d. Transitions between hard tile and other floor finishes.
  - e. Tile perimeters not against a wall or other solid vertical surface.
  - f. Transition at wall tile to rubber floor tile.
  - g. Other areas as indicated on Drawings.
4. Manufacturers:
  - a. Schluter-Systems: [www.schluter.com](http://www.schluter.com).
  - b. Substitutions: See Section 01 6000 - Product Requirements.

## **2.07 WATERPROOFING AND CRACK ISOLATION MEMBRANE**

- A. Waterproofing and Crack Isolation Membrane: Elastomeric liquid applied membrane complying with ANSI A118.10 and ANSI A118.12.
  1. Applications: Use at the following locations:
    - a. All floor and traffic areas.
    - b. Shower walls and floors.
    - c. Shower pans and walls.
    - d. Other areas as indicated.
  2. Thickness: As recommended by membrane manufacturer.
  3. Crack Resistance: No failure at 1/8 inch gap, minimum.
  4. Membrane system may or may not include fabric reinforcing.
  5. Products:
    - a. Without Fabric Reinforcing:
      - 1) Custom Building Products; RedGard: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
      - 2) LATICRETE International, Inc; Hydro Ban: [www.laticrete.com](http://www.laticrete.com).
      - 3) MAPEI Corp.; Mapelastic AquaDefense: [www.mapei.com](http://www.mapei.com).
      - 4) Substitutions: See Section 01 6000 - Product Requirements.
    - b. With Fabric Reinforcing:
      - 1) Bostik, Inc; GoldPlus: [www.bostik.com](http://www.bostik.com).
      - 2) Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane: [www.custombuildingproducts.com](http://www.custombuildingproducts.com).
      - 3) LATICRETE International, Inc; Hydro Barrier: [www.laticrete.com](http://www.laticrete.com).
      - 4) MAPEI Corp.; Mapelastic AquaDefense: [www.mapei.com](http://www.mapei.com).
      - 5) TEC, H.B. Fuller Construction Products Inc; HydraFlex: [www.tecspecialty.com](http://www.tecspecialty.com).
      - 6) Substitutions: See Section 01 6000 - Product Requirements.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
  1. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
  2. Verify that substrates comply with tolerances of TCNA (HB).
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
  1. Verify that substrates comply with tolerances of TCNA (HB).

### **3.02 PREPARATION**

- A. Protect surrounding work from damage.



- B. Vacuum clean surfaces and damp clean.

### 3.03 INSTALLATION - GENERAL

- A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Install waterproofing and crack isolation membrane according to manufacturer's instructions and TCNA (HB) recommendations.
  - 1. Applications: Use at the following locations:
    - a. All floor and traffic areas.
    - b. Shower walls and floors.
    - c. Other areas as indicated.
- C. Bond Coats:
  - 1. Use latex-portland cement thin-set mortar, unless otherwise indicated.
    - a. Exceptions:
      - 1) For tiles that have at least one side greater than 15 inches long, use large format tile latex-portland cement medium-bed mortar.
      - 2) For large areas of glass tile, other than accents and bands, use glass tile latex-portland cement thin-set mortar.
    - b. Bond Coat Color: White or gray.
      - 1) Exception: White at glass tiles.
- D. Grout:
  - 1. Use high performance grout.
- E. Install tile prior to installation of equipment, cabinets, and other recessed and surface mounted items.
- F. Completely cover substrates with tile, including those which will be under and behind surface mounted items in finished construction.
- G. Lay tile from center lines outward unless otherwise indicated.
- H. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- I. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly.
- J. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- K. Form internal angles square and external angles square, with metal trim, or bullnose trim pieces as indicated.
- L. Install accessories rigidly in place in accordance with manufacturer's instructions..
- M. Install metal trim in accordance with manufacturer's instructions.
- N. Sound tile after setting. Replace hollow sounding units.
- O. Keep control and expansion joints free of mortar, grout, and adhesive.
- P. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- Q. Grout tile joints unless otherwise indicated.
- R. Joint Sealant:
  - 1. Use joint sealant at the following locations instead of grout.
    - a. Tile changes in plane.
    - b. Tile-to-tile control joints .
    - c. Junctions of tile and dissimilar materials
    - d. And elsewhere as required by TCNA (HB), EJ171 movement joint guidelines.
  - 2. Install joint sealant with bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- S. Grout Sealers:
  - 1. Seal the following:

- a. High performance grout joints only as recommended by grout manufacturer.

**3.04 INSTALLATION - WALL TILE**

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244C.
  1. Provide waterproofing and crack isolation membrane in wet areas and elsewhere as indicated.
- B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
  1. Provide waterproofing and crack isolation membrane where indicated.
- C. Over concrete and masonry install in accordance with TCNA (HB) Method W202I.
  1. Provide waterproofing and crack isolation membrane in wet areas and elsewhere as indicated.

**3.05 CLEANING**

- A. Clean tile and grout surfaces.

**3.06 PROTECTION**

- A. Do not permit traffic over finished floor surface for 4 days after installation.

**END OF SECTION**

**SECTION 09 5100 - ACOUSTICAL CEILINGS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Suspended acoustical ceilings including:
  - 1. Metal grid suspension systems.
- B. Removal, salvaging, and reinstallation of existing suspended acoustical ceilings.

**1.02 REFERENCE STANDARDS**

- A. ASTM B164 - Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire; 2014.
- B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.
- C. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2017.
- D. ASTM C834 - Standard Specification for Latex Sealants 2017.
- E. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces 2008 (Reapproved 2019).
- F. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2019.
- G. CISCA (CSH) - Ceiling Systems Handbook.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- C. Product Data: Provide data on suspension system components and acoustical panels.
- D. Samples:
  - 1. Acoustical Panels: Submit 3 samples, 6 by 6 inch in size, for each type and finish of acoustical panel.
  - 2. Metal Grid Suspension Systems: Submit 3 samples each, 12 inches long, for each type and finish of suspension system main runner, cross runner, perimeter molding, and fascia trim.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Acoustical Panels: Quantity equal to 2 percent of total installed, but not less than one box for each type and finish.

**1.05 QUALITY ASSURANCE**

- A. Metal Grid Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- B. Acoustical Panel Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- C. Installer Qualifications: Company experienced in performing acoustical ceiling installations, with minimum of 5 years of documented experience.

**1.06 FIELD CONDITIONS**

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

**1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Warranties: Provide the following manufacturer warranties:
  - 1. Acoustic Panel Warranty: Against defects in materials and workmanship.
    - a. Warranty Length:
      - 1) 30 years.
  - 2. Metal Grid Suspension Systems: Against defects in materials and workmanship.
    - a. Warranty Length:
      - 1) 30 years.
  - 3. Sag Warranty: Acoustic panels shall not show visible sag.
    - a. Warranty Length: 30 years.
  - 4. Mold and Mildew Warranty: Acoustic panels shall be free from mold and mildew growth.
    - a. Warranty Length: 30 years.
  - 5. Rust Warranty: Metal grid suspension systems shall be free from the occurrence of 50 percent red rust per ASTM D610.
    - a. Warranty Length: 30 years.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Acoustic Panels: Provide either the specified product or a comparable product by one of the following:
  - 1. Armstrong World Industries, Inc: [www.armstrongceilings.com](http://www.armstrongceilings.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. Rockfon North America: [www.rockfon.com](http://www.rockfon.com).
  - 4. USG Corporation: [www.usg.com](http://www.usg.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Suspension Systems and Fascia Trim: Provide either the specified product or a comparable product by one of the following:
  - 1. Armstrong World Industries, Inc: [www.armstrong.com](http://www.armstrong.com).
  - 2. CertainTeed Corporation: [www.certainteed.com](http://www.certainteed.com).
  - 3. Rockfon North America/Chicago Metallic: [www.rockfon.com](http://www.rockfon.com).
  - 4. USG Corporation: [www.usg.com](http://www.usg.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.
- C. Source Limitations: Obtain acoustic panels, suspension systems, and fascia trims from one manufacturer unless otherwise indicated or approved in writing by Architect.

**2.02 ACOUSTICAL PANELS**

- A. Acoustical Panels - General: ASTM E1264, Class A.
- B. ACT-1 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
  - 1. Size: 24 by 24 inches.
  - 2. Thickness: 5/8 inch.
  - 3. Composition: Wet felted.
  - 4. Light Reflectance: 0.84, determined in accordance with ASTM E1264.
  - 5. NRC: 0.55, determined in accordance with ASTM E1264.
  - 6. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
  - 7. Edge: Reveal edge.
  - 8. Surface Color: White.
  - 9. Suspension System: Exposed grid Type SG-1.
  - 10. Products:

- a. USG Interiors, LLC; Eclipse Clima Plus, No.76575: [www.usg.com](http://www.usg.com).

C.

### 2.03 SUSPENSION SYSTEMS

- A. Metal Grid Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, and perimeter moldings as required.
- B. SG-1 Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
  - 1. Profile: Tee; 15/16 inch wide face.
  - 2. Construction: Double web.
  - 3. Finish: White painted.
  - 4. Products:
    - a. USG Interiors, LLC; USG Donn Brand DX: [www.usg.com](http://www.usg.com).

### 2.04 FASCIA TRIM

- A. Fascia Trim: Metal fascia trim for free form ceiling drops and open edges of metal grid suspension systems.
  - 1. Material: Extruded aluminum; ASTM B221, in alloy and temper as recommended by trim manufacturer.
  - 2. Color/Finish: Provide custom color; match Architect's control sample.
  - 3. Trim Height: 6 inches.
  - 4. Products:
    - a. USG Interiors, LLC; Compasso Elite: [www.usg.com](http://www.usg.com).

### 2.05 ACCESSORIES

- A. Provide all required accessories including perimeter moldings, splice plates, clips, and associated hardware, hangers, rivets, and fasteners.
- B. Hanger Wire, Anchors, and Related Support Materials:
  - 1. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
  - 2. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
  - 3. Size attachment devices for five times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
  - 4. Size hanger wire for three times hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, but not less than 0.106-inch diameter wire; three times the design load shall be less than yield stress of wire.
- C. Perimeter Moldings: Same metal and finish as grid.
  - 1. At Wall Perimeters: Provide L-shaped molding for mounting at same elevation as face of grid.
  - 2. Provide inside and outside prefabricated corner mouldings.
  - 3. At Bullnose Corners: Provide radius corner moldings to match bullnose radius of adjacent walls.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

### 3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

**3.03 INSTALLATION - SUSPENSION SYSTEM**

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, CISCA (CSH), and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
  - 1. Install moldings in bed of acoustical sealant.
  - 2. Install moldings and grid in the same plane.
  - 3. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends.
  - 4. Use longest practical lengths.
  - 5. Corners:
    - a. At Bullnose Corners: Provide prefabricated radius corner moldings to match bullnose radius of walls.
    - b. At Square Corners: Provide prefabricated corner moldings.
      - 1) At Other Angles Corners: Overlap perimeter moldings.
  - 6. Do not use exposed fasteners, including pop rivets.
- E. Fascia Trim: Install fascia trim of type indicated at perimeter and transition locations indicated according to manufacturer's written instructions.
- F. Hang metal grid suspension systems independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Connect hangers directly to structure, inserts, eye screws, or other connections that are secure and appropriate for substrate. Connections shall not deteriorate or corrode.
- H. Fasten hangers to structural members, cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  - 1. Do not attach hangers to metal forms, steel deck tabs, or metal decking.
- I. Support metal grid suspension systems with hangers not more than 48 inches o.c. along main grid members.
  - 1. Support grid members directly from hangers unless otherwise indicated.
  - 2. Provide hangers not more than 8 inches from ends of each member.
- J. Install hangers plumb except where required to miss obstructions; brace splayed hangers as required to offset horizontal forces.
- K. Install supplemental hanger supports to bridge large ducts and other wide obstacles that interfere with required hanger spacings or when steel framing is not located appropriately for required hanger spacings.
- L. Size hangers and supplemental supports to support ceiling loads within performance limits established by referenced standards and this specification section.
- M. Secure wire hangers to metal grid suspension systems and above supports with four tight turns, minimum.
- N. Hangers shall not contact adjacent materials within the ceiling plenum.
- O. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- P. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- Q. Do not eccentrically load system or induce rotation of runners.
- R. Do not install dented, bent, or kinked metal grid suspension members.

**3.04 INSTALLATION - ACOUSTICAL PANELS**

- A. Install acoustical panels in accordance with manufacturer's instructions and as supplemented in this section.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical panels level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
  - 1. Make field cut edges of same profile as factory edges.
  - 2. Field paint exposed cut edges.
  - 3. No shadow trims to be used.
- G. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions, unless otherwise indicated.
- H. Lay acoustical insulation continuously across top of acoustical panel ceiling system without gaps where indicated.

**3.05 TOLERANCES**

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

**END OF SECTION**





**SECTION 09 6500 - RESILIENT FLOORING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Resilient tile flooring.
  - 1. Waterjet cutting.

**1.02 REFERENCE STANDARDS**

- A. ASTM F1344 - Standard Specification for Rubber Floor Tile 2015.
- B. ASTM F1516 - Standard Practice or Sealing Seams of Resilient Flooring Products by Heat Weld Method (when Recommended); 2018.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section.
  - 1. The following are required to attend:
    - a. Architect.
    - b. Construction Manager.
    - c. Installer.
    - d. Manufacturer's Representative.
    - e. Owner.
  - 2. Meeting shall review the following:
    - a. Design intent.
    - b. Substrate preparations.
    - c. Installation methods and instructions.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
  - 1. Waterjet Cutting: Submit detailed drawings of waterjet cut floor patterns and designs. Include colors and dimensions.
- D. Verification Samples:
  - 1. Resilient Tile Flooring: Submit 3 samples, full size, for each color and pattern specified.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Flooring Materials: Quantity equal to 2 percent of total installed, but not less than one box or roll for each type and color.

**1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum 5 years documented experience.

**1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

**1.07 FIELD CONDITIONS**

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

**PART 2 PRODUCTS****2.01 TILE FLOORING**

- A. General:
1. Waterjet Cutting:
    - a. Refer to Drawings for size of floor design.
    - b. Cut patterns and designs using a waterjet process.
    - c. Waterjet cutting shall be done by the following company:
      - 1) Custom Tile and Marble of Romulus, MI.
        - (a) Contact: Dale Bliss; 313-304-1515.
        - 2) Substitutions: Not permitted.
      - 2) Substitutions: Not permitted.
    - d. Floor design shall consist of [RF2] in up to four (4) colors.



- B. RF1 Rubber Tile: Homogeneous, color and pattern throughout thickness.
1. Products:
    - a. Nora Systems, Inc. by Interface; norament arago: [www.nora.com](http://www.nora.com).
    - b. Substitutions: Not permitted.
  2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
  3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA
  4. Size: 40 by 20 inch nominal.
  5. Total Thickness: 0.14 inch (3.5 mm).
  6. Texture: Modeled / Stone.
  7. Edge: Square.
  8. Installation Pattern: 1/3 Offset.
  9. Colors: Architect shall select one (1) color from manufacturer's full line.
  10. Manufacturer's Representative: Mary McAtamney (586) 612-5444.
- C. [RF2] Rubber Tile: Homogeneous, color and pattern throughout thickness.
1. Products:
    - a. [Nora Systems, Inc. by Interface]; [norament satura]: [[www.nora.com](http://www.nora.com)].
    - b. Substitutions: Not permitted.

2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E648 or NFPA 253.
4. Size: [40] by [40] inch nominal.
5. Total Thickness: 0.14 inch (3.5 mm).
6. Texture: [Hammered].
7. Edge: Square
8. Colors: [Architect shall select four (4) colors from manufacturer's full line].
9. Manufacturer's Representative: Mary McAtamney (586) 612-5444.

## **2.02 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
  1. Coordinate selection of products with Owner's maintenance service.
- C. Floor Moldings, Stair Coverings, and Resilient Base: Refer to Section 09 6513 - Resilient Bases and Accessories.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
  1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.
- C. Mat bond tests are required. This test determines the compatibility of flooring with the substrate and may provide an indication of the presence of excessive moisture or other contaminants.
- D. A water droplet test for absorbency of the concrete or cementitious substrate is always recommended when using nora ED120 or nora AC100 adhesive.

### **3.02 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.
- E. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

### **3.03 INSTALLATION - GENERAL**

- A. The installation area must be fully enclosed, weather tight and climate controlled between 63 degrees Fahrenheit and 75 degrees Fahrenheit and 40% to 60% ambient relative humidity (RH) for at least 48 hours prior, during and 72 hours after installation.
- B. Starting installation constitutes acceptance of subfloor conditions.
- C. Install in accordance with manufacturer's written instructions.
- D. Adhesive-Applied Installation:
  1. Fully adhere resilient floor finishes to substrates using a full spread of adhesive completely covering substrate.
  2. Spread only enough adhesive to permit installation of materials before initial set.

3. Fit joints and butt seams tightly.
4. Set flooring in place, press with heavy roller to attain full adhesion.
- E. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- F. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- G. Install flooring in recessed floor access covers, maintaining floor pattern.
- H. At movable partitions, install flooring under partitions without interrupting floor pattern.
- I. Coordinate with Section 09 6513 - Resilient Bases and Accessories for installation of floor moldings, stair coverings, and resilient base.
  1. Permanently fuse joint together using welding rod.
  2. Finish seams flush with adjacent flooring material.

#### **3.04 INSTALLATION - TILE FLOORING**

- A. Mix tile from containers to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Installed floor tile shall be without open cracks, bubbling, telegraphing of adhesive spreader marks, and other imperfections.
- C. Install resilient tile in floor patterns indicated.
- D. Where no patterns are indicated, lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

#### **3.05 CLEANING**

- A. Remove excess adhesive from floor surfaces without damage.
- B. Clean, seal, and wax in accordance with manufacturer's written instructions.
  1. Seal resilient floor finishes only when recommended by resilient floor finish manufacturer.
  2. Wax resilient floor finishes only when recommended by resilient floor finish manufacturer.
    - a. Apply not less than two coats as recommended by manufacturer.
  3. Do not seal or wax luxury vinyl tile.
- C. Clean resilient flooring not more than 5 days prior to Substantial Completion in accordance with resilient flooring manufacturer's instructions

#### **3.06 PROTECTION**

- A. Prohibit traffic on resilient flooring for 48 hours after installation.
- B. After cleaning, place protective coverings over finish floors; do not remove coverings until Date of Substantial Completion.

#### **END OF SECTION**

**SECTION 09 6513 - RESILIENT BASES AND ACCESSORIES****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Resilient base.
- B. Floor moldings.

**1.02 REFERENCE STANDARDS**

- A. ASTM F1861 - Standard Specification for Resilient Wall Base 2016.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Shop Drawings: Indicate seaming plans and floor patterns.
- D. Verification Samples:
  - 1. Resilient Base, Floor Moldings, and Stair Coverings: Submit 3 samples, 12 inches long illustrating color, pattern, and profile for each accessory specified.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Wall Base: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.
  - 3. Extra Stair Covering Materials: Quantity equal to 2 percent of total installed, but not less than 8 linear feet for each type and color.
  - 4. Extra Floor Moldings: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified resilient accessories with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in installing specified resilient accessories with minimum 5 years documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

**1.06 FIELD CONDITIONS**

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

**PART 2 PRODUCTS****2.01 RESILIENT BASE**

- A. RB1Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, cove, for hard surface flooring and Style A, straight, for carpet, unless otherwise indicated.
  - 1. Manufacturers: Provide products from one of the following:
    - a. Armstrong Flooring Inc.: [www.armstrongflooring.com](http://www.armstrongflooring.com).
    - b. Burke Flooring: [www.burkeflooring.com](http://www.burkeflooring.com).
    - c. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).

- d. Roppe Corp: [www.roppe.com](http://www.roppe.com).
- e. Substitutions: See Section 01 6000 - Product Requirements.
- 2. Height: 4 inch.
- 3. Thickness: 0.125 inch.
- 4. Finish: Satin.
- 5. Length: Roll.
- 6. Colors: Architect shall select up to two (2) colors from manufacturer's full range..

## **2.02 FLOOR MOLDINGS**

- A. Floor Moldings: Resilient edge and transition strips for changes in flooring materials.
  - 1. Manufacturers:
    - a. Armstrong Flooring Inc.: [www.armstrongflooring.com](http://www.armstrongflooring.com).
    - b. Burke Flooring: [www.burkeflooring.com](http://www.burkeflooring.com).
    - c. Johnsonite, a Tarkett Company: [www.johnsonite.com](http://www.johnsonite.com).
    - d. Roppe Corp: [www.roppe.com](http://www.roppe.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
  - 2. Material: Rubber as is standard with manufacturer.
  - 3. Profiles: As standard with manufacturer and as appropriate for floor finishes, unless otherwise indicated.
  - 4. Provide floor moldings at the following locations unless otherwise indicated:
    - a. Open perimeters of resilient flooring; reducer strips.
    - b. Open perimeters of carpeting; edge guards.
    - c. Changes in floor finishes from resilient flooring to carpeting; transition strips.
    - d. Changes in floor finishes from resilient flooring to existing terrazzo; reducer strips.
    - e. Other areas as indicated or required for complete floor finish installations.
  - 5. Colors: As selected by Architect.

## **2.03 ACCESSORIES**

- A. Primers and Adhesives: Waterproof; types recommended by accessories manufacturer.
- B. Filler for Coved Base: Plastic.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that surfaces are flat to tolerances acceptable to stair covering manufacturer, free of cracks that might telegraph through stair coverings, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of stair coverings to substrate.
- B. Verify that surfaces are flat, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of floor moldings to substrate.
- C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

### **3.02 PREPARATION**

- A. Clean substrates.

### **3.03 INSTALLATION - GENERAL**

- A. Install in accordance with manufacturer's written instructions.
- B. Adhesive-Applied Installation:
  - 1. Fully adhere resilient base, stair coverings, and floor moldings, to substrates using a full spread of adhesive completely covering substrate.
  - 2. Spread only enough adhesive to permit installation of materials before initial set.
  - 3. Fit joints and butt seams tightly.
- C. Install floor moldings at unprotected or exposed edges, where flooring terminates, and where indicated.
  - 1. Resilient Strips: Attach to substrate using adhesive.

**3.04 INSTALLATION - RESILIENT BASE**

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install with minimal amount of joints; tops of adjacent pieces shall be aligned.
- C. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- D. Install base on solid backing. Bond tightly to wall and floor surfaces.
- E. At masonry and other irregular substrates fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
- F. Scribe and fit to door frames and other interruptions.

**3.05 INSTALLATION - FLOOR MOLDINGS**

- A. Install floor moldings in one piece for full width of installation, where possible.
- B. Where joints are unavoidable, fit tightly together and align adjacent molding profiles.
- C. Adhere over entire surface. Fit accurately and securely.

**3.06 CLEANING**

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.

**3.07 PROTECTION**

- A. Prohibit traffic on resilient stair coverings and floor moldings for 48 hours after installation.

**END OF SECTION**





**SECTION 09 6813 - TILE CARPETING****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Carpet tile, fully adhered.

**1.02 REFERENCE STANDARDS**

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials 2016.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2019a, with Editorial Revision (2020).
- C. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2019.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings.
  - 1. Waterjet Cutting: Submit drawings, both overall plan and details, of waterjet cut floor pattern and design. Include colors and dimensions.
- D. Verification Samples:
  - 1. Carpet Tile: Submit 3 samples, full size, for each color and pattern specified.
- E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Carpet Tiles: Quantity equal to 2 percent of total installed, but not less than one box for each type and color.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum 5 years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum 5 years documented experience.

**1.05 FIELD CONDITIONS**

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

**1.06 EXTRA MATERIALS**

- A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
  - 1. Carpet Tile Flooring: Furnish not less than one box for each 50 boxes or fraction thereof, for each type, color, pattern, and size installed.

**PART 2 PRODUCTS****2.01 MATERIALS**

- A. General:
  - 1. Waterjet Cutting:
    - a. Refer to Drawings for design.
    - b. Cut patterns and designs using a waterjet process.
- B. CPT1 Tile Carpeting:
  - 1. Product:
    - a. Forbo; Flotex Modular: [www.forbo.com](http://www.forbo.com).

- b. Substitutions: Not permitted.
- 2. Construction: Flocked.
- 3. Tile Size: 19.69 by 19.69 inch, nominal.
- 4. Pattern: Metro (Tile)
- 5. Color:
  - a. CPT1A Architect shall select one (1) color from manufacturer's full range.
    - 1) Design intent: Grey
  - b. CPT1B Architect shall select one (1) color from manufacturer's full range.
    - 1) Design intent: Grey
  - c. CPT1C Architect shall select one (1) color from manufacturer's full range.
    - 1) Design intent: Red
- 6. Installation Pattern: As indicated on drawings.
- 7. Installation Direction: Monolithic.
- 8. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
- 9. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
- 10. Fiber: Nylon; type 6,6.
- 11. Density Factor: 80,000,000 fibers/m<sup>2</sup>.
- 12. Secondary Backing Material: Recycled vinyl cushioned backing.

## **2.02 ACCESSORIES**

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.
- C. Floor Moldings, Stair Coverings, and Resilient Base: Refer to Section 09 6513 - Resilient Bases and Accessories.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
  - 1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

### **3.02 PREPARATION**

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- D. Vacuum clean substrate.

### **3.03 INSTALLATION**

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Install carpet tile in floor patterns indicated.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Trim carpet tile neatly at walls and around interruptions.

- H. Coordinate with Section 09 6513 - Resilient Bases and Accessories for installation of floor moldings, stair coverings, and resilient base.

**3.04 CLEANING**

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.
- C. Complete final cleaning of floor not more than 5 days prior to Substantial Completion.

**3.05 PROTECTION**

- A. After cleaning, protect finish floors from damage until Date of Substantial Completion.

**END OF SECTION**



**SECTION 09 8433 - ACOUSTIC WALL UNITS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Absorption panels:
  - 1. Fabric-wrapped, glass-fiber board panels.

**1.02 REFERENCE STANDARDS**

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method 2017.
- B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014 (Reapproved 2019).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests 2016.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
- D. Verification Samples: Submit 3 samples of each type and finish of panel specified; 12 by 12 inch, showing construction, edge details, finish, and mounting method.
- E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.
- B. Installer Qualifications: Company specializing in installing acoustic wall units with minimum 5 years documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

**1.06 MOCK-UP**

- A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
- B. For each type of acoustical wall unit, build mockup of typical wall area include a minimum of 2 acoustical wall units. Include typical joint between acoustical wall units. Construct mock-ups of acoustical units at locations indicated by Architect.
  - 1. Approved mock-ups may remain as part of the Work.

**PART 2 PRODUCTS****2.01 FABRIC-WRAPPED GLASS-FIBER BOARD PANELS**

- A. Drawing Designations: AWP1
- B. Products:
  - 1. Acoustic Surfaces, Inc; Fabrisorb High Impact: [www.acousticalsurfaces.com](http://www.acousticalsurfaces.com).
  - 2. Conwed Designscape/Wall Technology, an Owens Corning company; Respond IR Series [www.conweddesignscape.com](http://www.conweddesignscape.com).

3. Decoustics, a Saint-Gobain company; High Impact Resistant Wall Panel (H.I.R. #1): [www.decoustics.com](http://www.decoustics.com).
  4. Integrated Interiors, Inc.; 1000 Series Acoustic Panel: [www.integratedinteriors.com](http://www.integratedinteriors.com)
  5. LBI Boyd; APS Acoustic Panels and Systems: [www.lbiboyd.com](http://www.lbiboyd.com)
  6. MBI Products Company, Inc; Colorsonix: [www.mbiproducts.com](http://www.mbiproducts.com).
  7. Sound Concepts; HIR 1 - High Impact: [www.soundconceptscan.com](http://www.soundconceptscan.com).
  8. Sound Seal, Inc; S-2100 High Impact: [www.soundseal.com](http://www.soundseal.com).
  9. Substitutions: See Section 01 6000 - Product Requirements.
- C. Panel Core: Manufacturer's standard rigid glass-fiber board; complying with ASTM C612.
1. Density: 6 to 7 lb/cu ft.
- D. Facer: Manufacturer's standard high-density, impact-resistant, glass-fiber facer; laminated to core.
1. Thickness: 1/8 inch.
  2. Density: 16 to 20 lb/cu ft.
- E. Edges: Perimeter edges reinforced by a formulated resin hardener.
- F. Fabrics:
1. AWP1
    - a. Products:
      - 1) Carnegie; Xorel: [www.carnegiefabrics.com/carnegie-xorel](http://www.carnegiefabrics.com/carnegie-xorel).
      - 2) Substitutions: Not permitted.
    - b. Pattern: Meteor 6427.
    - c. Color: Architect shall select up to two (2) colors from manufacturer's full range.
    - d. Fiber Content: 100% IFR Xorel.
    - e. Weight: 13 oz/sq yd.
    - f. Width: 54 inches.
- G. Panel Shape: Flat.
- H. Edge Profile: Square.
- I. Corner Detail in Elevation: Square, unless otherwise indicated.
- J. Nominal Overall Panel Thickness:
1. AWP1: 2-1/8 inches.
- K. Panel Sizes and Shapes - Width and Height: As indicated on Drawings.
- L. Mounting Method: Back mounted with manufacturer's standard metal z-clips.
- M. Performance Requirements:
1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
  2. Noise Reduction Coefficient (NRC):
    - a. 1-1/8 inch panels: 0.8 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
    - b. 2-1/8 inches panels: 1.0 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.
    - c. 4-1/8 inches panels: 1.1 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.

## 2.02 FABRICATION

- A. Use manufacturer's standard methods of construction; fabricate panels to sizes and configurations as indicated.
- B. Provide cutouts for electrical outlets and similar items.
- C. Fabric facings shall be installed without sagging, wrinkles, blisters, or visible seams.
  1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
- D. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

**2.03 ACCESSORIES**

- A. Spline-Mounting Accessories: Manufacturer's standard concealed connecting splines of extruded aluminum or plastic designed for screw attachment to walls, with coordinating moldings and trim for miscellaneous conditions.
- B. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:
  - 1. Designed to support full weight of panels and provide lateral support, with one part mechanically attached to back of panel and the other attached to substrate.
- C. Furring Strips: Wood furring, minimum 2 inches wide by depths indicated; straight and without significant knots or other defects.
- D. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.
  - 1. Products:
    - a. Franklin International, Inc; Titebond GREENChoice Heavy Duty Construction Adhesive; [www.titebond.com](http://www.titebond.com).
    - b. PPG Architectural Coatings; Liquid Nails LN-903 Heavy Duty Construction Adhesive: [www.liquidnails.com](http://www.liquidnails.com).
    - c. Substitutions: See Section 01 6000 - Product Requirements.

**PART 3 EXECUTION****3.01 EXAMINATION**

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.02 INSTALLATION**

- A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
- B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
  - 1. Maintain panel joint widths/reveals as indicated
- C. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
  - 1. Plumb and level.
  - 2. Flatness.
  - 3. Width of joints.

**3.03 CLEANING**

- A. Clean acoustical units upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

**3.04 PROTECTION**

- A. Provide protection of installed acoustical panels until Date of Substantial Completion.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

**END OF SECTION**





**SECTION 09 9100 - PAINTING****PART 1 GENERAL****1.01 SUMMARY**

- A. Exterior painting.
- B. Interior painting.
- C. Dryfall painting.
- D. Concrete stains.

**1.02 RELATED REQUIREMENTS**

- A. Section 09 9600 - High-Performance Coatings: Epoxy paints.

**1.03 DEFINITIONS**

- A. Conform to ASTM D16 for interpretation of terms used in this section
- B. DFT: Dry film thickness, measured in mils.
- C. WFT : Wet film thickness, measured in mils.

**1.04 REFERENCE STANDARDS**

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- C. ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films; 2013.
- D. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
- E. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
- F. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- G. ASTM E96/E96M - Standard Test Methods of Water Vapor Transmission of Materials - 2016
- H. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health; v1.1, 2010.
- I. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
- J. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.
- K. SSPC-SP 1 - Solvent Cleaning; 2015.
- L. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- M. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

**1.05 SUBMITTALS**

- A. Refer to Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product data for each paint product. Include complete list of products to be used, with the following information for each:
  - 1. Manufacturer's name, product name and/or catalog number, and general product category.
    - a. Example of general product categories:
      - 1) Interior finish coat - latex, eggshell.
      - 2) Exterior primer for ferrous metal.
  - 2. For each paint system and substrate, indicate which paint products are to be used.
    - a. Examples:
      - 1) Interior latex eggshell system for gypsum board:
        - (a) Primer: Name of specific product provided.

- (b) Finish Coats: Name of specific product provided.
  - 2) Exterior latex semigloss system for ferrous metals.
    - (a) Primer: Name of specific product provided.
    - (b) Finish Coats: Name of specific product provided.
- 3. Use same designations indicated on Drawings and Schedules.
- C. Samples: Submit 3 paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating each color and sheen specified.
  - 1. Paint color submittals will not be considered until color submittals for major materials not to be painted, such as masonry and storefront finishes, have been approved.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, and color samples of each color and finish used.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
  - 1. See Section 01 6000 - Product Requirements, for additional provisions.
  - 2. Extra Paint and Finish Materials: 1 gallon of each color, sheen, and type; from the same product run.
  - 3. Label each container with color, sheen, and type in addition to the manufacturer's label.
- H. Field Quality Control Reports.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum 5 years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years documented experience.

#### **1.07 MOCK-UPS**

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Mock-ups shall demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Architect specifically approves such deviations in writing.
- C. Provide a mock-up for each paint system, substrate, color and sheen as follows:
  - 1. Vertical and Horizontal Surfaces: Provide mockup samples of at least 100 sq. ft.
  - 2. Doors and Frames: Provide mock-up samples of one complete door and frame.
  - 3. Railings and Other Lineal Materials: Provide mock-up samples of at least 8 lineal feet.
  - 4. Include mock-up for each dryfall paint system and color.
- D. Locate where directed by Architect.
- E. Mock-ups may remain as part of work.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

#### **1.09 FIELD CONDITIONS**

- A. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.

- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside humidity ranges required by paint product manufacturer.
- D. Do not apply interior coatings when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
- E. Minimum Application Temperatures for Paints: 50 degrees F unless otherwise required by manufacturer's instructions.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Provide paint and coating products from same manufacturer, unless otherwise specified.
  - 1. Exceptions shall be permitted, provided approval of Architect is obtained using specified procedures for substitutions.
- B. Paint Manufacturers.
  - 1. Sherwin-Williams: The Sherwin-Williams Company: [www.sherwin-williams.com](http://www.sherwin-williams.com).
  - 2. Substitutions: Not permitted.
- C. Concrete Stain Manufacturers:
  - 1. H&C: H&C Products Group/Sherwin-Williams: [www.hcconcrete.com](http://www.hcconcrete.com).
  - 2. Substitutions: See Section 01 6000 - Product Requirements.

### **2.02 PAINTS AND FINISHES - GENERAL**

- A. Exclusions:
  - 1. This section excludes epoxy paints and other high performance coatings for the following:
    - a. Interior non-traffic surfaces (epoxy paints).
  - 2. Refer to Section 09 9600 - High-Performance Coatings.
- B. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
  - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
  - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
  - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
  - 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
  - 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- C. Volatile Organic Compound (VOC) Content and Emissions:
  - 1. Volatile Organic Compound (VOC) Content:
  - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Sheen/Gloss Criteria.
  - 1. Product names are not acceptable as gloss level identification.
  - 2. Determine gloss value of paint finish by testing paint samples according to ASTM D523, using 60 degree geometry. Sheen/Gloss levels shall be defined as follows:
    - a. Gloss Level 1: Flat/Matte, value between 0 and 5 units.
    - b. Gloss Level 2: Velvet, value between 5 and 10 units.
    - c. Gloss Level 3: Eggshell, value between 10 and 20 units.
    - d. Gloss Level 4: Satin, value between 20 and 35 units.
    - e. Gloss Level 5: Semigloss, value between 35 and 70 units.

- f. Gloss Level 6: Gloss, value between 70 and 85 units.
- g. Gloss Level 7: High Gloss, value more than 85 units.
- 3. Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: To match Architect's samples unless indicated otherwise on Drawings.
  - 1. Provide tinted deep tone primers at deep tone colors, and as recommended by paint manufacturer.

### 2.03 EXTERIOR PAINTS

- A. Exterior Paint Systems - Latex.
  - 1. Primers: For all sheens unless otherwise indicated.
    - a. Primer for ferrous metal and galvanized steel; one coat.
      - 1) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer, B66W310 Series; DFT 3.0 mils
    - b. Primer for previously painted surfaces.
      - 1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.
  - 2. Semi-gloss Sheen.
    - a. Finish coats for ferrous metal and galvanized steel; two coats.
      - 1) Sherwin Williams; Pro Industrial DTM Acrylic Semi-Gloss, B66W01100 Series; DFT 2.5 mils.

### 2.04 INTERIOR PAINTS

- A. General:
  - 1. For the following locations, provide the paint sheen indicated, unless otherwise indicated on Drawings:
    - a. Ceilings, Soffits and Ceiling Drops: Flat sheen.
    - b. Gypsum Board, except at Ceilings: Eggshell sheen.
    - c. Masonry: Semigloss sheen.
    - d. Metals: Semigloss sheen
- B. Interior Paint Systems - Latex.
  - 1. Primers: For all sheens unless otherwise indicated.
    - a. Primer for concrete masonry units; one coat.
      - 1) Sherwin Williams; PrepRite Interior/Exterior Latex Block Filler, B25W25; DFT 8.0 mils.
    - b. Primer for ferrous metal and galvanized steel; one coat.
      - 1) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer, B66W310 Series; DFT 3.0 mils.
    - c. Primer for gypsum board; one coat.
      - 1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W02600; DFT 1.0 mils.
    - d. Primer for previously painted surfaces; one coat.
      - 1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.
    - e. Primer for insulated piping and insulated ductwork; one coat.
      - 1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.
  - 2. Semigloss Sheen:
    - a. Finish coats for all surfaces except metals; two coats.
      - 1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Semi-Gloss, B31-2600 Series; DFT 1.6 mils.
    - b. Finish coats for ferrous metal and galvanized steel; two coats.
      - 1) Sherwin Williams; Pro Industrial DTM Acrylic Semi-Gloss, B66W01150 Series; DFT 2.5 mils.
  - 3. Eggshell Sheen:

- a. Finish coats for all surfaces; two coats.
  - 1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Eg-Shel, B20-2600 Series; DFT 1.7 mils.
4. Flat Sheen:
  - a. Finish coats for all surfaces; two coats.
    - 1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series; DFT 1.6 mils.

## 2.05 DRYFALL PAINTS

- A. General:
  1. Provide dryfall paint at exposed ceiling construction, unless otherwise indicated
- B. Interior Dryfall Systems - Waterborne.
  1. Flat Sheen:
    - a. Undercoat; one coat. Unless otherwise recommended by the dryfall manufacturer, prime substrates with one of the following products:
      - 1) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat, B42 Series; DFT 2.0 mils
    - b. Finish coat; one coat.
      - 1) Sherwin Williams; Pro Industrial Waterborne Acrylic Dryfall Flat, B42 Series; DFT 2.0 mils.

## 2.06 CONCRETE STAINS

- A. General:
  1. Locations:
    - a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using concrete stains.
- B. Concrete Stains:
  1. For traffic surfaces:
    - a. Water-based, film-forming, solid color, acrylic concrete stain; two coats.
      - 1) H&C: H&C Colortop Water-Based Solid Color Concrete Stain; DFT As recommended by manufacturer.

## 2.07 ACCESSORY MATERIALS

- A. Accessory Materials: Provide sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials; report incompatible primer conditions and submit recommended changes for Architect's approval.
  1. Do not proceed with remedial action or change without receiving written authorization from Architect.
- E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below following maximums:
  1. Interior Materials:
    - a. Gypsum Wallboard: 12 percent.
    - b. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

2. Report unacceptable conditions and submit recommended remedial action for Architect's approval.
  - a. Do not proceed with remedial action or change without receiving written authorization from Architect.

### 3.02 PREPARATION

- A. General:
  1. Clean surfaces thoroughly and correct defects prior to application.
  2. Prepare surfaces using the methods recommended by the top coat manufacturer for achieving the best result for the substrate under the project conditions.
  3. Remove or repair existing paints or finishes that exhibit surface defects.
  4. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
    - a. After work is completed, reinstall removed items.
  5. Seal surfaces that might cause bleed through or staining of topcoat.
  6. Remove mildew from impervious surfaces by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- B. Concrete - Non-Traffic Surfaces:
  1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
  2. Clean concrete according to ASTM D4258. Allow to dry.
- C. Masonry:
  1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
- D. Gypsum Board:
  1. Interior:
    - a. Fill minor defects with filler compound; make smooth and flush with adjacent surfaces.
    - b. Spot prime defects after repair.
- E. Ferrous Metal - Non-galvanized:
  1. Solvent clean according to SSPC-SP 1.
  2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
    - a. Re-prime entire shop-primed item.
  3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning." Protect from corrosion until coated.
- F. Galvanized Surfaces:
  1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
  2. Remove loose paint and other debris according to SSPC-SP 2.
- G. Previously Painted Existing Surfaces:
  1. Remove all loose paint, dust, dirt, mold, mildew, oil, grease, rust, loose mill scale, mortar, and any other surface contamination.
  2. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.
    - a. Tightly adhered existing paint may remain.
  3. Spot prime all bare areas with appropriate primer before re-priming entire surface.

### 3.03 APPLICATION - PAINT PRODUCTS

- A. Apply products in accordance with manufacturer's written instructions.

- B. Provide smooth, opaque coatings of uniform finish, color, appearance, and coverage without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.
- C. Terminate paint in neat lines.
- D. Apply paint products to properly prepared surfaces.
  - 1. Do not apply coatings over dirt, rust, scale, grease, moisture, or other conditions detrimental to application of coatings
- E. Primers:
  - 1. Apply first coat of primer to surfaces as soon as practical after preparation and before subsequent surface deterioration.
  - 2. Re-prime shop-primed surfaces.
- F. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.
  - 1. Sand between coats as recommended by manufacturer; before applying next coat vacuum clean surfaces of loose particles and use tack cloth to remove any remaining dust and particles just prior to applying next coat.
- G. Provide completed work matching approved samples for color, sheen, texture, coverage and quality of work.
  - 1. Remove, refinish, or repaint work not complying with requirements.
- H. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- I. Use applicators and methods best suited for substrate and type of material being applied and according to manufacturer's instructions.
  - 1. Brush Application: Use brushes best suited for type of material applied; use brush of appropriate size for surface or item being painted; produce results free of visible brush marks.
  - 2. Roller Application: Use rollers of fiber type and nap length as recommended by manufacturer for material and texture required.
  - 3. Spray Application: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
- J. Number of Coats: Each paint system specifies a number of coats. This is the minimum number required.
  - 1. If undercoats, stains, or other imperfections are visible after final coat of paint, apply additional coats until paint is of uniform finish, color, and appearance without defects or imperfections.
- K. Minimum Coating Thickness: Provide dry film thickness for each coat as indicated, but not less than that recommended by the coating manufacturer.
  - 1. Number of coats and film thicknesses required are same regardless of application method.
  - 2. Ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.

#### **3.04 APPLICATION - DRYFALL PAINTS**

- A. Apply products in accordance with manufacturer's written instructions.
- B. Dryfall overspray may adhere to hot surfaces; protect hot equipment and surfaces not intended to be painted from overspray.
- C. Do not apply succeeding coats until previous coat has dried completely as recommended by manufacturer.
- D. Provide even uniform coatings without runs, sags, laps, holidays, spotting, cloudiness, or other imperfections.

#### **3.05 APPLICATION - CONCRETE STAINS**

- A. Apply products in accordance with manufacturer's written instructions.

- B. Provide even uniform coatings without brush marks, runs, sags, laps, holidays, spotting, cloudiness, or other imperfections.

### 3.06 SURFACES TO BE PAINTED

- A. General: Paint all exposed surfaces except where indicated not to be painted or to remain natural.
  - 1. The term "exposed" includes areas visible through permanent and built-in fixtures when they are in place.
  - 2. If surface, material, or item is not specifically mentioned, paint in same manner, color, and sheen as similar surfaces, materials, or items, regardless of whether indicated or not.
  - 3. Paint surfaces that are cut and patched to permit installation of electrical services, piping, and ductwork.
- B. Equipment and Furniture:
  - 1. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces.
  - 2. Paint surfaces to be concealed behind permanently installed fixtures, equipment, and furnishings, using primer only, prior to installation of permanent item.
- C. Registers and Grilles: Paint interior surfaces of ducts, for a minimum of 18 inches or beyond sight line, whichever is greater, with a flat black (non-reflecting) paint.
- D. Access Panels: Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- E. Doors:
  - 1. Exterior Doors: Finish doors on tops, bottoms, and all four edges the same as exterior faces.
  - 2. Interior Doors: Finish doors on tops, bottoms, and all four edges the same as face of non-secured side.
- F. Panelboards for Service Panels, Telephone and Other Electrical Equipment:
  - 1. Paint both sides and all edges of plywood before installation.
    - a. Color and Sheen: Gray, semi-gloss, unless otherwise indicated.
- G. Mechanical and Electrical:
  - 1. This Section includes painting of all mechanical, fire protection, and electrical items.
    - a. Do not paint sprinkler heads and polished fire protection components.
    - b. Do not paint insulated pipe, duct work or equipment before insulation is applied.
  - 2. Piping, Insulated Piping, Pipe Hangers, and Supports:
    - a. In finished/public areas, paint exposed piping the same color and sheen as surface it is mounted on unless otherwise indicated.
    - b. In utility areas, paint exposed piping according to piping color coding scheme; otherwise paint the same color and sheen as surface it is mounted on unless otherwise indicated.
    - c. Paint all exposed pipe hangers and supports the same color and sheen as surface it is mounted on unless otherwise indicated.
      - 1) Any portion of hangers and supports encompassing the actual pipe shall be painted to match the pipe color and sheen.
  - 3. Ductwork, Insulated Ducts, and Supports:
    - a. In finished/public areas, paint exposed ductwork and supports the same color and sheen as surface it is mounted on unless otherwise indicated.
    - b. In utility areas, paint exposed ductwork according to color coding scheme; otherwise paint the same color and sheen as surface it is mounted on unless otherwise indicated.
    - c. Paint all exposed hangers and supports the same color and sheen as surface it is mounted on unless otherwise indicated.
      - 1) Any portion of hangers and supports encompassing the actual ductwork shall be painted to match the ductwork color and sheen.



4. Electrical Conduit, Fittings and Junction Boxes:
  - a. In finished/public areas, paint exposed conduit, fittings and junction boxes same color and sheen as surface it is mounted on unless otherwise indicated.
  - b. In utility areas, paint exposed conduit, fittings and junction boxes according to color coding scheme; otherwise paint the same color and sheen as surface it is mounted on unless otherwise indicated.
5. Mechanical and Electrical Equipment:
  - a. Exterior Equipment: Paint all equipment exposed to the weather.
    - 1) Do not paint factory-finished equipment unless otherwise indicated.
  - b. Paint shop-primed mechanical and electrical equipment same color and sheen as surface it is mounted on unless otherwise indicated.
  - c. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
  - d. Paint interior surfaces of convector and baseboard heating cabinets to match face panels.

### 3.07 SURFACES NOT TO BE PAINTED

- A. Do not paint or finish the following unless otherwise indicated:
  1. Factory-finished items; factory-primed items are not considered factory-finished.
  2. Items indicated to receive other finish.
  3. Items indicated to remain naturally finished.
  4. Fire rating labels.
  5. Equipment serial number and capacity labels.
  6. Operating parts of equipment.
  7. Aluminum components.
  8. Polished and brushed stainless steel items.
  9. Metal flashings.
  10. Brick.
  11. Cast-in-place concrete.
  12. Floors.
  13. Surfaces concealed by suspended ceilings.
  14. Concealed piping, ductwork, and conduit.
  15. Surfaces within pipe and duct spaces.
  16. Acoustical materials.

### 3.08 IDENTIFICATION AND COLOR CODING

- A. Partition Identification.
  1. Permanently label each partition required to have protected openings, such as fire walls, fire barriers, fire partitions, smoke barriers, and smoke partitions.
    - a. Labeling:
      - 1) Labeling may be either painted stencils or premanufactured self-adhesive stickers.
      - 2) Lettering not less than 3 inches in height, minimum 3/8 inch stroke width, in contrasting color. Suggested wording as follows:
        - (a) "2 HOUR FIRE BARRIER - PROTECT ALL OPENINGS" or similar.
      - 3) Colors and exact wording of labels shall comply with local code(s).
    - b. Locations:
      - 1) Where possible, locate labels in accessible concealed floor, floor-ceiling, and attic spaces.
      - 2) Locate labels within 15 feet of the ends of each wall and intervals not to exceed 30 feet measured horizontally along the wall. Minimum of one label per run of wall.
        - (a) Locate 6 inches above accessible ceiling or 6 inches below ceiling/roof in exposed construction unless otherwise required by local code(s).
      - 3) Where multiple construction types occur in single run of wall:

- (a) At accessible ceilings, paint 2 inch wide vertical line full height above ceiling to note changes in wall construction, label area between the line as indicated.
  - (b) At exposed construction, paint 2 inch wide vertical line 2 inches beyond top and bottom of lettering and label area between the line as indicated.
- B. Mechanical and Electrical Identification and Color Coding :
- 1. Refer to Divisions 21, 22, 23, and 26 for color coding scheme and identification of mechanical and electrical services; if no identification is provided, paint as follows:
    - a. Color Coding Scheme and Identification:
      - 1) Piping: None; paint to match surface on which it is mounted.
      - 2) Ductwork: None; paint to match surface on which it is mounted.
      - 3) Conduit: None; paint to match surface on which it is mounted.

### 3.09 FIELD QUALITY CONTROL

- A. Owner may provide field inspection.
- B. All painted surfaces shall be inspected as follows:
  - 1. Paint shall be rejected for the following:
    - a. Lacking minimum dry film thicknesses.
      - 1) Inspector may test for proper dry film thickness using methods as recommended by the inspector.
    - b. Poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, and corners.
    - c. Damage from touching, or disturbing paint in any other manner, before sufficiently dry.
    - d. Damage from application to moist surfaces or damage caused by inadequate protection from the weather.
    - e. Damage or contamination of paint from blown contaminants including but not limited to dust.
  - 2. Paint shall be rejected if any of the following are evident under natural lighting for exterior surfaces and final lighting source, including daylighting, for interior surfaces:
    - a. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
    - b. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
    - c. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles from a distance of not less than 48 inches.
- C. Visible defects are defined as follows:
  - 1. Brush and roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint coatings.
  - 2. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.
- D. Paint rejected by the inspection shall be repaired or replaced at the expense of the Contractor.
  - 1. Small affected areas shall be touched up.
  - 2. Large affected areas shall be repainted.
  - 3. Small and large areas shall be as defined by the Architect.
  - 4. Areas without sufficient dry film thickness shall be repainted.
  - 5. Paint runs and sags shall be removed by scraper or sanding and repainted.

### 3.10 CLEANING

- A. At end of each workday, remove empty cans, rags, and other discarded paint materials from site.
  - 1. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.

### 3.11 PROTECTION

- A. Protect other work, whether being painted or not, against damage from painting activities.

1. Correct damage by cleaning, repairing, replacing as approved by Architect
- B. Protect finishes until completion of project.
- C. Touch-up damaged finishes after Substantial Completion.

**END OF SECTION**



**SECTION 10 1400 - SIGNAGE****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Dimensional characters.

**1.02 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on each type of sign.
- C. Shop Drawings: For each sign type, provide dimensioned elevation including letter sizes and locations, graphics, colors and finishes, mounting methods, mounting heights, and material descriptions.
- D. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
  - 1. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
  - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
  - 3. Submit for approval by Owner through Architect prior to fabrication.
- E. Samples:
  - 1. Dimensional Characters: Submit 3 samples, full size, of each dimensional character style, font, color, and method of attachment.
    - a. For specified sizes 12 inches and under, provide samples matching specified size.
    - b. For specified sizes over 12 inches, provide 12 inch high samples unless actual specified size requested by Architect.
- F. Verification Samples: Submit samples showing colors specified.
  - 1. Where colors are not specified, submit two sets of color selection charts or chips.
- G. Maintenance Data: Include data on regular cleaning.

**1.03 QUALITY ASSURANCE**

- A. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

**1.04 DELIVERY, STORAGE, AND HANDLING**

- A. Package signs as required to prevent damage before installation.
- B. Store tape adhesive at normal room temperature.

**1.05 FIELD CONDITIONS**

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

**PART 2 PRODUCTS****2.01 MANUFACTURERS**

- A. Dimensional characters:
  - 1. A.R.K. Ramos: [www.arkramos.com](http://www.arkramos.com).
  - 2. Gemini Inc.: [www.geminisignproducts.com](http://www.geminisignproducts.com).
  - 3. ASI Signage Innovation: [www.asisignage.com](http://www.asisignage.com)
  - 4. The Supersine Company: [www.supersine.com](http://www.supersine.com).
  - 5. Substitutions: See Section 01 6000 - Product Requirements.

**2.02 DIMENSIONAL CHARACTERS**

- A. Metal Characters:
  - 1. Cut Characters: Cut characters from solid plate of thickness and metal indicated.

- a. Precisly cut characters with smooth square edges.
- b. Charaters shall be flat and free of warps, distortions or other surface imperfections.
- c. Material:
  - 1) Aluminum Plate: ASTM B209 in alloy and temper as recommended by dimensional character manufacturer.
    - (a) Thickness: 3/4 inch.
- d. Character Styles (Fonts): Helvetica Medium, upper case.
- e. Character Sizes: 10 inch high.
- f. Finish: Clear anodized.
- g. Mounting: Manufacturer's standard non-corrosive concealed studs (pin mounting). Provide fasteners as applicable for substrates indicated.
  - 1) Projected Mounting: Mount dimensional characters 1 inch off the substrate; from face of substrate to back of dimensional character.
  - 2) At exterior locations, provide stainless steel fasteners and hardware.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate surfaces are ready to receive work.

#### **3.02 INSTALLATION**

- A. General:
  1. Install in accordance with manufacturer's instructions.
  2. Install neatly, with horizontal edges level.
- B. Dimensional Characters:
  1. Mount dimensional characters at heights and locations indicated; with characters equally spaced unless otherwise indicated.

#### **3.03 CLEANING AND PROTECTION**

- A. Clean signage as recommended by signage manufacturer.
- B. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

#### **END OF SECTION**

**SECTION 10 2239 - FOLDING PANEL PARTITIONS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Top-supported folding panel partitions, horizontal opening.
  - 1. Manual individual panels.

**1.02 REFERENCE STANDARDS**

- A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable 2020.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2020.
- D. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing 2020a.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2013.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2020.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- I. ASTM E413 - Classification for Rating Sound Insulation 2016.
- J. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics 2015.

**1.03 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
  - 1. Require attendance by representatives of installer.
  - 2. Notify Architect 5 business days in advance of scheduled meeting date.

**1.04 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, and track switching components.
- C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.
- D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, adjacent construction and finish trim, and stacking depth.
  - 1. Include wiring diagrams of power and control wiring.
- E. Samples:
  - 1. Fabric Finishes: Submit 3 samples of each fabric, 8 by 10 inch in size illustrating color, finish, and texture.
- F. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.

- I. Operation and Maintenance Data: Operating procedures, troubleshooting and repair methods, wiring diagrams, parts lists, and identification of authorized maintenance firms located in vicinity of project.
- J. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

#### **1.05 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience and approved by manufacturer.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until installation.

#### **1.07 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manual Individual/ Paired Panels.
- B. Basis-of-Design product: Modernfold, a DORMA Group Company; Acousti-Seal 931: [www.moderfold.com](http://www.moderfold.com).
- C. Other Manufacturers: Provide either the product identified as "Basis of Design" or equivalent products as manufactured by one of the following:
  - 1. Hufcor, Inc.; [www.hufcor.com](http://www.hufcor.com).
  - 2. Moderco, Inc.: [www.moderco.com](http://www.moderco.com).
  - 3. Substitutions: See Section 01 6000 - Product Requirements.

#### **2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING**

- A. Folding Panel Partitions:
  - 1. Manually Operated: Side-opening; individual panels; side stacking; manually operated.
- B. Panel Construction:
  - 1. Frame: 16 gauge, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
  - 2. Panel Substrate Facing: Steel sheet, manufacturer's standard thickness.
  - 3. Hinges: Panel manufacturer's standard butt type; minimum of 3 hinges per panel joint.
  - 4. Panel Properties:
    - a. Thickness Without Finish: 3 inches.
    - b. Width: Up to 48 inches (1219 mm).
    - c. Weight: 8 lb/sq ft.
- C. Panel Finishes:
  - 1. Facing: Vinyl coated fabric with a total weight of not less than 16 oz. per lineal yard, 54 inches wide, Type 2, and having a flame spread rating of 25 or less when tested in accordance with ASTM E84.
  - 2. Exposed Metal Trim: Custom powder coated paint finish.
- D. Panel Seals:
  - 1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
  - 2. Acoustic Seals: Flexible acoustic seals at jambs and ceilings, retractable floor seals.
- E. Suspension System:



1. Track: Formed steel or extruded aluminum; thickness and profile designed to support loads.
    - a. Track shall provide support for adjacent ceiling materials.
    - b. Connect track to structural support with adjustable steel hanger brackets and 3/8 inch diameter threaded rods.
      - 1) Hanger bracket thickness and profile designed to support track and associated loads.
    - c. Include all associated hardware and accessories.
  2. Carriers: Nylon wheels on trolley carrier at top of every panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.
- F. Performance Requirements:
1. Acoustic Performance:
    - a. Sound Transmission Class (STC): 35 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
  2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
  3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

### 2.03 MATERIALS

- A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Steel Tubes: ASTM A500/A500M or ASTM A513/A513M, Type 5
- D. Steel Sheet: Cold rolled commercial steel or structural steel; ASTM A1008/A1008M.
- E. Vinyl Coated Fabric: ASTM F793 Category VI, polyvinyl fluoride (PVC) finish for washability and improved flame retardance; color as selected by Architect from manufacturer's standard range.
- F. Acoustic Insulation:
  1. Type: Manufacturers standard.
  2. Thickness: As required for acoustic performance indicated.

### 2.04 FINISHES

- A. Steel and Aluminum Finishes: Manufacturer's standard powder coated paint.
  1. Color: Standard color as selected by Architect.
- B. Vinyl-Coated Fabric: Manufacturer's standard.
  1. Color and Pattern: Architect shall select one (1) color/pattern from manufacturer's full range.

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.
- C. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.
- D. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

### 3.02 INSTALLATION

- A. Install partition in accordance with manufacturer's instructions and ASTM E557.
- B. Install self-supporting truss system including lateral bracing in accordance with manufacturer's instructions.
- C. Install components level and plumb.
- D. Install electric operator, wiring, and controls. Locate control station(s) as indicated.
- E. Fit and align partition assembly and pocket doors level and plumb.

**3.03 ADJUSTING**

- A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.
- B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
- C. Adjust partition assembly to achieve lightproof seal.

**3.04 CLEANING**

- A. Clean finish surfaces and partition accessories.

**3.05 CLOSEOUT ACTIVITIES**

- A. Demonstrate operation of partition and identify potential operational problems.

**END OF SECTION**

**SECTION 11 5213 - PROJECTION SCREENS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Front projection screen assemblies.

**1.02 RELATED REQUIREMENTS**

- A. Section 26 0583 - Wiring Connections: Electrical supply, conduit, and wiring for electric motor operated projection screens.

**1.03 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Wiring diagrams for motor operators and actuators, and controls and switches.
- C. Shop Drawings: Indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
- D. Samples:
  - 1. Case and Frame Finishes: Submit 3 samples {CH#126110} in size for each color selected.
  - 2. Screen Fabrics: Submit 3 samples, 4 by 4 inches in size, for each type, color, and finish.
- E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.
- I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

**1.04 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least {CH#125659} years of documented experience.

**1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.
- B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F, and stack in accordance with manufacturer's recommendations.
- C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

**1.06 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide 1 year manufacturer warranty for projection screen assembly.
  - 1. Additionally provide 5 year tab separation warranty for tab-tentioned screens.

**PART 2 PRODUCTS****2.01 FRONT PROJECTION SCREENS**

- A. PS2Front Projection Screen, Motorized.

1. Basis of Design: Legrand AV Inc., Da-Lite Brand; Tensioned Advantage Deluxe Electrol: [www.lagrاندav.com](http://www.lagrاندav.com).
    - a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      - 1) Draper, Inc.; Access V: [www.draperinc.com](http://www.draperinc.com).
      - 2) Substitutions: See Section 01 6000 - Product Requirements.
  2. Factory assembled unless otherwise indicated.
  3. Screen Size:
    - a. Diagonal: 189 inches.
    - b. Height: 100 inches.
    - c. Width: 160 inches.
  4. Concealed-in-Ceiling Screen Cases: Steel, case fully enclosed except for slot allowing viewing screen passage.
    - a. Bottom closure panel detachable or hinged to allow accessibility for service and maintenance.
    - b. Metal Thickness: 0.0478 inch (18 gage), minimum.
    - c. Finish: Powder coat.
    - d. Color: White.
    - e. End Caps: Steel; finished to match case.
    - f. Provide manufacturer's standard supports for suspension from ceiling.
      - 1) Includes minimum 3/8 inch threaded rods and case mounting brackets.
  5. Screen Material: Matte light diffusing fabric.
  6. Masking Borders: Black, on four sides.
  7. Extra Drops: Black; 13 inch wide.
    - a. Location: Top of screen.
  8. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.
- B. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

## 2.02 SCREEN MATERIALS

- A. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
1. Basis of Design: Legrand AV Inc., Da-Lite Brand; Matte White: [www.lagrاندav.com](http://www.lagrاندav.com).
    - a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      - 1) Draper, Inc.; Optiview Matt White XT1000E: [www.draperinc.com](http://www.draperinc.com).
      - 2) Substitutions: See Section 01 6000 - Product Requirements.
  2. Material: Matte white vinyl on fiberglass backing, with nominal gain of 1.0 over viewing angle not less than 70 degrees from axis, horizontally and vertically.
  3. Seams: Seamless unless height exceeds 120 inches.

## 2.03 ELECTRICAL COMPONENTS

- A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.
- B. Motors: Direct drive, 110 V, 60 Hz.
- C. Controls: Three (3) position control switch with plate.
1. Security: Provide key-locking cover plate; provide 2 keys.
  2. Control Board - Basis of Design Legrand AV Inc., Da-Lite Brand
    - a. SCB-100 RS-232 Serial Control Board – Built-in

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify that substrate is finished and ready to accept screen installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that openings for recessed screens are correctly sized.
- D. Verify type and location of electrical connections.
- E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

#### **3.02 PREPARATION**

- A. Coordinate screen installation with installation of projection systems.
- B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

#### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.
- B. Do not field cut screens.
- C. Install screens in mountings as specified and as indicated on drawings.
- D. Install plumb and level.
- E. Install electrically operated screens ready for connection to power and control systems by others.
- F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.
- G. Test electrical screens for proper working condition. Adjust as needed.

#### **3.04 PROTECTION**

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

#### **END OF SECTION**



**SECTION 12 3216 - MANUFACTURED PLASTIC LAMINATE-CLAD CASEWORK****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Manufactured plastic laminate casework.
- B. Miscellaneous pieces including tables and mobile cabinets.
- C. Countertops.

**1.02 DEFINITIONS**

- A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
- B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
- C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation, and bottoms of cabinets less than 30 inches above finished floor.

**1.03 REFERENCE STANDARDS**

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.
- B. ANSI A208.1 - American National Standard for Particleboard 2016.
- C. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use 2016.
- D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015.
- E. ASTM C1036 - Standard Specification for Flat Glass 2016.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014, with Errata (2018).
- H. BHMA A156.18 - American National Standard for Materials and Finishes 2016.
- I. BHMA A156.9 - American National Standard for Cabinet Hardware 2015.
- J. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood 2016.
- K. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.
- L. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.
- M. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

**1.04 ADMINISTRATIVE REQUIREMENTS**

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.
- C. Coordinate the work with placement of concealed framing, blocking, and reinforcements that support casework.

**1.05 SUBMITTALS**

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each product. Include component dimensions, configurations, construction details, joint details, attachments.
- C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include filler panels, rough-in and anchors, reinforcements, and blocking, placement dimensions and tolerances, clearances required, and keying information.

1. Indicate manufacturer's catalog number for each unit of casework.
  2. Indicate plumbing locations and electrical service locations.
- D. Samples:
1. Plastic Laminate: Submit 3 samples 3 by 6 inches in size showing each color, texture, and finish selected.
  2. Edge Banding: Submit 3 samples 6 inches in length showing each color and finish selected.
  3. Solid Surfacing: Submit 3 samples 4 by 4 inches in size, for each type, color, pattern, and finish.
- E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
- F. Casework Samples: Representative of types in the project.
1. To be provided only upon request of Architect.
    - a. Base Cabinet: Cabinet with drawer and door and specified hardware.
    - b. Wall Cabinet: Cabinet with shelves and supports, door and specified hardware.
- G. Manufacturer's Qualification Statement.
- H. Installer's Qualification Statement.
- I. Maintenance Data: Manufacturer's recommendations for care and cleaning.
- J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
1. See Section 01 6000 - Product Requirements, for additional provisions.
  2. Door Hinges: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
  3. Door Catches: Quantity equal to 2 percent of total installed, but not less than 5, includes fasteners.
  4. Door Pulls: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
  5. Shelf Supports: Quantity equal to 2 percent of total installed, but not less than 10.
  6. Drawer Slides: For each size and type, quantity equal to 2 percent of total installed, but not less than 2 pairs; includes fasteners.
  7. Locks: For each type, quantity equal to 2 percent of total installed, but not less than 2; includes fasteners.
  8. Grommets: Quantity equal to 2 percent of total installed, but not less than 5.

#### **1.06 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than 5 years of documented experience and approved by manufacturer.

#### **1.07 DELIVERY, STORAGE, AND HANDLING**

- A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation.
- B. Environmental Requirements: Do not deliver casework until the following conditions have been met:
1. Building has been enclosed (windows and doors sealed and weather-tight).
  2. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place and will remain operating.
  3. Painting and other "wet work" construction is complete in the casework areas.
- C. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
- D. Storage:



1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the above environmental requirements.

#### **1.08 WARRANTY**

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion. Defects include, but are not limited to:
  1. Delamination of components.
  2. Failure of adhesives.
  3. Failure of hardware.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Basis of Design: Catalog numbers indicated on Drawings are for products manufactured by TMI Systems Design Corporation: [www.tmisystems.com](http://www.tmisystems.com).
  1. Provide either the indicated "Basis of Design" products or equivalent products from one of the following:
    - a. Advanced Cabinet Systems: [www.advancedcabinetsystems.com](http://www.advancedcabinetsystems.com).
    - b. Case Systems: [www.casesystems.com](http://www.casesystems.com).
    - c. Stevens Industries, Inc.: [www.stevensind.com](http://www.stevensind.com).
    - d. Wood-Metal Industries; [www.wood-metal.com](http://www.wood-metal.com).
    - e. Substitutions: See Section 01 6000 - Product Requirements.
- B. Obtain casework from single source and manufacturer, unless otherwise indicated.

#### **2.02 PERFORMANCE REQUIREMENTS**

- A. Accessibility: Comply with ICC A117.1 and ADA Standards.

#### **2.03 MATERIALS**

- A. Casework Adhesives: As recommended by casework manufacturer.
- B. Laminate Adhesive: Type recommended by casework manufacturer to suit application.
- C. Wood-based Materials - General:
  1. Maximum Moisture Content: 7 percent.
- D. Hardwood Plywood: HPVA HP-1, particleboard core.
- E. Particleboard: ANSI A208.1, Grade M-2.
  1. Moisture resistant where indicated.
- F. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.
  1. Moisture resistant where indicated.
- G. Laminates:
  1. High-Pressure Decorative Laminate (HPDL); NEMA LD 3; Grades as indicated.
  2. Thermally Fused Laminate (TFL) : Melamine resin; NEMA LD 3, Grade VGL.
- H. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness.
  1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.
  2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.
- I. Tempered Glass: Annealed float glass ASTM C1036, Type 1 (Transparent Flat), Class 1 (Clear), Quality Q3; fully tempered per ASTM C1048, Kind FT. Complying with ANSI Z97.1.
  1. Glass Thickness: 1/4 inch, minimum.
  2. Exposed Edges: Ground smooth.

#### **2.04 HARDWARE AND ACCESSORIES**

- A. Hardware and Accessories, General:
  1. Cabinet Hardware: Comply with BHMA A156.9, types as indicated for quality grade specified.

- a. Finishes:
  - 1) Exposed Hardware: Provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finishes:
    - (a) Satin Stainless Steel: BHMA 630.
    - (b) Satin Chromium Plated: BHMA 626.
  - 2) Concealed Hardware: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- 2. Provide all fasteners, hardware and accessories for a complete installation including:
  - a. Undercounter plastic laminate support panels or metal support brackets.
  - b. Free-standing table hardware.
- B. Hinges: Semiconcealed type, Grade 1, 5 knuckle, semi-concealed, institutional hinges, with 3 way adjustment, 270 degree opening, steel with satin finish.
  - 1. Provide two hinges for doors less than 36 inches high, and provide three hinges for doors more than 36 inches high.
  - 2. Provide four hinges for tall cabinet doors.
- C. Door Catches: Heavy-duty magnetic or roller type catch and strike plate.
  - 1. Doors up to 48 inches high shall have single catch mounted at bottom door edge.
  - 2. Doors over 48 inches high shall have catch at both the top and bottom edges of door.
- D. Pulls:
  - 1. Type: Back-mounted wire pulls, standard U-shape style.
    - a. Material: Solid aluminum, stainless steel, or chrome-plated brass.
    - b. Overall Size: 4-1/2 inches wide by 1 inch deep.
  - 2. Provide as follows:
    - a. Doors: Single pull.
    - b. Drawers up to 24 inches Wide: Single pull.
    - c. Drawers over 24 inches Wide: Two pulls.
- E. Drawer Slides: Epoxy coated with nylon rollers or zinc plated with steel ball-bearings; self-closing with positive stop both directions. Load rating at full extension as follows:
  - 1. Drawers less than 2 inches deep: 50 lbs.
  - 2. All Drawers 2 to 4 inches deep: 100 lbs.
  - 3. File Drawer and Drawers over 4 inches deep: 150 lbs.
- F. Adjustable Shelf Supports: Double-pin clear polycarbonate shelf rests with shelf anti-tipping feature complying with BHMA A156.9, Type B04013. Designed to mount into pre-drilled holes in casework sides. Each shelf rest shall support 200 lbs, minimum.
- G. Locks: Removable core, disc tumbler, cam style lock with strike for drawers and doors. At other locations, use lock style to suit application.
  - 1. Door Locks: BHMA A156.11, E07121.
  - 2. Drawer Locks: BHMA A156.11, E07041.
  - 3. Provide locks on all doors and drawers.
    - a. All locks within a room shall be keyed alike and different than adjacent rooms. All locks on the Project shall be master keyed.
      - 1) Provide 2 keys for each room and three 3 master keys.
- H. Sliding Door Track: Manufacturer's standard anodized aluminum double channel assembly with track/door rollers; type and size to suit sliding-doors.
- I. Grommets: 2 inch outside diameter, molded-plastic grommets and matching plastic caps with wire passage slot.
  - 1. Color: Black.
- J. Coat Rods:
  - 1. Rod: Minimum 1 inch diameter steel tube; minimum wall thickness 0.075 inch (14 gage).
  - 2. Brackets: Steel mounting brackets.

- K. Casters: Non-marking, soft, rubber wheels with ball bearing assembly.
  - 1. Brakes: Provide 2 brakes, minimum, per mobile unit.
  - 2. Load Capacity: 200 pounds, minimum, per caster.

## 2.05 MANUFACTURED PLASTIC LAMINATE CASEWORK

- A. Cabinet Construction - General:
  - 1. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
    - a. Laminate-clad panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels.
    - b. Provide cabinet sizes and configurations as indicated on Drawings.
  - 2. Quality Standard: AWI/AWMAC/WI (AWS), unless noted otherwise.
    - a. Grade: Premium.
  - 3. Design Style: Flush overlay, frameless construction.
- B. Core Material: Particleboard or MDF, unless otherwise indicated.
- C. Component Thicknesses: Not less than the following.
  - 1. General component thicknesses unless otherwise indicated:
    - a. Base Cabinets: 3/4 inch.
    - b. Wall Cabinets: 3/4 inch.
    - c. Tall Cabinets: 3/4 inch.
  - 2. Cabinet Backs:
    - a. 1/4 inch thick.
  - 3. Shelves:
    - a. 36 inches or less in length: 3/4 inch thick, unless otherwise indicated.
    - b. Over 36 inches in length: 1 inch thick.
  - 4. Doors:
    - a. Height 48 inches or less: 3/4 inch thick.
    - b. Height over 48 inches: 1 inch thick
  - 5. Drawer Subfronts, Sides and Backs: 1/2 inch thick.
  - 6. Drawer Bottoms:
    - a. 24 inches or less in width: 1/4 inch thick.
    - b. Over 24 inches in width: 1/2 inch thick.
- D. Exposed Materials:
  - 1. Laminates: High-Pressure Decorative Laminate (HPDL), Grade VGS.
    - a. Manufacturers:
      - 1) Formica Corporation: [www.formica.com](http://www.formica.com).
      - 2) Panolam Industries International, Inc. Nevamar: [www.nevamar.com](http://www.nevamar.com)
      - 3) Panolam Industries International, Inc. Pionite: [www.pionitelaminates.com](http://www.pionitelaminates.com)
      - 4) Wilsonart: [www.wilsonart.com](http://www.wilsonart.com)
      - 5) Substitutions: Not permitted.
  - 2. Edgebanding: Provide specified edgebanding unless noted otherwise.
- E. Semi-Exposed Materials:
  - 1. Laminates: Thermally Fused Laminate (TFL).
  - 2. Edgebanding: Provide specified edgebanding unless noted otherwise.
- F. Concealed Materials:
  - 1. Laminates: High-Pressure Decorative Laminate (HPDL), Grade BKM, BKV, BKL, or CLS as appropriate for conditions.
- G. Joints doweled, glued and screwed.
- H. Drawer Materials and Construction: Hardwood veneer plywood. Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Drawer Construction Method: Multiple dovetailed or doweled; with captured bottoms.

- I. All cabinets shall be manufactured with balance construction; apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- J. Laminates: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
- K. Edgebanding: Do not use more than one piece for any single length.
- L. Glazing for Doors: Clear tempered glass.
- M. Aprons and Modesty Panels: Provide panels matching construction and finish of casework.
- N. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
- O. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
- P. Provide cutouts for electrical receptacles and other utility, mechanical, and electrical components as indicated.
- Q. Access Panels: Provide as required for maintenance of utility service and mechanical and electrical components.
- R. Mobile Cabinets: Same construction as fixed base cabinets, with modifications.
  - 1. Toe kick space eliminated.
  - 2. Cabinet underside reinforced as is standard with the manufacturer to provide caster mounting points.
    - a. Four casters, minimum.
  - 3. For cabinets with drawers, include a counterweight to prevent the cabinet from tipping when one drawer is opened.

## 2.06 COUNTERTOPS

- A. Fabricate in accordance with AWI/AWMAC/WI (AWS), Section 11 - Countertops, Premium Grade, unless otherwise noted.
- B. Solid Surface Countertops: Solid surfacing sheet over continuous substrate.
  - 1. Solid Surfacing: Complying with ISFA 2-01; acrylic or polyester resin, mineral filler, and pigments; homogenous and non-porous; color and pattern consistent throughout thickness.
  - 2. Flat Sheet Thickness: 1/2 inch, minimum.
  - 3. Substrate: Particle board, medium density fiberboard (MDF), or plywood.
    - a. Thickness: 3/4 inch.
    - b. Moisture resistant.
  - 4. Other Components Thickness: 1/2 inch, minimum.
  - 5. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
  - 6. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
    - a. Field applied.
  - 7. Fabricate in accordance with manufacturer's standard requirements.
  - 8. Manufacturers:
    - a. DuPont; Corian: [www.corian.com](http://www.corian.com).
    - b. Substitutions: Not permitted.
- C. Fabrication:
  - 1. Solid Surfacing:
    - a. Fabricate tops up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
      - 1) Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
      - 2) Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

- b. Provide field-installed back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.

## 2.07 ACCESSORIES

- A. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- B. Countertop Adhesives: As recommended by solid surfacing manufacturer.

## 2.08 COLORS AND FINISHES

- A. Laminate Colors, Patterns, and Finishes:
  1. High-Pressure Decorative Laminates:
    - a. Architect shall select up to two (2) colors/patterns, from standard and premium laminates, from all manufacturers listed in Section 2.05.D.1.A.
  2. Thermally Fused Laminates:
    - a. Color: White or Almond.
- B. PVC Edgebanding Colors:
  1. Color(s): Matching adjacent laminate.
- C. Solid Surfacing Colors, Patterns, and Finishes:
  1. Colors:
    - a. Architect shall select up to two (2) colors from manufacturer's full range, from all price groups.

## PART 3 EXECUTION

### 3.01 PREPARATION

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

### 3.02 EXAMINATION

- A. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment.
- B. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
  1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
  2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.
- C. Verify adequacy of support framing and anchors.
- D. Verify that service connections are correctly located and of proper characteristics.

### 3.03 CASEWORK INSTALLATION

- A. Perform installation in accordance with manufacturer's instructions.
- B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
- E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
  1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.

3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
  4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.
- G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches on center, and at sides of cabinets with not less than two fasteners per side.
- H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.
- I. Install hardware uniformly and precisely.
- J. Replace units that are damaged, including those that have damaged finishes.

### **3.04 COUNTERTOP INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.
1. Variation From Level/Horizontal: 1/8 inch in 10 feet, maximum.
  2. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
  3. Field Joints: 1/16 inch wide, maximum.
  4. Do not exceed 1/64 inch difference between planes of adjacent units.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Attach solid surfacing countertops to subtops using compatible adhesive.
1. Secure back/end splashes to countertop and vertical substrates with waterproof adhesive.

### **3.05 ADJUSTING**

- A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

### **3.06 CLEANING**

- A. Clean casework and other installed surfaces thoroughly.

### **3.07 PROTECTION**

- A. Do not permit finished casework to be exposed to continued construction activity.
- B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
- C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

### **END OF SECTION**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

**1.03 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.
  1. AABC – Associated Air Balance Council.
  2. ABMA - American Bearing Manufacturers Association.
  3. ABMA – American Boiler Manufacturers Association.
  4. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The).
  5. AMCA - Air Movement and Control Association International, Inc.
  6. ANSI – American National Standards Institute.
  7. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers.
  8. ASTM – American Society for Testing Materials.
  9. CDA – Copper Development Association.
  10. CGA – Compressed Gas Association.
  11. CSA – CSA International.
  12. HI – Hydraulic Institute.
  13. Intertek – Intertek Group.
  14. NAIMA – North American Insulation Manufacturers Association.
  15. NEBB – National Environmental Balancing Bureau.
  16. NEC – National Electrical Code.

17. NECA - National Electrical Contractors Association.
  18. NEMA – National Electrical Manufacturer’s Association.
  19. NFPA – National Fire Protection Association.
  20. SMACNA – Sheet Metal and Air Conditioning Contractors National Association.
  21. UL – Underwriter’s Laboratories, Inc.
- 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.

#### **1.04 PERFORMANCE REQUIREMENTS**

- A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

#### **1.05 QUALITY ASSURANCE**

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.
1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.
1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.
  2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.
- C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner’s Representatives causes interference.
- G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

#### **1.06 CODES, PERMITS AND FEES**

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.



- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.
- D. Refer to Division 22 Section "Domestic Water Piping" for purchase and installation of potable water meters.

#### **1.07 DRAWINGS**

- A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.
- C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.
- D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

#### **1.08 MATERIAL AND EQUIPMENT MANUFACTURERS**

- A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.
- C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.
- D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
  - 1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

### **1.09 INSPECTION OF SITE**

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.
- B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

### **1.10 ITEMS REQUIRING PRIOR APPROVAL**

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
  - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
  - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.
- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

### **1.11 SUBMITTALS**

- A. Submit project specific submittals for review in compliance with Division 01.
- B. Prepare shop drawings to scale for the Architect/Engineer for review. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.
- C. All submittals shall be submitted in groupings of similar and/or related items. Plumbing fixture submittals shall be submitted as one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit shop drawing with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. All submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned "Rejected".
- E. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
- F. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
  - 1. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve

Mechanical Trades of full responsibility for the proper and correct execution of the work required.

2. Contractor is responsible for:
  - a. Dimensions, which shall be confirmed and correlated at the job site.
  - b. Fabrication processes and techniques of construction.
  - c. Quantities.
  - d. Coordination of Contractor's work with all other trades.
  - e. Satisfactory performance of Contractor's work.
  - f. Temporary aspects of the construction process.
- G. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.

#### **1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
- C. Format: Submit operations and maintenance manuals in the following format:
  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.
- D. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
  1. Routine maintenance procedures.
  2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
  3. Trouble-shooting procedures.
  4. Contractor's telephone numbers for warranty repair service.
  5. Submittals.
  6. Recommended spare parts lists.
  7. Names and telephone numbers of major material suppliers and subcontractors.
  8. System schematic drawings.

#### **1.13 RECORD DRAWINGS**

- A. Submit record drawings in compliance with Division 01.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

#### **1.14 INSTRUCTION OF OWNER PERSONNEL**

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

- C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.
- D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
- E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

#### **1.15 WARRANTY**

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

#### **PART 2 PRODUCTS**

Not Applicable

#### **PART 3 EXECUTION**

##### **3.01 MECHANICAL DEMOLITION WORK**

- A. All demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include all items such as, but not limited to, existing piping, draining of piping, pumps, ductwork, supports and equipment where such items are not required for the proper operation of the modified system.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner shall move and store these materials. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- E. Clean and flush the interior and exterior of all existing relocated equipment and its related piping, valves, and accessories that are to be reused of all mud, debris, pipe dope, oils, welding slag, loose mill scale, rust and other extraneous material so that the existing equipment and all accessories can be repainted and repaired as required to place in first-class working condition.
- F. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling or at mains. Cap or plug piping with same or compatible piping material.
- G. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.
  - 1. Cap or plug piping with same or compatible piping material.
  - 2. Cap or plug ducts with same or compatible ductwork material.

### **3.02 REFRIGERANT HANDLING**

- A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:
  - 1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
  - 2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
  - 3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.
- B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

### **3.03 WORK IN EXISTING BUILDINGS**

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.
- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.
- D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

### **3.04 TEMPORARY SERVICES**

- A. Provide temporary service as described in Division 01.
- B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

### **3.05 WORK INVOLVING OTHER TRADES**

- A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

### **3.06 ACCEPTANCE PROCEDURE**

- A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.
- B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.
- D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.
- E. Operation of the following systems shall be demonstrated:

1. Air Handling Systems.
  2. Refrigeration Systems.
  3. Heating Systems.
  4. Steam Pressure Reducing Stations.
  5. Domestic Hot Water Heaters.
  6. Domestic Hot Water Mixing Stations.
  7. Energy Recovery Systems.
  8. Temperature Controls.
  9. Building Automation System.
  10. Exhaust Systems.
- F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

**END OF SECTION**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 22 Section "Domestic Water Piping" for flushing and cleaning of potable water piping.
  - 3. Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for flushing and cleaning of HVAC piping.

## 1.02 SUMMARY

- A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheetmetal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

## 1.03 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

## 1.04 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.
- C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

## 1.05 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- D. Comply with NSF 372, "Drinking Water System Components – Lead Content" for potable domestic water piping and components.
- E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."



2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- G. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."
- H. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- I. Installer Qualifications:
  1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.
  2. 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.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner's Representative. Equipment stored in unprotected areas must be provided with temporary protection.
  1. Protect equipment and materials from theft, injury or damage.
  2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
  3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin "Handling and Care of Enameled Cast Iron Plumbing Fixtures", issued by the Plumbing Fixtures Manufacturer Association, and as approved.
  4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
  5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
  6. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### **1.07 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.
- D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.
  1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## **2.02 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 21, 22, and 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## **2.03 JOINING MATERIALS**

- A. Refer to individual Division 21, 22, and 23 piping Sections for special joining materials not listed below.
- B. Unions: Pipe Size 2 Inches and Smaller:
  1. Ferrous pipe: Malleable iron ground joint type unions.
  2. Unions in galvanized piping system shall be galvanized.
  3. Copper tube and pipe: Bronze unions with soldered joints.
- C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
  1. Ferrous pipe: Standard weight, forged steel weld neck flanges.
  2. Copper tube and pipe: Slip-on bronze flanges.
- D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.
- H. Brazing Filler Metals: Alloys meeting AWS A5.8.
  1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
  2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.
- I. 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.
- J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- K. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
- L. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- M. Solvent Cements for Joining ABS Piping: ASTM D 2235.
- N. Solvent Cements for Joining PVC to ABS Piping Transition: ASTM D 3138.
- O. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## **2.04 PIPE THREAD COMPOUNDS**

- A. Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Compounds for potable water service and similar applications acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

- C. Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds for galvanized carbon steel systems to coat raw carbon steel surfaces, in lieu of subsequent painting.
  - 1. Manufacturers:
    - a. Carboline "Carbo-Zinc 12."
    - b. Tnemec.
    - c. Koppers.
- D. Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures for steam or condensate.
  - 1. Manufacturers:
    - a. WKM; Division of Cooper Industries, Inc., Key "Graphite Paste."
    - b. Other approved.
- E. Use tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for natural gas system threaded joints.
  - 1. Manufacturers:
    - a. Cadillac Plastic.
    - b. Permacel.
    - c. Other approved.

## 2.05 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. IPEX Inc. (formerly Eslon Thermoplastics).
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.
    - e. Can-Tex Industries Division of Harsco Corp. "CT-Adaptors".
    - f. Joint Inc., "Caulder".

## 2.06 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.
- D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Capitol Manufacturing Co.
    - d. Central Plastics Company.
    - e. Epco Sales, Inc.
    - f. Pipeline Seal and Insulator, Inc.
    - g. Watts Water Technologies, Inc.; Watts Regulator Co.
    - h. Zurn Industries, Inc.; Wilkins Div.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; female NPT threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Lochinvar Corp.; V-Line Insulating Couplings.
- F. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.
  - 1. Manufacturers:
    - a. Anvil International, Inc.; Gruvlok Manufacturing; DI-LOK Nipples.
    - b. Elster Group; Perfection Corp.; ClearFlow.
    - c. Precision Plumbing Products, Inc.; ClearFlow.
    - d. Sioux Chief Manufacturing Co., Inc.
    - e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
    - f. Victaulic Co. of America; Style 47 ClearFlow.

## 2.07 MODULAR MECHANICAL SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.; Innerlynx.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.
  - 2. Sealing Elements: EPDM NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.08 SLEEVES

- A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.

## **2.09 ESCUTCHEONS**

- A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
    - e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
    - c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

## **2.10 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.

## **2.11 EPOXY BONDING COMPOUND**

- A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.
- B. Manufacturers:
  - 1. Euco 452 #450; Euclid Chemical Co.
  - 2. Epobond; L & M Construction Chemicals.
  - 3. Sikadur 87; Sika Corp.

## **2.12 LEAK DETECTOR SOLUTION**

- A. Commercial leak detector solution for pipe system testing.
- B. Manufacturers:
  - 1. American Gas and Chemicals Inc.; Leak Tec.
  - 2. Cole-Parmer Inst. Co.; Leak Detector.
  - 3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

## **2.13 PIPE ROOF PENETRATION ENCLOSURES**

- A. Manufacturers:
  - 1. Pate Company (The).
  - 2. Portals Plus, Inc.
  - 3. Thybar Corporation; Thycurb.
- B. Minimum 18 gage welded galvanized steel construction.
- C. Integral base plate.
- D. Built-in fully mitered cant.
- E. Factory installed insect and decay resistant wood nailer.
- F. Factory installed 1-1/2 inch thick, 3 pounds per cubic foot density rigid insulation.
- G. EPDM compression molded rubber cap for single or multiple pipes as required.
- H. Stainless steel draw-band clamps.

## **PART 3 EXECUTION**

### **3.01 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Refer to piping application schedules on the Drawings.

- B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer's instructions.
- C. 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. The Drawings shall be followed as closely as elements of construction will permit.
- D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.
- E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.
- F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- H. Clean and lubricate elastomer joints prior to assembly.
- I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- J. Install piping to conserve building space and not interfere with use of space.
- K. Group piping whenever practical at common elevations.
- L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- M. Slope piping and arrange systems to drain at low points.
- N. Slope horizontal piping containing noncondensable gases 1 inch per 100 feet, upward in the direction of the flow.
- O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- P. 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.
- Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.
- R. Do not penetrate building structural members unless specifically indicated on drawings.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.
- T. Install valves with stems upright or horizontal, not inverted.
- U. Provide clearance for installation of insulation and access to valves and fittings.
- V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.
- W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.
- X. Install piping free of sags and bends.
- Y. Install fittings for changes in direction and branch connections.

- Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:
1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.
  2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.
- AA. Install piping to allow application of insulation.
- BB. Select system components with pressure rating equal to or greater than system operating pressure.
- CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections "Hydronic Piping," "Piping Systems Flushing and Chemical Cleaning," and "HVAC Water Treatment."
- DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.
- EE. Sleeves are not required for core-drilled holes in poured concrete walls.
- FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.
- GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces of walls.
    - a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
    - b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
    - c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
    - d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
    - e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.
  4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.
  5. Seal sleeves in plaster/gypsumboard partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
  6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.
1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
  2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
  3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- JJ. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.
  1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- KK. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Specification Sections for materials.
- LL. Seal openings around pipes in sleeves and around duct openings through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Fire and/or smoke barriers shall be UL listed firestopping and shall have a fire rating equal to or greater than the penetrated barrier. Refer to Division 07 Specification Sections for materials.
- MM. Pipe Roof Penetration Enclosures:
  1. Coordinate delivery of roof penetration enclosures to jobsite.
  2. Locate and set curbs on roof.
  3. Framing, flashing, and attachment to roof structure are specified under Division 07.
  4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.
- NN. Verify final equipment locations for roughing-in.
- OO. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.02 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.
- B. Cut piping square.
- C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.
- E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.
- F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.
- G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.
- H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.
- I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.
- J. Provide temperature sensing device thermal wells and similar piping specialty connections.
- K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.



- L. Locate instrument connections in accordance with manufacturer's instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.
- M. 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."
- N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- O. 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.
- P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
  - 1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.
- Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.
  - 1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.
  - 2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.
- R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer's representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.
- S. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.
- T. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.
- U. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.
- V. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
  3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- W. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- X. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- Y. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

### **3.03 ACCESS DOORS**

- A. Provide access doors for installation by architectural trades unless noted otherwise. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents, filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.
- B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters' Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

### **3.04 EQUIPMENT CONNECTIONS**

- A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.
1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer's submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.
- B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

### **3.05 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
  2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

### **3.06 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

- E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.
- F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.
- G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer's name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

### **3.07 PAINTING**

- A. Painting of mechanical systems, equipment, and components is specified in Division 09.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.08 CONCRETE BASES**

- A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.
- B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

### **3.09 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer. Scrape, brush clean, and apply one coat of zinc rich primer after welding.
- D. Field Welding: Comply with AWS D1.1.

### **3.10 EPOXY BONDING TO EXISTING MATERIALS**

- A. Use epoxy bonding compound to set sleeves or pipes in existing concrete to bond new concrete and/or grout to existing materials or to bond dissimilar materials.
- B. The compound, when applied in accordance with the manufacturer's instructions, shall be capable of initial curing within 48 hours at temperatures as low as 40 deg F and shall be capable of bonding any combination of the following properly prepared materials: Wet or dry, cured or uncured concrete or mortar; vitrified clay; cast iron and carbon steel.

### **3.11 JACKING OF PIPE**

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

### **3.12 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

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

### **3.13 GROUTING**

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

### **3.14 CUTTING, CORING AND PATCHING**

- A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.
- B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

### **3.15 EXCAVATION AND BACKFILLING**

- A. Refer to Division 31 Specification Sections.
- B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.
- C. Provide all pumping and/or well pointing required for the mechanical work.
- D. Provide foundations if required to support underground piping.
- E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

### **3.16 FLASHING**

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

### **3.17 LUBRICATION**

- A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

### **3.18 FILTERS**

- A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.
- B. Immediately prior to final building acceptance by the Owner, Contractor shall:
  - 1. Replace all disposable type air filters with new units.

### **3.19 CLEANING**

- A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

- B. After equipment and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.
- D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section "Domestic Water Piping."
- E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.
- F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

**END OF SECTION**



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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 21 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
  - 3. Division 20 Section "Mechanical General Requirements."
  - 4. Division 20 Section "Basic Mechanical Materials and Methods."
  - 5. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
  - 6. Division 20 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.
  - 7. Division 23 Section(s) "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

#### 1.02 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. MFMA: Metal Framing Manufacturers Association.

#### 1.03 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

#### 1.04 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.

2. Thermal-hanger shield inserts.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  1. Trapeze pipe hangers. Include Product Data for components.
  2. Metal framing systems. Include Product Data for components.
  3. Pipe stands. Include Product Data for components.
  4. Equipment supports.
- C. Welding certificates.

#### **1.05 QUALITY ASSURANCE**

- A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
  1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture.
  2. MSS SP-69, Pipe Hangers and Supports – Selection and Application.
  3. MSS SP-89, Pipe Hangers and Supports – Fabrication and Installation Practices.
- B. Welding: Qualify procedures and personnel according to the following:
  1. AWS D1.1, "Structural Welding Code--Steel."
  2. AWS D1.2, "Structural Welding Code--Aluminum."
  3. AWS D1.3, "Structural Welding Code--Sheet Steel."
  4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  5. ASME Boiler and Pressure Vessel Code: Section IX.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### **2.02 HANGER ROD MATERIAL**

- A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.
  1. Rod continuously threaded.
  2. Use of rod couplings is prohibited.

#### **2.03 STEEL PIPE HANGERS AND SUPPORTS**

- A. Description: MSS SP-69, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.
  1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.
- B. Manufacturers:
  1. Anvil International, Inc.
  2. B-Line by Eaton.
  3. Carpenter & Paterson, Inc.
  4. Hilti USA.
  5. ERICO International Corp.
  6. PHD Manufacturing, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

#### **2.04 TRAPEZE PIPE HANGERS**

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

#### **2.05 METAL FRAMING SYSTEMS**

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Manufacturers:



1. Anvil International, Inc.; Anvil-Strut.
  2. B-Line by Eaton.
  3. Power-Strut Div.; Tyco International, Ltd.
  4. Unistrut Corp.; Tyco International, Ltd.
  5. Hilti USA.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## **2.06 METAL INSULATION SHIELDS**

- A. Manufacturers:
1. Anvil International, Inc.
  2. B-Line by Eaton.
  3. Carpenter & Paterson, Inc.
  4. ERICO International Corp.
  5. PHD Manufacturing, Inc.
- B. Description: MSS SP-69, Type 40, protective shields. Shields shall span an arc of 180 degrees.
- C. Shield Dimensions for Pipe: Not less than the following:
1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

## **2.07 PIPE COVERING PROTECTION SADDLES**

- A. Manufacturers:
1. Anvil International, Inc.
  2. B-Line by Eaton.
  3. Carpenter & Paterson, Inc.
  4. ERICO International Corp.
  5. PHD Manufacturing, Inc.
- B. Description: MSS SP-69, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.
1. Saddles shall match insulation thickness.
  2. Saddle length: 12 inches.
  3. Furnish with center rib for pipe sized NPS 12 and larger.

## **2.08 PLASTIC INSULATION SHIELDS**

- A. Manufacturers:
1. B-Line by Eaton; Snap'N Shield.
- B. Description: Polypropylene copolymer protective shields designed to snap directly onto strut channel. Shields shall span an arc of 180 degrees.
1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F.
- C. Certifications:
1. UL Classified for USA: UL-723 (ASTM E 84).
  2. UL listed for Canada: ULC-S102.2.
  3. Meets UL94 HB flammability standards.
- D. Shield Dimensions for Pipe: Not less than the following:
1. NPS 1/4 to NPS 2: 12 inches long.

## **2.09 THERMAL-HANGER SHIELDS**

- A. Manufacturers:
1. B-Line by Eaton.
  2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  3. Rilco Manufacturing Company, Inc.
  4. American Mechanical Insulation Sales Inc. (AMIS).
  5. ERICO International Corp.
  6. Value Engineered Products, Inc.
- B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.

1. Minimum Compressive Strength of Insert Material:
  - a. 100-psig- for sizes smaller than NPS 6.
  - b. 600-psig- for sizes NPS 6 and larger.
- C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.
- F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.
- G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:
  1. Manufacturer:
    - a. B-Line by Eaton/Armacell; Armafix IPH.
  2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:
    - a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.
- H. Thermal-Hanger Shields for Small Diameter Piping:
  1. Manufacturer:
    - a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.
  2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
    - a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 1-1/2 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

## 2.10 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  1. Manufacturers:
    - a. B-Line by Eaton.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.
- B. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.
  1. Manufacturers:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head.
    - c. MKT Fastening, LLC.
    - d. Powers Fasteners.
  2. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
  3. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
  4. Washer and Nut: Zinc-coated steel.
- C. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.
  1. Manufacturers:
    - a. Superior Concrete Accessories; Threaded Insert.
    - b. Dayton Sure-Grip and Shore Co.

- c. Richmond Screw Anchor Co.
- D. Slotted Inserts: Continuous galvanized steel with temporary slot fillers and complete with nuts, studs, washers and the like, for 3/4 inch bolts.
  - 1. Manufacturers:
    - a. B-Line by Eaton; B22-I Continuous Concrete Insert.
    - b. Unistrut Corp.; P-3200 Continuous Insert.
    - c. Hohman and Barnard, Inc.
    - d. Richmond Screw Anchor Co.
    - e. Hilti, Inc.; CIS13812/PG.

## **2.11 ROOF AND GRADE MOUNTED PIPING SUPPORTS**

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.
  - 1. Manufacturers:
    - a. B-Line by Eaton; Dura-Blok.
    - b. Eco Support Products.
    - c. ERICO International Corp.
    - d. MIRO Industries; Conduit and Condensate Supports.
    - e. Portable Pipe Hangers.
  - 2. Base: Plastic, stainless steel, or recycled rubber.
  - 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
- C. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.
  - 1. Manufacturers:
    - a. B-Line by Eaton; Dura-Blok.
    - b. Eco Support Products.
    - c. ERICO International Corp.
    - d. MIRO Industries; Conduit and Condensate Supports.
    - e. Portable Pipe Hangers.
  - 2. Base: Plastic, stainless steel, or recycled rubber.
  - 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
  - 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- D. High, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and clevis type pipe support, for roof installation without membrane penetration.
  - 1. Manufacturers:
    - a. B-Line by Eaton; Dura-Blok.
    - b. Eco Support Products.
    - c. ERICO International Corp.
    - d. MIRO Industries; Water and Steam Supports.
    - e. Portable Pipe Hangers.
  - 2. Base: Plastic, stainless steel, or recycled rubber.
  - 3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
  - 4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- E. Low, Fixed-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
  - 1. Manufacturers:

- a. B-Line by Eaton; Dura-Blok.
- b. Eco Support Products.
- c. ERICO International Corp.
- d. MIRO Industries; Gas and Mechanical Supports.
- e. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
- F. Low, Adjustable-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.
  1. Manufacturers:
    - a. B-Line by Eaton; Dura-Blok.
    - b. Eco Support Products.
    - c. ERICO International Corp.
    - d. MIRO Industries; Gas and Mechanical Supports.
    - e. Portable Pipe Hangers.
  2. Base: Plastic, stainless steel, or recycled rubber.
  3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
  4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.
- G. High, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  1. Manufacturer:
    - a. B-Line by Eaton; Dura-Blok.
    - b. Eco Support Products.
    - c. ERICO International Corp.
    - d. MIRO Industries; Water and Steam Supports.
    - e. Portable Pipe Hangers.
  2. Bases: Two or more plastic, steel, or recycled rubber.
  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.
- H. Custom, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports or rollers, for roof installation without membrane penetration.
  1. Manufacturer:
    - a. B-Line by Eaton; Dura-Blok.
    - b. Eco Support Products.
    - c. ERICO International Corp.
    - d. MIRO Industries; Custom Design Products.
    - e. Portable Pipe Hangers.
  2. Bases: Four or more plastic, steel, or recycled rubber.
  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.
  6. Pipe Rollers: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
- I. Curb-Mounting Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.
  1. Roof Curb Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
    - a. Manufacturers:
      - 1) Pate.
      - 2) Thybar; Thycurb.
      - 3) Roof Products and Systems.

- 4) Greenheck.
- 5) Creative Metals.

## **2.12 ROOF MOUNTED EQUIPMENT SUPPORTS**

- A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.
- B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.
  1. Manufacturers:
    - a. B-Line by Eaton; Dura-Blok.
    - b. ERICO International Corp.
    - c. MIRO Industries; HD and LD Mechanical Unit Supports.
    - d. Portable Pipe Hangers.
  2. Base: Plastic, stainless steel, or recycled rubber.
  3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rod, and accessories.
- C. Roof Rail-Type Equipment Stands: Welded 18 gage galvanized steel shell, base plate and counter flashing. Factory installed chemically treated wood nailer. Fully mitered end sections. Internal bulkhead reinforcement.
  1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.
    - a. Manufacturers:
      - 1) Pate.
      - 2) Thybar; TEMS Series.
      - 3) Roof Products and Systems.
      - 4) Greenheck.
      - 5) Creative Metals.

## **2.13 EQUIPMENT SUPPORTS**

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## **2.14 MISCELLANEOUS MATERIALS**

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

## **PART 3 EXECUTION**

### **3.01 HANGER AND SUPPORT APPLICATIONS**

- A. Refer to application schedules on the Drawings.
- B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.
- C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.
- F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.
- G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.
- H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

- I. Use padded hangers for piping that is subject to scratching.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. MSS Type 8 or spring type to meet system requirements.
- 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. Concrete Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Anchor Devices, Concrete and Masonry: in accordance with Group I, Group II, Type 2, Class 2, Style 1 and Style 2, Group III and Group VIII or FS FF-S-325A. Furnish cast-in floor type equipment anchor devices with adjustable positions. Furnish built in anchor devices for masonry, unless otherwise approved by the Architect. Powder actuated anchoring devices shall not be used to support any mechanical systems components.
  - 2. Inserts, Concrete: TYPE 18 or 19. When applied to loads equivalent to piping in sizes NPS 2 and larger, and where otherwise required by imposed loads, a one foot length of 1/2 inch NPS 4 reinforcing rod shall be inserted and wired through wing slots. Proprietary type continuous inserts may be proposed and shall be submitted for approval.
  - 3. Use mechanical-expansion anchors where required in concrete construction.
  - 4. Use chemical fasteners where required in concrete construction.
- M. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Beam Clamps:
    - a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
    - b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.
- N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
    - a. Provide spring supports at point of support where vertical movement will occur.
    - b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
    - c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
    - d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
    - e. Sway braces; TYPE 50.
    - f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.
- 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-102 for metal framing system selections and applications that are not specified in piping system Sections.

### 3.02 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structural frame.
- B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.
- C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.
- D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.
- E. File and paint cut ends and shop or field prime paint supporting element components.
- F. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.
- G. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.
- H. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.
- I. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.
- J. Where necessary, brace piping and supports against reaction, sway and vibration.
- K. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- L. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- M. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
- N. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.
- O. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.
- P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide

- for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.
- Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.
  - R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.
  - S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.
  - T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
  - U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
  - V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.
  - W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
  - X. Building structure shall not be reinforced except as approved by the Architect in writing.
  - Y. Use approved cast-in-place inserts or built-in anchors for attachment to concrete structure. Size inserts and anchors for the total applied load with a safety factor in accordance with applicable codes but in no case less than 5. Coordinate installation of all imbedded items in accordance with manufacturer's instructions. Position anchorage and imbedded items as indicated and/or where required and support against displacement during placing of concrete. Cutting or repositioning of concrete beam or girder or reinforcing steel to accommodate inserts will not be allowed. Provide removable closures in imbedded device openings to prevent entry of concrete.
  - Z. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
  - AA. Use cast-in-place inserts in concrete beams and girders. Drilled anchors/wedge type inserts shall be used on vertical surfaces only. Coordinate with structural engineer.
  - BB. Attach piping supports to the side of concrete beams and concrete joist. Provide supplementary support steel as required. Cast-in-place or drilled anchors will not be permitted in the bottom of concrete beams and concrete joist.
  - CC. Attach piping supports to the side of concrete beams or concrete joist. Where intermediate hangers are required to meet the hanger spacing schedule, the Contractor may propose attachment of intermediate pipe supports to the bottom of the concrete slab pending submittal of a satisfactory pull out test. The Contractor shall submit pull out test criteria, pull out test results, proposed hanger detail and hanger point loads to the Architect for written approval.
  - DD. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
    - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
    - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.



- EE. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- FF. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- GG. Roof-Mounting Pipe and Equipment Stand Installation:
  - 1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.
  - 3. Maintain support manufacturer's recommended spacing.
- HH. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- II. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- JJ. 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.
- KK. Install lateral bracing with pipe hangers and supports to prevent swaying.
- LL. 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.
- MM. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- NN. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- OO. Refer to individual piping sections for hanger spacing and hanger rod sizes.

### **3.03 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.04 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.05 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.

**3.06 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Equipment Supports: Painting is specified in Division 09 painting Sections.
- C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  1. Division 20 Section "Mechanical General Requirements."

#### 1.02 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. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

#### 1.03 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### 1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
  1. Seton.

2. Brady.
3. EMED.
4. Craftmark.
5. Brimar Industries, Inc.
6. Marking Services Inc. (MSI).
7. Kolbi Pipe Marker Co.

## **2.02 EQUIPMENT IDENTIFICATION DEVICES**

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  2. Location: Accessible and visible.
  3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  1. Terminology: Match schedules as closely as possible.
  2. Data:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
  3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  1. Data: Instructions for operation of equipment and for safety procedures.
  2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
  4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
- D. Access Panel and Door Markers: 1/16-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.
  1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

## **2.03 PIPING IDENTIFICATION DEVICES**

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
  2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
  3. Legends: Spelled out in full or commonly used and accepted abbreviations.
  4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
  5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
  - 1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
  - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.
- F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.
- G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

#### **2.04 DUCT IDENTIFICATION DEVICES**

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.
- B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

#### **2.05 VALVE TAGS**

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect/Engineer. Provide 5/32-inch hole for fastener.
  - 1. Material: 0.032-inch- thick brass.
  - 2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

#### **2.06 VALVE SCHEDULES**

- A. Valve Schedules: For each piping system, on standard-size 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-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
  - 2. Frame: Finished hardwood or extruded aluminum.
  - 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

#### **2.07 WARNING TAGS**

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
  - 4. Color: Yellow background with black lettering.

### **PART 3 EXECUTION**

#### **3.01 APPLICATIONS, GENERAL**

- A. Products specified are for applications referenced in other Division 20, 21, 22, and 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### 3.02 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
  2. Fans, blowers, primary balancing dampers, and mixing boxes.
  3. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
1. Letter Size: Minimum 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.
  2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fire department hose valves and hose stations.
    - c. Meters, gages, thermometers, and similar units.
    - d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
    - e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - g. Fans, blowers, primary balancing dampers, and mixing boxes.
    - h. Packaged HVAC central-station and zone-type units.
    - i. Tanks and pressure vessels.
    - j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- C. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
    - a. Green: For cooling equipment and components.
    - b. Yellow: For heating equipment and components.
    - c. Orange: For combination cooling and heating equipment and components.
    - d. Brown: For energy-reclamation equipment and components.
  2. Letter Size: Minimum 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.
  3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
  4. Include signs for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
    - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - e. Fans, blowers, primary balancing dampers, and mixing boxes.
    - f. Packaged HVAC central-station and zone-type units.

- g. Tanks and pressure vessels.
  - h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.
- D. Install access panel markers with screws on equipment access panels.
- E. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

### 3.03 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
- 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
  - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 markers.
- C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

### 3.04 DUCT IDENTIFICATION

- A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:
- 1. Refer to Schedule.
  - 2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.
  - 3. Letter Size: Minimum 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.
- B. Identify ductwork with vinyl markers and flow direction arrows.
- C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.05 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
- 1. Valve-Tag Size and Shape:
    - a. Cold Water: Minimum 1-1/2 inches, round or square.
    - b. Hot Water: Minimum 1-1/2 inches, round or square.

c. Fire Protection: Minimum 1-1/2 inches, round or square.

**3.06 VALVE-SCHEDULE INSTALLATION**

A. Mount valve schedule on wall in accessible location in each major equipment room.

**3.07 WARNING-TAG INSTALLATION**

A. Write required message on, and attach warning tags to, equipment and other items where required.

**3.08 ADJUSTING**

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

**3.09 CLEANING**

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

**3.10 SCHEDULES**

A. Paint colors are listed here for reference only. Painting is specified under Division 9.

**PIPE LABELING AND COLOR CODING**

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Sanitary Sewer	SAN	White on Green	Dark Brown
Sanitary Vent	V	White on Green	Dark Brown
Rain Conductor	RC	White on Green	Dark Brown
Domestic Cold Water	CW	White on Green	Light Green
Domestic Hot Water	HW	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Fire Protection	FP	White on Red	Bright Red

**SHEET METAL WORK**

<u>Service</u>	<u>Abbrev.</u>	<u>Labels</u>	<u>Ductwork</u>
Air Conditioning Supply	Supply Air	White on Green	White
Air Conditioning Return	Return Air	White on Green	White
Exhaust Systems	Exhaust Air	Black on Yellow	Green
Outside Air Intake	Outside Air	White on Green	White
Mixed Air	Mixed Air	White on Green	White

**END OF SECTION**



**SECTION 20 0700 - MECHANICAL INSULATION**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Materials and Methods."
  - 3. Division 20 Section "Hanger and Supports" for thermal hanger shield inserts.
  - 4. Division 22 Section "Plumbing Fixtures: for protective shielding guards.
  - 5. Division 23 Section "Metal Ducts" for duct liners.

**1.02 SUMMARY**

- A. This Section includes mechanical insulation for pipe, duct, and equipment.

### **1.03 DEFINITIONS**

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVC: Polyvinyl Chloride.
- E. PVDC: Polyvinylidene chloride.
- F. SSL: Self-sealing lap.

### **1.04 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

### **1.05 OUTDOOR, ABOVEGROUND PIPING INSULATION SYSTEMS DESCRIPTION**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

### **1.06 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION**

- A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

### **1.07 ABOVEGROUND, OUTDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION**

- A. Acceptable outdoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

### **1.08 EXTERNAL DUCT LAGGING SYSTEM**

- A. System for controlling low frequency sound transmission in metal ducts consisting of:
  - 1. One layer of 1-inch thick rigid fiberglass duct board.
  - 2. Two layers of 5/8-inch thick gypsum board.

### **1.09 EQUIPMENT INSULATION SYSTEMS DESCRIPTION**

- A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

### **1.10 SUBMITTALS**

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
  - 1. ESR Report: For fire-rated grease duct insulation.
- B. Shop Drawings: Show details for the following:
  - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Insulation application at pipe expansion joints for each type of insulation.
  - 3. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 4. Removable insulation at piping specialties, equipment connections, and access panels.
  - 5. Application of field-applied jackets.
  - 6. Application at linkages of control devices.
  - 7. Field application for each equipment type
  - 8. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- C. Field quality-control inspection reports.

### **1.11 QUALITY ASSURANCE**

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction.

Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

#### **1.12 DELIVERY, STORAGE, AND HANDLING**

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer's original packaging.

#### **1.13 COORDINATION**

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 20 Section "Hangers and Supports."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

#### **1.14 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**

#### **2.01 INSULATION MATERIALS, GENERAL REQUIREMENTS**

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. 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.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Adhesives used shall be fire resistant in their dry states and UL listed.

#### **2.02 PIPE INSULATION MATERIALS**

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the products specified.
  - a. Armacell LLC; AP Armaflex.
  - b. Nomaco K-Flex; Insul-Tube and Insul-Sheet.

B. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
  - a. Johns Manville; Micro-Lok.
  - b. Knauf Insulation; 1000 Pipe Insulation.
  - c. Manson Insulation Inc.; Alley-K.
  - d. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

C. Mineral-Wool, Preformed Pipe Insulation, Type II:

1. Products: Subject to compliance with requirements, provide one of the products specified.
  - a. Fibrex Insulations Inc.; Coreplus 1200.
  - b. Rock Wool Manufacturing Company; Delta PC and PF.
  - c. Roxul Inc.; 1200 Pipe Insulation.
2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

### **2.03 DUCTWORK INSULATION MATERIALS**

- A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap FSK.
    - e. Owens Corning; All-Service Duct Wrap.
- B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.

### **2.04 DUCTWORK LAGGING MATERIALS**

- A. Board Insulation: Minimum 3 pounds per cubic foot density, glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. CertainTeed Corp.; CertaPro Commercial Board.
    - b. Johns Manville; 800 Series Spin-Glas.
    - c. Knauf Insulation; Insulation Board.
    - d. Manson Insulation Inc.; AK Board.
    - e. Owens Corning; Fiberglas 700 Series.
- B. Gypsum Board: Gypsum core wall panel surfaced with paper on front, back, and long edges.
  1. Comply with ASTM C 1396.
  2. Edges: Square.
- C. Acoustical Sealant:
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Acoustical Surfaces, Inc.; Noise S.T.O.P. Sealant.
    - b. Johns Manville; Dux Seal.

### **2.05 INSULATING CEMENTS**

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.

- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

## 2.06 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Armacell LCC; 520 Adhesive.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - c. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
    - f. Vimasco Corporation.
- D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Red Devil, Inc.; Celulon Ultra Clear.
    - e. Speedline Corporation; Speedline Vinyl Adhesive.

## 2.07 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.
    - e. Mon-Eco Industries, Inc.; 55-40.
    - f. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 5. Color: White.

- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-10.
    - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    - d. Marathon Industries, Inc.; 550.
    - e. Mon-Eco Industries, Inc.; 55-50.
    - f. Vimasco Corporation; WC-1/WC-5.
  - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
  - 4. Solids Content: 63 percent by volume and 73 percent by weight.
  - 5. Color: White.

## 2.08 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-52.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    - c. Marathon Industries, Inc.; 130.
    - d. Mon-Eco Industries, Inc.; 11-30.
    - e. Vimasco Corporation; 136.
  - 2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
  - 3. Service Temperature Range: Minus 50 to plus 180 deg F.
  - 4. Color: White.

## 2.09 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-76-8.
    - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Vimasco Corporation; 750.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: Aluminum.
- B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-76.
  - 2. Materials shall be compatible with insulation materials, jackets, and substrates.
  - 3. Fire- and water-resistant, flexible, elastomeric sealant.
  - 4. Service Temperature Range: Minus 40 to plus 250 deg F.
  - 5. Color: White.
- C. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Childers Products, H.B. Fuller Company; CP-76.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Pittsburgh Corning Corporation; Pittseal 444.
    - f. Vimasco Corporation; 750.
  - 2. 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.

5. Color: White or gray.

## 2.10 FACTORY-APPLIED JACKETS

- A. Insulation systems 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.

## 2.11 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 specified; roll stock ready for shop or field cutting and forming.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Johns Manville; Zeston and Ceel-Co.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated tank heads and tank side panels.
- D. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Johns Manville; Zeston and Ceel-Co.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers:
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.
- E. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. PABCO-Childers Metals; ITW Insulation Systems; Metal Jacketing Systems.
    - b. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
    - a. Sheet and roll stock ready for shop or field sizing or 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 or 2.5-mil- thick Polysurlyn.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
      - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
  3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

- a. Sheet and roll stock ready for shop or field sizing factory cut and rolled to size.
- b. Material, finish, and thickness are indicated in field-applied jacket systems.
- 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 or 2.5-mil- thick Polysurlyn.
- e. Factory-Fabricated Fitting Covers:
  - 1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - 2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
  - 3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- F. Self-Adhesive Outdoor Jacket: 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. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. MFM Building Products Corp.; FlexClad-400
    - b. Polyguard; Alumaguard.
    - c. Venture Tape Corp.; VentureClad.
- G. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Dow Chemical Company (The), Saran 540 Vapor Retarder Film.
- H. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Dow Chemical Company (The), Saran 560 Vapor Retarder Film.
- I. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
- J. Sound Barrier Jacket: Uni-composite film laminated to 0.020 inch thick stucco embossed aluminum using viscoelastic film adhesive.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. PABCO-Childers Metals; ITW Insulation Systems; 1 pound Muffl-Jac.
  2. Properties:
    - a. Sound Transmission Class (STC): 29.
    - b. Thickness (film): 0.080 to 0.110 inch.
    - c. Weight (film): 1 pound per square foot.
    - d. Service Temperature Range: Minus 40 deg F to 180 deg F.
  3. Proprietary sound jacketing by steam pressure reducing valve manufacturer is also acceptable.

## 2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.



2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 6 mils.

4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

## 2.13 SECUREMENTS

- A. Bands:
  1. Products: Subject to compliance with requirements, provide one of the products specified.
    - a. PABCO-Childers Metals; ITW Insulation Systems; Pab-Bands and Fabstraps.
    - b. RPR Products, Inc.; Bands.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
  3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
  4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
  1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the products specified.
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. Products: Subject to compliance with requirements, provide one of the products specified.
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; Cupped Head Weld Pin.
      - 3) Midwest Fasteners, Inc.; Cupped Head.
      - 4) Nelson Stud Welding; CHP.
  3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the products specified.
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      - 2) GEMCO; Perforated Base.
      - 3) Midwest Fasteners, Inc.; Spindle.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the products specified.

- 1) GEMCO; Nylon Hangers.
- 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
- b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
- c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
- d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products: Subject to compliance with requirements, provide one of the products specified.
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
    - 2) GEMCO; Press and Peel.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the products specified.
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Manufacturers:
    - 1) GEMCO.
    - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.
- D. Wire: 0.062-inch soft-annealed, stainless steel.
  1. Manufacturers:
    - a. ACS Industries, Inc.
    - b. C & F Wire.
    - c. PABCO-Childers Metals; ITW Insulation Systems.
    - d. RPR Products, Inc.

#### **2.14 CORNER ANGLES**

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation 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.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.03 COMMON INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at the 4 o'clock or 8 o'clock position on 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 as recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 thermal hanger 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 thermal hanger 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 the 4 o'clock or 8 o'clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. For below ambient services, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer's recommendations.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### **3.04 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 Below-Grade 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:
1. Terminate ductwork insulation at angle closure of fire damper sleeves.
  2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
    - a. Firestopping is specified in Division 07 Section "Through-Penetration Firestop Systems."
- F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
  2. Pipe: Install insulation continuously through floor penetrations.
    - a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

### **3.05 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, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union 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.
- E. Install removable and reusable insulation covers in accordance with fabricator's instructions, and at the following locations:

### **3.06 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  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.

### **3.07 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
  3. For piping systems with surface temperatures below ambient, install a continuous unbroken vapor barrier. Seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
    - a. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
    - b. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
- B. Insulation Installation on Pipe Flanges:
  1. Install PVC fitting covers when available.
  2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
    - a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
    - b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
  3. 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 PVC fitting covers when available.
  2. When PVC fitting covers 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 PVC fitting covers when available.
  2. When PVC fitting covers 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.

### **3.08 DUCT AND PLENUM INSULATION INSTALLATION**

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with 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. Adhesive may be omitted from top surface of horizontal rectangular ducts.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.



- c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not over compress insulation during installation.
  - e. Impale insulation over pins and attach speed washers.
  - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over compress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped

pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
  3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer's installation instructions.

### **3.09 DUCT LAGGING INSTALLATION**

- A. Install between silencers and shaft or Mechanical Equipment Room walls, and where indicated on Drawings.
- B. Ensure sufficient clearance between ductwork to be lagged and adjacent items.
- C. Install lagging as detailed on Drawings.
- D. Adhere board insulation with adhesive. Do not use pins.
- E. Install gypsum board layers. Stagger joints between layers. Seal joints with acoustical sealant.

### **3.10 FIELD-APPLIED JACKET INSTALLATION**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
  2. For services with surface temperatures below ambient, maintain continuous unbroken vapor barrier.
- 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.
- D. Where sound barrier jackets are indicated, install in accordance with manufacturer's instructions.
- E. Where PVDC jackets are indicated, install as follows:
  1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
  2. Wrap factory-preserved jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install preserved jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
  3. Continuous jacket can be spiral wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer

to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.

4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouting," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

### **3.11 FINISHES**

- A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.
- 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.

### **END OF SECTION**



**SECTION 21 1100 - FIRE-SUPPRESSION SYSTEM**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Provisions of Division 20 Section "Mechanical General Requirements" apply to this Section.
- C. Related Sections include the following:
  - 1. Division 33 Section "Water Distribution" for piping outside the building.
  - 2. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
  - 3. Division 20 Section "Basic Mechanical Materials and Methods."
  - 4. Division 20 Section "Hangers and Supports."
  - 5. Division 28 Section "Fire Alarm" for alarm devices not specified in this Section.

## 1.02 SUMMARY

- A. This Section includes water-based fire-suppression systems inside the building. Rework existing wet pipe fire protection piping and sprinkler heads associated with the new work areas.

## 1.03 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- C. PE: Polyethylene plastic.
- D. Underground Service-Entrance Piping: Underground service piping below the building.
- E. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

## 1.04 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

## 1.05 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. High-Pressure Piping System Component Working Pressure: Listed for 250 psig minimum.
- C. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- D. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:
    - a. Automobile Parking Areas: Ordinary Hazard, Group 1.
    - b. Building Service Areas: Ordinary Hazard, Group 1.
    - c. Churches: Light Hazard.
    - d. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - e. Dry-Cleaners: Ordinary Hazard, Group 2.
    - f. General Storage Areas: Ordinary Hazard, Group 1.
    - g. Laundries: Ordinary Hazard, Group 1.
    - h. Libraries, Except Stack Areas: Light Hazard.
    - i. Library Stack Areas: Ordinary Hazard, Group 2.
    - j. Machine Shops: Ordinary Hazard, Group 2.
    - k. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - l. Office and Public Areas: Light Hazard.
    - m. Plastics Processing Areas: Extra Hazard, Group 2.
    - n. Printing Plants: Extra Hazard, Group 1.
    - o. Repair Garages: Ordinary Hazard, Group 2.
    - p. Residential Living Areas: Light Hazard.
    - q. Restaurant Service Areas: Ordinary Hazard, Group 1.
    - r. Solvent Cleaning Areas: Extra Hazard, Group 2.
    - s. Upholstering Plants: Extra Hazard, Group 1.
  - 3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. 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/sq. ft. over 1500-sq. ft. area.
    - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm/sq. ft. over 2500-sq. ft. area.
    - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm/sq. ft. over 2500-sq. ft. area.

- f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
- 4. Maximum Protection Area per Sprinkler:
  - a. Office Spaces: 225 sq. ft.
  - b. Storage Areas: 130 sq. ft.
  - c. Mechanical Equipment Rooms: 130 sq. ft.
  - d. Electrical Equipment Rooms: 130 sq. ft.
  - e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.
- E. Water velocity in the piping system shall not exceed the following:
  - 1. Underground mains: 16 ft./sec.
  - 2. Aboveground mains: 32 ft./sec.
  - 3. Sprinkler branch lines: 24 ft./sec.

#### **1.06 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For 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.
- D. Qualification Data: For qualified Installer and professional engineer.
- E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable.
  - 1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.
- F. Welding certificates.
- G. Fire-hydrant flow test report.
- H. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping"
- I. Field quality-control reports.
- J. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in operation and maintenance manuals.

#### **1.07 QUALITY ASSURANCE**

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.
- D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
  - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
  - 4. NFPA 230, "Fire Protection of Storage."

### 1.08 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Coordinate with ceiling installer to ensure proper grid type and installation for use with flexible sprinkler drops.

### 1.09 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of two spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.02 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with mechanical-joint bell end and plain end.
  - 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 gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with push-on-joint bell end and plain end.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Gaskets: AWWA C111, rubber.
- C. Encasement for Underground Ductile-Iron Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

### 2.03 STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.
  - 1. Cast-Iron Threaded Flanges: ASME B16.1.
  - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
  - 3. Gray-Iron Threaded Fittings: ASME B16.4.
  - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
  - 5. Steel Threaded Couplings: ASTM A 865.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.
  - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll- grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.
  - 1. Grooved-Joint Piping Systems:
    - a. Manufacturers:



- 1) Anvil International, Inc.; Model 7401.
- 2) Tyco Fire & Building Products; Grinnell Mechanical Products; Model 577 or 772.
- 3) Victaulic Co. of America; Style 005 or 009.
- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

#### **2.04 STANDARD-WEIGHT GALVANIZED STEEL PIPE AND FITTINGS**

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized, with factory- or field-formed threaded ends.
  1. Cast-Iron Threaded Flanges: ASME B16.1, hot-dip galvanized.
  2. Malleable-Iron Threaded Fittings: ASME B16.3, hot-dip galvanized.
  3. Gray-Iron Threaded Fittings: ASME B16.4, hot-dip galvanized.
  4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe, hot-dip galvanized. Include ends matching joining method.
  5. Steel Threaded Couplings: ASTM A 865, hot-dip galvanized.
- B. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized with factory- or field-formed, square-cut-grooved ends.
  1. Grooved-Joint Piping Systems:
    - a. Manufacturers:
      - 1) Anvil International, Inc.; Model 7401.
      - 2) Tyco Fire & Building Products; Grinnell Mechanical Products; Model 577 or 772.
      - 3) Victaulic Co. of America; Style 005 or 009.
    - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
    - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

#### **2.05 SCHEDULE 10 BLACK STEEL PIPE AND FITTINGS**

- A. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13 specified wall thickness in NPS 6 to NPS 10, and with factory applied antimicrobial coating on inner wall of pipe.
  1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  2. Steel Flanges and Flanged Fittings: ASME B16.5.
- B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.
  1. Grooved-Joint Piping Systems:
    - a. Manufacturers:
      - 1) Anvil International, Inc.; Model 7401.
      - 2) Tyco Fire & Building Products; Grinnell Mechanical Products; Model 577 or 772.
      - 3) Victaulic Co. of America; Style 005 or 009.
    - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
    - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

#### **2.06 COVER SYSTEM FOR SPRINKLER PIPING**

- A. Manufacturers:

1. DecoShield Systems, Inc.
- B. Description: System of support brackets and covers made to protect sprinkler piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Extruded PVC sections of length, shape, and size required for size and routing of CPVC piping.

## **2.07 DIELECTRIC FITTINGS**

- A. Refer to Division 20 Section "Mechanical General Requirements."

## **2.08 FLEXIBLE CONNECTORS**

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
  1. NPS 2 and Smaller: Threaded.
  2. NPS 2-1/2 and Larger: Flanged.
  3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Manufacturers:
  1. Anamet Inc.
  2. Flex-Hose Co., Inc.
  3. Flexicraft Industries.
  4. Hispan Precision Products, Inc.
  5. Metraflex, Inc.
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

## **2.09 SPRINKLER SPECIALTY FITTINGS**

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping system.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
  1. Manufacturers:
    - a. Tyco Fire & Building Products LP.
    - b. Fire-End and Croker Corp.
    - c. Viking Corp.
    - d. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
  1. Manufacturers:
    - a. Elkhart Brass Mfg. Co., Inc.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
  1. Manufacturers:
    - a. AGF Manufacturing Co.
    - b. Tyco Fire & Building Products LP.
    - c. G/J Innovations, Inc.
    - d. Triple R Specialty of Ajax, Inc.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
  1. Manufacturers:
    - a. CECA, LLC.
    - b. Merit.
- F. Flexible Sprinkler Drop Fittings:

1. Manufacturers:
    - a. Victaulic Co. of America; AquaFlex Sprinkler Fittings; AH-2 with AB1 Bracket Assembly.
    - b. FlexHead Industries, Inc.
  2. Description: UL listed and FMG approved flexible hose for connection to sprinkler, and with bracket for connection to commercial ceiling grid.
  3. Standard: UL 2443.
  4. Pressure Rating: 175 psig minimum.
  5. Size: Same as connected piping, for sprinkler.
- G. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

## **2.10 LISTED FIRE-PROTECTION VALVES**

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.
- B. Gate Valves with Wall Indicator Posts:
  1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
  2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.
  3. Manufacturers:
    - a. McWane, Inc.; Kennedy Valve Div.
    - b. NIBCO.
    - c. Crane Co.; Crane Valve Group; Stockham Valves.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
  1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  3. NPS 3: Ductile-iron body with grooved ends.
  4. Manufacturers:
    - a. NIBCO.
    - b. Victaulic Co. of America.
- D. Butterfly Valves: UL 1091.
  1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
    - a. Manufacturers:
      - 1) McWane, Inc.; Kennedy Valve Div.
      - 2) Mueller Company.
      - 3) NIBCO.
      - 4) Tyco Fire & Building Products.
      - 5) Victaulic Co. of America.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
  1. Manufacturers:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Crane Co.; Crane Valve Group; Jenkins Valves.
    - c. Tyco Fire & Building Products.
    - d. Hammond Valve.
    - e. McWane, Inc.; Kennedy Valve Div.
    - f. Mueller Company.
    - g. NIBCO.
    - h. Crane Co.; Crane Valve Group; Stockham Valves.
    - i. Victaulic Co. of America.
    - j. Watts Water Technologies, Inc.; Watts Regulator Co.
- F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.
    - a. Manufacturers:
      - 1) Crane Co.; Crane Valve Group; Crane Valves.
      - 2) Hammond Valve.
      - 3) NIBCO.
  2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
    - a. Manufacturers:
      - 1) McWane, Inc.; Clow Valve Co.
      - 2) Crane Co.; Crane Valve Group; Crane Valves.
      - 3) Crane Co.; Crane Valve Group; Jenkins Valves.
      - 4) Hammond Valve.
      - 5) Milwaukee Valve Company.
      - 6) Mueller Company.
      - 7) NIBCO.
- G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
  2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
    - a. Manufacturers:
      - 1) Milwaukee Valve Company.
      - 2) NIBCO.
      - 3) Victaulic Co. of America.
  3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
    - a. Manufacturers:
      - 1) Tyco Fire & Building Products LP.
      - 2) McWane, Inc.; Kennedy Valve Div.
      - 3) Milwaukee Valve Company.
      - 4) NIBCO.
      - 5) Victaulic Co. of America.

## **2.11 UNLISTED GENERAL-DUTY VALVES**

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

## **2.12 SPRINKLERS**

- A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum pressure rating if sprinklers are components of high-pressure piping system.
- B. Manufacturers:
  1. Reliable Automatic Sprinkler Co., Inc.
  2. Tyco Fire & Building Products.
  3. Victaulic Co. of America.
  4. Viking Corp.
- C. Automatic Sprinklers:
  1. With heat-responsive glass bulb element complying with the following:
    - a. UL 199, for nonresidential applications.
    - b. UL 1767, for early-suppression, fast-response applications.

- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
  - 1. Concealed ceiling sprinklers, including cover plate.
  - 2. Extended-coverage sprinklers.
  - 3. Flush ceiling sprinklers, including escutcheon.
  - 4. Pendent sprinklers.
  - 5. Pendent, dry-type sprinklers.
  - 6. Quick-response sprinklers.
  - 7. Recessed sprinklers, including escutcheon.
  - 8. Sidewall sprinklers.
  - 9. Sidewall, dry-type sprinklers.
  - 10. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.
- G. Special Coatings: Wax, lead, and corrosion-resistant paint.
- H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
  - 1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.
  - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

**PART 3 EXECUTION**

**3.01 PREPARATION**

- A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14, and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

**3.02 EXAMINATION**

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.03 PIPING APPLICATIONS, GENERAL**

- A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

**3.04 SPRINKLER RISER AND STANDPIPE SYSTEM PIPING APPLICATIONS**

- A. Sprinkler Risers and Standpipes: Use the following:

Pipe Type	4" & Smaller	5" & 6"	8" - 12"
Standard weight steel, threaded fittings	YES	YES	NO
Standard weight steel, grooved fittings	YES	YES	YES
Standard weight steel, welded fittings	YES	YES	YES
Galv. standard weight steel, threaded fittings	YES	YES	NO

Pipe Type	4" & Smaller	5" & 6"	8" - 12"
Galv. standard weight steel, grooved fittings	YES	YES	YES
Schedule 30 steel, threaded fittings	NO	NO	NO
Schedule 30 steel, grooved fittings	NO	NO	NO
Schedule 10 steel, grooved fittings	NO	NO	NO
Schedule 10 steel, welded fittings	NO	NO	NO
Type K copper, grooved fittings	NO	NO	NO
Type L copper, grooved fittings	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO
Type L copper, brazed fittings	NO	NO	NO

### 3.05 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	1 1/2" & Smaller	2"	2 1/2" - 3 1/2"	4"	5" - 6"
Standard weight steel, threaded fittings	YES	YES	YES	YES	NO
Standard weight steel, locking fittings	NO	NO	NO	NO	NO
Standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Standard weight steel, welded fittings	NO	YES	YES	YES	YES
Galv. standard weight steel, threaded fittings	YES	YES	YES	YES	YES
Galv. standard weight steel, locking fittings	NO	NO	NO	NO	NO
Galv. standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Schedule 30 steel, threaded fittings	NO	NO	NO	NO	NO
Schedule 30 steel, locking fittings	NO	NO	NO	NO	NO
Schedule 30 steel, grooved fittings	NO	NO	NO	NO	NO
Schedule 30 steel, welded fittings	NO	NO	NO	NO	NO
Thinwall steel, threaded fittings	NO	NO	NO	NO	NO
Thinwall steel, locking fittings	NO	NO	NO	NO	NO
Thinwall steel, grooved fittings	NO	NO	NO	NO	NO
Thinwall steel, welded fittings	NO	NO	NO	NO	NO

Pipe Type	<u>1 1/2" &amp; Smaller</u>	<u>2"</u>	<u>2 1/2" – 3 1/2"</u>	<u>4"</u>	<u>5" – 6"</u>
Schedule 10 steel, welded fittings	NO	YES	YES	YES	YES
Schedule 10 steel, grooved fittings	NO	NO	YES	YES	YES
Hybrid steel, grooved fittings	NO	NO	NO	NO	NO
Hybrid steel, welded fittings	NO	NO	NO	NO	NO
Schedule 5 steel, press sealed fittings	NO	NO	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO	NO	NO
Type L copper, brazed fittings	NO	NO	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO	NO	NO
Type L copper, grooved fittings	NO	NO	NO	NO	NO
CPVC pipe, solvent cement fittings	YES	YES	YES	NO	NO

B. Dry-Pipe Sprinklers: Use the following:

Pipe Type	<u>1 1/2" &amp; Smaller</u>	<u>2"</u>	<u>2 1/2" - 4"</u>
Galv. standard weight steel, threaded fittings	YES	YES	YES
Galv. standard weight steel, grooved fittings	NO	NO	YES
Type K copper, brazed fittings	NO	NO	NO
Type L copper, brazed fittings	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO
Type L copper, grooved fittings	NO	NO	NO

### 3.06 VALVE APPLICATIONS

A. The following requirements apply:

1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13 and NFPA 14.
  - a. Shutoff Duty: Use ball, butterfly, or gate valves.
2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
  - a. Shutoff Duty: Use ball, butterfly, or gate valves.
  - b. Throttling Duty: Use ball or globe valves.

### 3.07 JOINT CONSTRUCTION

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.
- C. 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.
- D. Use of saddle style tees is not acceptable.
- E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
  1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
  2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
  3. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.
- F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for additional requirements.

### **3.08 WATER-SUPPLY CONNECTION**

- A. Connect fire-suppression piping to building's interior water distribution piping.
- B. Install shutoff valve, double-check, detector-assembly backflow preventor, pressure gage, drain, and other accessories indicated at connection to water distribution piping.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

### **3.09 PIPING INSTALLATION**

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.
- B. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints. Encase piping in corrosion-protective encasement.
- C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install drain valves on standpipes.
- J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- K. Install alarm devices in piping systems.
- L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
  1. Install standpipe system piping according to NFPA 14.
  2. Install sprinkler system piping according to NFPA 13, except use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
  3. Refer to Division 20 Section "Hangers and Supports" for additional requirements.
- 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 will not be subject to freezing.
- N. Drain dry-type standpipe piping.
- O. Drain dry-pipe sprinkler piping.
- P. Pressurize and check dry-pipe sprinkler system piping and air compressors.



- Q. Fill wet-standpipe system piping with water.
- R. Fill wet-pipe sprinkler system piping with water.

### **3.10 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING**

- A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

### **3.11 VALVE INSTALLATION**

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 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. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.
- D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
- E. Specialty Valves:
  - 1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.
  - 2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.
    - a. Install air compressor and compressed-air supply piping.

### **3.12 SPRINKLER APPLICATIONS**

- A. Use the following sprinkler types:
  - 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 as indicated.
  - 5. Sprinkler Finishes:
    - a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.
    - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
    - c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
    - d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
  - 6. Sprinkler Guards: For exposed sprinkler heads subject to damage.

### **3.13 SPRINKLER INSTALLATION**

- A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.
- C. Install sprinklers into flexible sprinkler drop fittings and install into bracket on ceiling grid. Install according to manufacturer's instructions and NFPA, State, and local guidelines. Ceiling grid must meet requirements of ASTM C 635 and C 636, coordinate with ceiling installer.

### **3.14 CONNECTIONS**

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.
- C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

- D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- E. Electrical Connections: Power wiring and fire alarm wiring are specified in Division 26.
- F. Connect alarm devices to fire alarm.
- G. Ground equipment according to Division 26 Section "Grounding and Bonding."
- H. Connect wiring according to Division 26 Section "Conductors and Cables."
- I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.15 LABELING AND IDENTIFICATION**

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 20 Section "Mechanical Identification."

### **3.16 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
  - 4. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
  - 5. Verify that equipment hose threads are same as local fire department equipment.
  - 6. Test each double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- C. Verify that air compressors and their accessories are installed and operate correctly.
- D. Verify that specified tests of piping are complete.
- E. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- F. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- G. Verify that potable-water supplies have correct types of backflow preventers.
- H. Energize circuits to electrical equipment and devices.
- I. Adjust operating controls and pressure settings.
- J. Coordinate with fire alarm tests. Operate as required.
- K. Coordinate with fire-pump tests. Operate as required.
- L. Report test results promptly and in writing to Architect and authorities having jurisdiction.

### **3.17 CLEANING AND PROTECTION**

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

### **3.18 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves. Refer to Division 20 Section "Mechanical General Requirements."

### **END OF SECTION**

**SECTION 22 0523 - GENERAL DUTY VALVES FOR PLUMBING**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical Identification" for valve tags and charts.
  - 2. Division 22 piping Sections for specialty valves applicable to those Sections only.
  - 3. Division 23 Section "General-Duty Valves for HVAC" for HVAC valves.
  - 4. Division 23 Section "Temperature Controls" for control valves and actuators.

**1.02 SUMMARY**

- A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

**1.03 DEFINITIONS**

- A. The following are standard abbreviations for valves:
  - 1. CWP: Cold working pressure.
  - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 3. NBR: Acrylonitrile-butadiene rubber.
  - 4. NRS: Nonrising stem.
  - 5. OS&Y: Outside screw and yoke.
  - 6. PTFE: Polytetrafluoroethylene plastic.
  - 7. RPTFE: Reinforced polytetrafluoroethylene plastic.
  - 8. SWP: Steam working pressure.
  - 9. TFE: Tetrafluoroethylene plastic.
  - 10. WOG: Water, oil, and gas.

**1.04 SUBMITTALS**

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.

#### **1.05 QUALITY ASSURANCE**

- A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Prepare valves for shipping as follows:
  1. Protect internal parts against rust and corrosion.
  2. Protect threads, flange faces, grooves, and weld ends.
  3. Set angle, gate, and globe valves closed to prevent rattling.
  4. Set ball and plug valves open to minimize exposure of functional surfaces.
  5. Set butterfly valves closed or slightly open.
  6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
  1. Maintain valve end protection.
  2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

### **PART 2 PRODUCTS**

#### **2.01 VALVES, GENERAL**

- A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:
  1. Shutoff Service: Ball and butterfly valves.
  2. Throttling Service: Angle, ball, butterfly, or globe valves.
  3. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- D. For valves not indicated in the Application Schedules, select valves with the following end connections:
  1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
  2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
  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.
  6. For Steel Piping, NPS 5 and Larger: Flanged ends.
  7. For Grooved-End Systems: Valve ends may be grooved.
- E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.
  1. Exceptions:
    - a. Valves in pumped sanitary systems.
    - b. Valves in pumped storm systems.

- c. Drain valves.
  - d. Valves in general air or vacuum systems.
  - e. Valves in irrigation systems.
  - f. Valves in non-potable water systems.
  - g. Valves in other plumbing systems not intended for human consumption.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
- 1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
  - 2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
  - 3. Handwheel: For valves other than quarter-turn types.
  - 4. Lever Handle: For quarter-turn valves NPS 6 and smaller.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: AWWA C606.
- K. Solder Joint: With sockets according to ASME B16.18.
- 1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.
- L. Threaded: With threads according to ASME B1.20.1.
- M. Valve Bypass and Drain Connections: MSS SP-45.

## **2.02 BRONZE BALL VALVES**

- A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.
- B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Series 70LF-140/240.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company; Model UPBA100S/150S.
    - d. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.
    - e. Watts Water Technologies, Inc.
- C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-140/240.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company; UPBA400S/450S.
    - d. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.
    - e. Watts Water Technologies, Inc.

## **2.03 GENERAL SERVICE BUTTERFLY VALVES**

- A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
- 1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
  - 2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

- B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
    - b. Bray International, Inc.
    - c. DeZurik.
    - d. Forum Energy Technologies; ABZ Valve.
    - e. Hammond Valve.
    - f. Milwaukee Valve Company.
    - g. NIBCO INC.; LD-2000-3/5.
    - h. Pentair Valves & Controls; Keystone.
    - i. Tyco Flow Control; Grinnell Flow Control.
    - j. Watts Water Technologies.
- C. Lug-Style (Single-Flange) Size NPS 14 and Larger, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, and phenolic-backed EPDM seat (liner) attached to the body.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
    - b. Bray International, Inc.
    - c. DeZurik.
    - d. Forum Energy Technologies; ABZ Valve.
    - e. Milwaukee Valve Company.
    - f. NIBCO INC.; LD-1000-5.
    - g. Pentair Valves & Controls; Keystone.
    - h. Tyco Flow Control; Grinnell Flow Control.
    - i. Watts Water Technologies.
- D. Grooved-End Butterfly Valves with EPDM-Encapsulated Ductile-Iron Disc: Ductile-iron body with grooved or shouldered ends and polyamide coating inside and outside; Type 416 stainless-steel stem, PTFE bronze sintered on steel bushing, and 300-psig CWP Rating for Valves NPS 2 through NPS 8, 200 psig CWP Rating for Valves NPS 10 through NPS 12.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International, Inc.
    - b. NIBCO INC.; Model GD-4765-3/5.
    - c. Tyco Fire & Building Products; Grinnell Mechanical Products.
    - d. Victaulic Co. of America.

#### **2.04 BRONZE CHECK VALVES**

- A. Bronze Check Valves, General: MSS SP-80.
- B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Model 162T-LF and 163T-LF (61YLF Series).
    - b. Milwaukee Valve Company; Model UP509/UP1509.
    - c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
    - d. Watts Water Technologies; LFCVY/LFCVYS.

## 2.05 IRON SWING CHECK VALVES

- A. Iron Swing Check Valves, General: MSS SP-71.
- B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
    - b. Crane Co.; Crane Valves.
    - c. Crane Co.; Stockham Div.
    - d. Hammond Valve; IR1124-HI.
    - e. Milwaukee Valve Company; Model F-2974.
    - f. NIBCO INC.; Model F-918-B.
    - g. Watts Water Technologies.
- C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Model 920F.
    - b. Crane Co.; Crane Valves.
    - c. Crane Co.; Stockham Div.
    - d. Hammond Valve; IR322.
    - e. Milwaukee Valve Company; Model F-2970.
    - f. NIBCO INC.; Model F-968-B.
    - g. Watts Water Technologies.
- D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Mueller Co.
    - b. NIBCO, INC.; Model G-917-W.
    - c. Tyco Fire & Building Products; Grinnell Mechanical Products.
    - d. Victaulic Co. of America.

## 2.06 LIFT CHECK VALVES

- A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).
    - b. Hammond Valve; UP943 and UP947.
    - c. Milwaukee Valve Company; UP548T and UP1548T.
    - d. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.
    - e. Watts Water Technologies; LF600.
  - 2. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. CWP Rating: 250 psig.
    - c. Body Design: Vertical flow.
    - d. Body Material: Lead free brass or bronze.
    - e. Ends: Threaded or Solder.
    - f. Disc: PTFE, or TFE.

## 2.07 BRONZE GLOBE VALVES

- A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

- B. Class 125, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 200 psig CWP rating.
  - 1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Model 121T-LF.
    - b. Hammond Valve; UP418 and UP440.
    - c. Milwaukee Valve Company; Model UP502 and UP1502.
    - d. Watts Water Technologies, Inc.; LFGLV.

## **2.08 CAST-IRON GLOBE VALVES**

- A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.
- B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.
  - 1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
    - a. Apollo Valves; by Conbraco Industries, Inc.; Model 711F.
    - b. Crane Co.; Crane Valves.
    - c. Crane Co.; Stockham Valves.
    - d. Hammond Valve.
    - e. Milwaukee Valve Company; Model F-2981.
    - f. NIBCO INC.; Model F-718-B.
    - g. Watts Water Technologies, Inc.

## **2.09 CAST-IRON ANGLE VALVES**

- A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.
- B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. NIBCO INC.; Model F-818-B.
    - b. Crane Co.; Stockham Valves.
    - c. Crane Co.; Crane Valves.

## **2.10 DRAIN VALVES**

- A. Ball-Valve-Type, Hose-End Drain Valves:
  - 1. Bronze ball valve as specified in this Section. Lead free construction is not required.
  - 2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## **2.11 SOURCE QUALITY CONTROL**

- A. Identification: Factory label or color coding to identify lead free valves.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
  - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. 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.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.



- E. 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.
- F. Do not attempt to repair defective valves; replace with new valves.

### **3.02 VALVE INSTALLATION**

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.
- E. Install valves in position to allow full stem movement.
- F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.
- G. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.

### **3.03 JOINT CONSTRUCTION**

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

### **3.04 ADJUSTING**

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### **END OF SECTION**

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PBA2013.0406.01 & 2013.0408.01

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Mechanical Materials and Methods" for materials and methods common to mechanical piping systems.
  - 3. Division 20 Section "Hangers and Supports."
  - 4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
  - 5. Division 20 Section "Valves" for general duty plumbing valves.
  - 6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

#### 1.02 SUMMARY

- A. This Section includes domestic water piping inside the building.

#### 1.03 PERFORMANCE REQUIREMENTS

- A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

#### 1.04 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Refer to Application Schedules on the Drawings for valve types to be used.
- C. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

#### 1.05 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control test reports.

#### 1.06 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

- C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

### **1.07 PROJECT 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 proceed with interruption of water service without Owner's written permission.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.02 PIPING MATERIALS**

- A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

### **2.03 COPPER TUBE AND FITTINGS**

- A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.
  - 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- C. Grooved-Joint Systems:
  - 1. Manufacturers:
    - a. Anvil International, Inc.; Gruvlok Manufacturing; Model 7401.
    - b. Tyco Fire & Building Products; Grinnell Mechanical Products; Model 672.
    - c. Victaulic Company; Style 606 and Style 607.
  - 2. Grooved-End-Tube Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
  - 3. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
- D. Copper or Bronze Pressure-Seal Fittings:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Viega North America; ProPress System.
    - b. NIBCO Inc.; Press System.
    - c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
    - d. Apollo Valves; by Conbraco Industries; ApolloXpress.
  - 2. Housing: Copper.
  - 3. O-Rings and Pipe Stops: EPDM.
  - 4. Tools: Manufacturer's special tools.

5. Maximum 200-psig working-pressure rating at 250 deg F.
- E. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. T-DRILL Industries Inc.

### **PART 3 EXECUTION**

#### **3.01 PIPING SYSTEM INSTALLATION**

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
  1. Install hose-end drain valves at low points in water mains, risers, and branches.
  2. Install stop-and-waste drain valves where indicated.
- D. Install domestic water piping level without pitch and plumb.

#### **3.02 JOINT CONSTRUCTION**

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

#### **3.03 HANGER AND SUPPORT INSTALLATION**

- A. Pipe hanger and support devices are specified in Division 20 Section "Hangers and Supports." Install the following:
  1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  2. Individual, Straight, Horizontal Piping Runs: According to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.
- E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
  2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  3. NPS 2: 10 feet with 3/8-inch rod.
  4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
  6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
- F. Install supports for vertical steel piping every 15 feet.
- G. Install hangers for drawn-temper 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.
- H. Install supports for vertical copper tubing every 10 feet.

- I. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- J. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.04 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 20 Section "Basic Mechanical Materials and Methods" for dielectric fittings.
- C. Install piping adjacent to equipment and machines to allow service and maintenance.
- D. Connect domestic water piping to the following:
  1. Water Heaters: Cold water supply and hot water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

### **3.05 FIELD QUALITY CONTROL**

- A. Inspect domestic water piping as follows:
  1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
  4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping as follows:
  1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

### **3.06 ADJUSTING**

- A. Perform the following adjustments before operation:
  1. Close drain valves.
  2. Open shutoff valves to fully open position.
  3. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
  4. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  5. Check plumbing specialties and verify proper settings, adjustments, and operation.

### **3.07 CLEANING AND DISINFECTION**

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
  - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.

**END OF SECTION**

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TMP13172G & 13174H  
PBA2013.0406.01 & 2013.0408.01



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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Mechanical Materials and Methods."
  - 3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
  - 4. Division 22 Section "Domestic Water Piping".

**1.02 PERFORMANCE REQUIREMENTS**

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

**1.03 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Flow Reports and Settings: For calibrated balancing valves.
- E. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

**1.04 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- C. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

3. Comply with NSF 372, "Drinking Water System Components – Lead Content" for components with wetted surfaces in contact with potable water.

## **PART 2 PRODUCTS**

### **2.01 BACKFLOW PREVENTERS AND VACCUM BREAKERS.**

- A. Intermediate Atmospheric-Vent Backflow Preventers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. FEBCO; a Division of Watts Water Technologies, Inc.
    - c. Watts Water Technologies, Inc.; Watts Regulator Co.
    - d. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1012.
  3. Operation: Continuous-pressure applications.
  4. Size: as indicated on drawings.
  5. Body: Bronze.
  6. End Connections: Union, solder joint.
  7. Finish: chrome.
- B. Reduced-Pressure-Principle Backflow Preventers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. FEBCO; a Division of Watts Water Technologies, Inc.
    - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    - d. Watts Water Technologies, Inc.; Watts Regulator Co.
    - e. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1013.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
  5. Size and Capacities: As scheduled on the drawings.
  6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
  7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
  8. Configuration: Designed for horizontal, straight through flow.
  9. Accessories:
    - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    - c. Y-Pattern strainer and soft-seated check valve.
- C. Pressure Vacuum Breakers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. FEBCO; a Division of Watts Water Technologies, Inc.
    - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    - d. Watts Water Technologies, Inc.; Watts Regulator Co.
    - e. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1020.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 5 psig (35 kPa) maximum, through middle 1/3 of flow range.
  5. Size and Capacity: As indicated on the drawings.
  6. Accessories:
    - a. Valves: Ball type, on inlet and outlet.
- D. Spill-Resistant Vacuum Breakers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Apollo Valves; Conbraco Industries, Inc.
- b. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: As indicated on the drawings.
5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

## **2.02 BALANCING VALVES**

- A. Calibrated Balancing Valves NPS 1/2:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong International, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Apollo Valves; by Conbraco Industries, Inc.
    - d. Bell & Gossett; Xylem Inc.
    - e. Flo Fab Inc.
    - f. Flow Design Inc.
    - g. Griswold Controls.
    - h. NIBCO INC.
    - i. IMI Indoor Climate; Tour & Andersson.
    - j. Taco, Inc.
    - k. Watts Water Technologies, Inc.; Watts Regulator Co.
  2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
  3. Body: Dezincification resistant brass, or bronze.
  4. Minimum Flow Rate: 0.3 gpm.
- B. Calibrated Balancing Valves NPS 3/4 to NPS 2:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong International, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Apollo Valves; by Conbraco Industries, Inc.
    - d. Bell & Gossett; Xylem Inc.
    - e. Flo Fab Inc.
    - f. Flow Design Inc.
    - g. Griswold Controls.
    - h. NIBCO INC.
    - i. IMI Indoor Climate; Tour & Andersson.
    - j. Taco, Inc.
    - k. Watts Water Technologies, Inc.; Watts Regulator Co.
  2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
  3. Body: Dezincification resistant brass, or bronze.
  4. Size: Same as connected piping, but not larger than NPS 2.

## **2.03 TEMPERATURE-ACTUATED WATER MIXING VALVES**

- A. Water-Temperature Limiting Devices, Refer to Plumbing Fixture Schedule on Plans:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. Bradley Corporation.
    - c. Lawler Manufacturing Company, Inc.
    - d. Leonard Valve Company.
    - e. Watts Water Technologies, Inc.; Watts Regulator Co.
    - f. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1070.
  3. Pressure Rating: 125 psig.
  4. Type: Thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: 1/2-inch union or 3/8-inch compression; with integral check valves.
7. Accessories: Adjustable temperature-control knob.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Rough bronze.

#### **2.04 STRAINERS FOR DOMESTIC WATER PIPING**

##### **A. Y-Pattern Strainers:**

1. Manufacturers:
  - a. Apollo Valves; Conbraco Industries, Inc.
  - b. Keckley.
  - c. Metraflex.
  - d. Mueller Steam Specialty.
  - e. NIBCO, Inc.
  - f. Spence.
  - g. SSI Equipment, Inc.
  - h. Watts Water Technologies, Inc.
  - i. Yarway.
2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.

#### **2.05 WATER HAMMER ARRESTERS**

##### **A. Water Hammer Arresters (Copper Tube Type):**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. PPP Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Watts Water Technologies, Inc.; Watts Regulator Co.
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.

#### **2.06 AIR VENTS**

##### **A. Bolted-Construction Automatic Air Vents:**

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 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.

#### **2.07 DOMESTIC WATER CARTRIDGE FILTERS**

##### **A. Off-Floor Cartridge Filters:**

1. Manufacturers:
  - a. Culligan International Company.
  - b. Harmsco Filtration Products.
  - c. Osmonics, Inc.; Hytrex Filters Div.
  - d. Parker Hannifin Corporation; Process Filtration Div.
  - e. Water Equipment Technologies (WET); Xylem Inc.
  - f. Watts Premier.
2. Description: Simplex, wall-mounting housing with replaceable element for removing suspended particles from water.
  - a. Housing: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element; with element support.
    - 1) Pipe Connections: Threaded according to ASME B1.20.1.
    - 2) Support: Wall bracket.
  - b. Element: Replaceable; of shape to fit housing.
3. Capacity and Characteristics:
  - a. Refer to Schedule on Drawings.

## **2.08 BACKFLOW PREVENTERS**

- A. Dual-Check-Valve Backflow Preventers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. FEBCO; a Division of Watts Water Technologies, Inc.
    - c. Watts Water Technologies, Inc.; Watts Regulator Co.
    - d. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1024.
  3. Operation: Continuous-pressure applications.
  4. Size: As indicated on the drawings.
  5. Body: Bronze with union inlet.
- B. Reduced-Pressure-Principle Backflow Preventers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; Conbraco Industries, Inc.
    - b. FEBCO; a Division of Watts Water Technologies, Inc.
    - c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
    - d. Watts Water Technologies, Inc.; Watts Regulator Co.
    - e. Zurn Plumbing Products Group; Wilkins Div.
  2. Standard: ASSE 1013.
  3. Operation: Continuous-pressure applications.
  4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
  5. Size and Capacities: As scheduled on the drawings.
  6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with AWWA C550.
  7. End Connections: Threaded for NPS 2 and smaller.
  8. Configuration: Designed for horizontal, straight through flow.
  9. Accessories:
    - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller.
    - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
    - c. Y-Pattern strainer and soft-seated check valve.

## **PART 3 EXECUTION**

### **3.01 INSTALLATION**

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.

- C. Install Y-pattern strainers for water on supply side of each control valve, solenoid valve, and pump.
- D. Install water hammer arresters in water piping according to PDI-WH 201.
- E. Install air vents at high points of water piping.
- F. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."
- C. Connect wiring according to Division 26 Section "Conductors and Cables."

### **3.03 FIELD QUALITY CONTROL**

- A. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### **3.04 ADJUSTING**

- A. Set field-adjustable flow set points of balancing valves as follows:
  - 1. Set calibrated balancing valves at calculated presettings.
  - 2. Measure flow at all stations and adjust where necessary.
  - 3. Record settings and mark balancing devices.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

### **END OF SECTION**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements".
  - 2. Division 20 Section "Basic Mechanical Materials and Methods".
  - 3. Division 22 Section "Drainage Piping Specialties".

**1.02 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. TPE: Thermoplastic elastomer.

**1.03 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
  - 2. Sanitary Sewer, Force-Main Piping: 125 psig.

**1.04 SYSTEMS DESCRIPTIONS**

- A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

**1.05 SUBMITTALS**

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

**1.06 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
- C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

### **1.07 PROJECT CONDITIONS**

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
  - 1. Notify Owner no fewer than two days in advance of proposed interruption of sanitary waste service.
  - 2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.02 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Manufacturers:
    - a. ANACO-Husky; McWane Plumbing Group.
    - b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
    - c. IDEAL-TRIDON.
    - d. Mission Rubber Company; a division of MCP Industries, Inc.
    - e. Tyler Pipe; McWane Plumbing Group.
  - 2. Standards: CISPI 310.
  - 3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
- C. Heavy-Duty, Hubless-Piping Couplings:
  - 1. Manufacturers:
    - a. ANACO-Husky; McWane Plumbing Group; SD 4000.
    - b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
    - c. IDEAL-TRIDON; Heavy-Duty "HD" No-Hub Couplings.
    - d. Norma Group; Clamp-All Products; HI-TORQ 125.
  - 2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
  - 3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### **2.03 COPPER TUBE AND FITTINGS**

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
  - 1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- B. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.
  - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  - 2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
  - 3. 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.
  - 4. Hard Copper Tube: ASTM B 88, Types L, water tube, drawn temper.



5. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
6. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
7. 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.

#### **2.04 PVC PIPE AND FITTINGS**

- A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.
  1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

### **PART 3 EXECUTION**

#### **3.01 EXCAVATION**

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#### **3.02 PIPING SYSTEM 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. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- D. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- F. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- G. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- H. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- I. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
  2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
  3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.
- J. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- K. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

- L. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.03 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- C. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

### 3.04 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
  - 3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  - 4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 20 Section "Hangers and Supports."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  - 4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  - 5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 3. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
  - 5. NPS 6: 10 feet with 5/8-inch rod.
  - 6. NPS 8: 10 feet with 3/4-inch rod.
- H. Install supports for vertical copper tubing every 10 feet.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.05 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### **3.06 IDENTIFICATION**

1. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

### **3.07 FIELD QUALITY CONTROL**

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

### **3.08 CLEANING**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### **END OF SECTION**



## SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Mechanical Materials and Methods."

#### 1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. FOG: Fats, oils, and greases.
- C. FRP: Fiberglass-reinforced plastic.
- D. HDPE: High-density polyethylene plastic.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PUR: Polyurethane plastic.
- H. PVC: Polyvinyl chloride plastic.

#### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings:
  - 1. Show fabrication and installation details for frost-resistant vent terminals.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

#### 1.04 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

## **PART 2 PRODUCTS**

### **2.01 AIR-ADMITTANCE VALVES**

- A. Fixture Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ayrlett, LLC.
    - b. Durgo, Inc.
    - c. Oatey.
    - d. ProSet Systems Inc.
    - e. RectorSeal.
    - f. Studor, Inc.
  2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
  3. Housing: Plastic.
  4. Operation: Mechanical sealing diaphragm.
  5. Size: Same as connected fixture or branch vent piping.
- B. Stack Air-Admittance Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Durgo, Inc.
    - b. Oatey.
    - c. Studor, Inc.
  2. Standard: ASSE 1050 for vent stacks.
  3. Housing: Plastic.
  4. Operation: Mechanical sealing diaphragm.
  5. Size: Same as connected stack vent or vent stack.
- C. Wall Box:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Durgo, Inc.
    - b. Oatey.
    - c. RectorSeal.
    - d. Studor, Inc.
  2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
  3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

### **2.02 TRAP SEAL PROTECTION DEVICES**

- A. Barrier Type Trap Seal Protection Devices:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
    - b. SureSeal Manufacturing; Inline Floor Drain Trap Sealer.
  2. Standard: ASSE 1072-2007.
  3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
  4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
  5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

### **2.03 THROUGH-PENETRATION FIRESTOP ASSEMBLIES**

- A. Through-Penetration Firestop Assemblies:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ProSet Systems Inc.
  2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
  3. Size: Same as connected soil, waste, or vent stack.

4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.

## **2.04 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES**

- A. Hub Outlets:
  1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
  2. Size: Same as connected waste piping.
- B. Deep-Seal Traps:
  1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
  2. Size: Same as connected waste piping.
    - a. NPS 2: 4-inch- minimum water seal.
    - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.
- C. 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.
- D. Sleeve Flashing Device:
  1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch 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.
- E. 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.
- F. 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.
- G. Frost-Resistant Vent Terminals:
  1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
  2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- H. Expansion Joints:
  1. Standard: ASME A112.21.2M.
  2. Body: Cast iron with bronze sleeve, packing, and gland.
  3. End Connections: Matching connected piping.
  4. Size: Same as connected soil, waste, or vent piping.

## **2.05 FLASHING MATERIALS**

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
  2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
  3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.
- C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- E. Fasteners: Metal compatible with material and substrate being fastened.
- F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- G. Solder: ASTM B 32, lead-free alloy.
- H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## **2.06 CAST-IRON CLEANOUTS**

- A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.
- B. Exposed Cast-Iron Cleanouts:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.; Series 58910.
    - b. MIFAB, Inc.; C1460.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; 4510 Series.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
  3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
  4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.
- C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.; C1220-R.
    - c. Sioux Chief Manufacturing Company, Inc.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4023S-F.
    - e. Tyler Pipe; Wade Div.
    - f. Watts Drainage Products Inc.
    - g. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Standard: ASME A112.36.2M.
  3. Type: Adjustable housing.
  4. Body or Ferrule: Cast iron.
  5. Clamping Device: Not required.
  6. Outlet Connection: Spigot.
  7. Closure: Brass, bronze, or plastic plug with tapered threads.
  8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
  9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
  10. Frame and Cover Shape: Round.
  11. Top Loading Classification: Medium Duty.
  12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- D. Cast-Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. Josam Company; Josam Div.
  - b. MIFAB, Inc.; C-1100-C-R-34.
  - c. Sioux Chief Manufacturing Company, Inc.
  - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.
  - e. Tyler Pipe; Wade Div.
  - f. Watts Drainage Products Inc.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
  3. Type: Adjustable housing.
  4. Body or Ferrule: Cast iron.
  5. Clamping Device: Required.
  6. Outlet Connection: Spigot.
  7. Closure: Brass, bronze, or plastic plug with tapered threads.
  8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
  9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
  10. Frame and Cover Shape: Round.
  11. Top Loading Classification: Medium Duty.
  12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
- E. Cast-Iron Wall Cleanouts (Finished Wall Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.; Model 58790-20.
    - b. MIFAB, Inc.; C1460-RD.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Standard: ASME A112.36.2M. Include wall access.
  3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
  4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
  5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.

## **2.07 FLOOR DRAINS AND FLOOR SINKS**

- A. Cast-Iron Floor Drains (General Purpose) FD-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Sioux Chief Manufacturing Company, Inc.; Finish Line Adjustable Drainage System.
    - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 2005Y-A.
    - e. Tyler Pipe; Wade Div.
    - f. Watts Drainage Products Inc.
    - g. Zurn Plumbing Products Group; Specification Drainage Operation.
  2. Standard: ASME A112.6.3.
  3. Pattern: Floor drain.
  4. Body Material: Gray iron.
  5. Seepage Flange: Required.
  6. Clamping Device: Required.
  7. Outlet: Bottom unless otherwise noted.
  8. Coating on Interior and Exposed Exterior Surfaces: Enamel.
  9. Top or Strainer Material: Nickel bronze.
  10. Top of Body and Strainer Finish: Nickel bronze.
  11. Top Shape: Round, with vandal proof screws.

12. Dimensions of Top or Strainer: 7 inch diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.
15. Trap-Seal Protection Device: Required.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install fixture air-admittance valves on fixture drain piping.
- G. Install stack air-admittance valves at top of stack vent and vent stack piping.
- H. Install air-admittance-valve wall boxes recessed in wall.
- I. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- J. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- K. Assemble open drain fittings and install with top of hub 1 inch above floor.
- L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- N. Install vent caps on each vent pipe passing through roof.
- O. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- Q. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

- R. Install grease interceptors, including trapping, 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 interceptors not having integral cleanout on outlet.
- S. Install wood-blocking reinforcement for wall-mounting-type specialties.
- T. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- U. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### **3.02 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20, 21, 22, and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping.

### **3.03 FLASHING INSTALLATION**

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  - 1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
  - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
  - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

### **3.04 LABELING AND IDENTIFYING**

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Grease interceptors.

**3.05 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**

## SECTION 22 4200 - PLUMBING FIXTURES

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  1. Division 10 Section "Toilet and Bath Accessories."
  2. Division 20 Section "Mechanical General Requirements."
  3. Division 20 Section "Basic Mechanical Materials and Methods."
  4. Division 22 Section "Drinking Fountains and Water Coolers."
  5. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
  6. Division 22 Section "Drainage Piping Specialties" for floor drains, and specialty fixtures not included in this Section.

#### 1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

### 1.03 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.
- D. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

### 1.04 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 an NRTL 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. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
- F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.
- G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

## PART 2 PRODUCTS

### 2.01 COUNTER-MOUNTING SINKS

- A. Sinks, SK-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkay Manufacturing Co.
    - b. Franke Consumer Products, Inc., Commercial Div.
    - c. Just Manufacturing Company.
    - d. Moen Commercial.
  - 2. Description: Single-bowl, counter-mounting, lay-in stainless-steel sink.
    - a. Overall Dimensions: 17 inches left to right by 20 inches front to back.
    - b. Metal Thickness: 18 gage, with sound dampened underside.
    - c. Bowl:
      - 1) Dimensions: 14 inches by 14 inches by 6 inches deep.
      - 2) Drain: 3-1/2-inch grid.
    - d. Sink Faucet: SF-1.
    - e. Water Temperature Limiting Device: Required.
    - f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).

- g. Disposer: Not required.
- h. Dishwasher Air-Gap Fitting: Not required.
- i. Hot-Water Dispenser: Not required.

## 2.02 SINK FAUCETS

### A. Sink Faucets, SF-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Standard Companies, Inc.
  - b. Chicago Faucets; No. 201-G8AE3-317AB.
  - c. Delta Faucet Company; Model 23C632-R7LS.
  - d. Kohler Co.
  - e. Moen Commercial.
  - f. Speakman Company.
  - g. T & S Brass and Bronze Works, Inc.
  - h. Zurn Plumbing Products Group; Z831C4-140.
2. Description: Sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
  - a. Body Material: Commercial, solid brass.
  - b. Finish: Polished chrome plate.
  - c. Mixing Valve: Two handle.
  - d. Centers: 8 inches.
  - e. Mounting: Deck.
  - f. Handle(s): Wrist blade, 4 inches.
  - g. Operation: Noncompression, manual.
  - h. Inlet(s): NPS 1/2.
  - i. Spout Type: 70-degree restricted swing gooseneck.
  - j. Spout Outlet: Aerator.
    - 1) Aerator.
  - k. Maximum Flow Rate:
    - 1) 2.2 gpm.

## 2.03 FIXTURE SUPPLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. BrassCraft; a Masco Company.
  2. McGuire Mfg. Co., Inc.
  3. Any of the approved plumbing fixture manufacturers.
- B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

## 2.04 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers (PSG-1):

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; SG-200BV.
  - f. TRUEBRO, Inc.
  - g. Zurn Plumbing Products Group; Z8946-3-NT.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

## **PART 3 EXECUTION**

### **3.01 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.

### **3.02 INSTALLATION**

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install counter-mounting fixtures in and attached to casework.
- G. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
- H. 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: Fixtures with flushometer valves, and faucets or valves with integral stops.
- I. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section "Domestic Water Piping Specialties."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
- M. 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.
- N. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- O. 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.
- P. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- Q. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
- R. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."



- S. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

### **3.03 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20 and 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. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding."
- E. Connect wiring according to Division 26 Section "Conductors and Cables."

### **3.04 FIELD QUALITY CONTROL**

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### **3.05 ADJUSTING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Adjust flow at laboratory faucets having serrated nozzles to prevent splashing.
- E. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.
- F. Install fresh batteries in sensor-operated mechanisms.

### **3.06 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.

### **3.07 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**

TMP Architecture, Inc.  
Peter Basso Associates, Inc.

TMP13172G & 13174H  
PBA2013.0406.01 & 2013.0408.01

**SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Mechanical Materials and Methods."

**1.02 DEFINITIONS**

- A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.
- B. Cast Polymer: Dense, cast-filled-polymer plastic.
- C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
- D. Fitting: Device that controls flow of water into or out of fixture.
- E. Fixture: Drinking fountain or water cooler.
- F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.
- G. TDS: Total dissolved solids.
- H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

**1.03 SUBMITTALS**

- A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

**1.04 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. 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 fixtures for people with disabilities.

- C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.
- D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.
- E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.
- F. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.
- G. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

## **PART 2 PRODUCTS**

### **2.01 PRESSURE (ELECTRIC) WATER COOLERS**

- A. Water Coolers, EWC-1:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkay Manufacturing Co.; EZH2O System LZSTL8WSLK.
    - b. Halsey Taylor.
    - c. Haws Corporation.
    - d. Murdock Manufacturing; A Member of Morris Group International.
    - e. Oasis Corporation.
    - f. Sunroc Corp.
  - 2. Description: Accessible, AHRI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult/child-mounting height with bottle filling station.
    - a. Cabinet: Bilevel with two attached cabinets baked enamel finish or vinyl-covered steel with stainless-steel top, and single filtered cooler with bottle filling station.
    - b. Bubbler: One, flexible or elastomeric overmolded, with adjustable stream regulator, located on each cabinet deck.
    - c. Control: Push bar.
    - d. Supply: NPS 3/8 with isolation valve.
    - e. Filter: Complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
    - f. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
    - g. 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.
      - 1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
      - 2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.
    - h. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:
      - 1) Electronic sensor for no-touch activation.
      - 2) Automatic 20-second shut-off timer.
      - 3) 1.1 gpm flow rate
      - 4) Anti-microbial protected plastic components.
    - i. Support: Refer to "Fixture Supports" Article.

### **2.02 FIXTURE SUPPORTS**

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

1. Josam Co.
  2. MIFAB Manufacturing, Inc.
  3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
  4. Tyler Pipe; Wade Div.
  5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
1. Type I: Hanger-type carrier with two vertical uprights.
  2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
  3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

### **PART 3 EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.
- B. Examine walls and floors for suitable conditions where fixtures are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### **3.02 APPLICATIONS**

- A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.
- B. Use mounting frames for recessed water coolers, unless otherwise indicated.
- C. Set freestanding and pedestal drinking fountains on floor.
- D. Set remote water coolers on floor, unless otherwise indicated.
- E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

#### **3.03 INSTALLATION**

- A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.
- B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.
- C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."
- E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

#### **3.04 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

**3.05 FIELD QUALITY CONTROL**

- A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
  - 1. Remove and replace malfunctioning units and retest as specified above.
  - 2. Report test results in writing.

**3.06 ADJUSTING**

- A. Adjust fixture flow regulators for proper flow and stream height.
- B. Adjust water cooler temperature settings.

**3.07 CLEANING**

- A. After completing fixture installation, 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.

**END OF SECTION**

**SECTION 23 0130 - HVAC AIR-DISTRIBUTION SYSTEM CLEANING**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 23 Section "Metal Ducts."
  - 3. Division 23 Section "Nonmetal Ducts."
  - 4. Division 23 Section "Duct Accessories."

**1.02 SUMMARY**

- A. Section includes cleaning HVAC air-distribution equipment, ducts, plenums, and system components.

**1.03 DEFINITIONS**

- A. ASCS: Air systems cleaning specialist.
- B. NADCA: National Air Duct Cleaners Association.
- C. VSMR: Ventilation system mold remediator.

**1.04 SUBMITTALS**

- A. Qualification Data: For an ASCS.
- B. Qualification Data: For an VSMR.
- C. Strategies and procedures plan.
- D. Cleanliness verification report.

**1.05 QUALITY ASSURANCE**

- A. ASCS Qualifications: A certified member of NADCA.
  - 1. Certification: Employ an ASCS certified by NADCA on a full-time basis.
  - 2. Supervisor Qualifications: Certified as an ASCS by NADCA.
- B. VSMR Qualifications: A certified member of NADCA.
  - 1. Certification: Employ a VSMR certified by NADCA on a full-time basis.
  - 2. Supervisor Qualifications: Certified as a VSMR by NADCA.
- C. UL Compliance: Comply with UL 181 and UL 181A for fibrous-glass ducts.

**PART 2 PRODUCTS (NOT USED)**

**PART 3 EXECUTION**

**3.01 ACCEPTABLE AGENCIES**

- A. Engage a NADCA member company with qualified ASCS and VSMR to clean HVAC air distribution systems.
  - 1. Acceptable HVAC air distribution system cleaning companies:
    - a. ACCU-Clean Services, LLC.; Hazel Park, MI.
    - b. Dalton Environmental Cleaning Corp.; Whitmore Lake, MI.

- c. DUCTZ; Ann Arbor, MI.
- d. Dusty Ducts, Inc.; Melvindale, MI.
- e. Fresh Air Solutions, Inc.; Carleton, MI.
- f. Safety King, Inc.; Utica, MI.
- g. Sani-Vac Service, Inc.; Warren MI.

### 3.02 EXAMINATION

- A. Examine HVAC air-distribution equipment, ducts, plenums, and system components to determine appropriate methods, tools, and equipment required for performance of the Work.
- B. Perform "Project Evaluation and Recommendation" according to NADCA ACR 2006.
- C. Prepare written report listing conditions detrimental to performance of the Work.
- D. Proceed with work only after unsatisfactory conditions have been corrected.

### 3.03 PREPARATION

- A. Prepare a written plan that includes strategies and step-by-step procedures. At a minimum, include the following:
  - 1. Supervisor contact information.
  - 2. Work schedule including location, times, and impact on occupied areas.
  - 3. Methods and materials planned for each HVAC component type.
  - 4. Required support from other trades.
  - 5. Equipment and material storage requirements.
  - 6. Exhaust equipment setup locations.
- B. Use the existing service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry and for inspection.
- C. Comply with NADCA ACR 2006, "Guidelines for Constructing Service Openings in HVAC Systems" Section.

### 3.04 CLEANING

- A. Comply with NADCA ACR 2006.
- B. Remove visible surface contaminants and deposits from within the HVAC system.
- C. Systems and Components to Be Cleaned:
  - 1. Air devices for supply and return air.
  - 2. Air-terminal units.
  - 3. Ductwork:
    - a. Supply-air ducts, including turning vanes and reheat coils, to the air-handling unit.
    - b. Return-air ducts to the air-handling unit.
    - c. Exhaust-air ducts.
  - 4. Air-Handling Units:
    - a. Interior surfaces of the unit casing.
    - b. Coil surfaces compartment.
    - c. Condensate drain pans.
    - d. Fans, fan blades, and fan housings.
  - 5. Filters and filter housings.
- D. Collect debris removed during cleaning. Ensure that debris is not dispersed outside the HVAC system during the cleaning process.
- E. Particulate Collection:
  - 1. For particulate collection equipment, include adequate filtration to contain debris removed. Locate equipment downwind and away from all air intakes and other points of entry into the building.
  - 2. HEPA filtration with 99.97 percent collection efficiency for particles sized 0.3 micrometer or larger shall be used where the particulate collection equipment is exhausting inside the building,
- F. Control odors and mist vapors during the cleaning and restoration process.
- G. Mark the position of manual volume dampers and air-directional mechanical devices inside the system prior to cleaning. Restore them to their marked position on completion of cleaning.



- H. System components shall be cleaned so that all HVAC system components are visibly clean. On completion, all components must be returned to those settings recorded just prior to cleaning operations.
- I. Clean all air-distribution devices, registers, grilles, and diffusers.
- J. Clean visible surface contamination deposits according to NADCA ACR 2006 and the following:
  - 1. Clean air-handling units, airstream surfaces, components, condensate collectors, and drains.
  - 2. Ensure that a suitable operative drainage system is in place prior to beginning wash-down procedures.
  - 3. Clean evaporator coils, reheat coils, and other airstream components.
- K. Duct Systems:
  - 1. Create service openings in the HVAC system as necessary to accommodate cleaning.
  - 2. Mechanically clean duct systems specified to remove all visible contaminants so that the systems are capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
- L. Debris removed from the HVAC system shall be disposed of according to applicable Federal, state, and local requirements.
- M. Mechanical Cleaning Methodology:
  - 1. Source-Removal Cleaning Methods: The HVAC system shall be cleaned using source-removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and to safely remove these contaminants from the facility. No cleaning method, or combination of methods, shall be used that could potentially damage components of the HVAC system or negatively alter the integrity of the system.
    - a. Use continuously operating vacuum-collection devices to keep each section being cleaned under negative pressure.
    - b. Cleaning methods that require mechanical agitation devices to dislodge debris that is adhered to interior surfaces of HVAC system components shall be equipped to safely remove these devices. Cleaning methods shall not damage the integrity of HVAC system components or damage porous surface materials such as duct and plenum liners.
  - 2. Cleaning Mineral-Fiber Insulation Components:
    - a. Fibrous-glass thermal or acoustical insulation elements present in equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment while the HVAC system is under constant negative pressure and shall not be permitted to get wet according to NADCA ACR 2006.
    - b. Cleaning methods used shall not cause damage to fibrous-glass components and will render the system capable of passing the HVAC System Cleanliness Tests (see NADCA ACR 2006).
    - c. Fibrous materials that become wet shall be discarded and replaced.
- N. Coil Cleaning:
  - 1. Measure static-pressure differential across each coil.
  - 2. See NADCA ACR 2006, "Coil Surface Cleaning" Section. Type 1, or Type 1 and Type 2, cleaning methods shall be used to render the coil visibly clean and capable of passing Coil Cleaning Verification (see applicable NADCA ACR 2006).
  - 3. Coil drain pans shall be subject to NADCA ACR 2006, "Non-Porous Surfaces Cleaning Verification." Ensure that condensate drain pans are operational.
  - 4. Electric-resistance coils shall be de-energized, locked out, and tagged before cleaning.
  - 5. Cleaning methods shall not cause any appreciable damage to, cause displacement of, inhibit heat transfer, or cause erosion of the coil surface or fins, and shall comply with coil manufacturer's written recommendations when available.
  - 6. Rinse thoroughly with clean water to remove any latent residues.
- O. Antimicrobial Agents and Coatings:
  - 1. Apply antimicrobial agents and coatings if active fungal growth is reasonably suspected or where unacceptable levels of fungal contamination have been verified. Apply antimicrobial

- agents and coatings according to manufacturer's written recommendations and EPA registration listing after the removal of surface deposits and debris.
2. When used, antimicrobial treatments and coatings shall be applied after the system is rendered clean.
  3. Apply antimicrobial agents and coatings directly onto surfaces of interior ductwork.
  4. Sanitizing agent products shall be registered by the EPA as specifically intended for use in HVAC systems and ductwork.

### **3.05 CLEANLINESS VERIFICATION**

- A. Verify cleanliness according to NADCA ACR 2006, "Verification of HVAC System Cleanliness" Section.
- B. Verify HVAC system cleanliness after mechanical cleaning and before applying any treatment or introducing any treatment-related substance to the HVAC system, including biocidal agents and coatings.
- C. Perform visual inspection for cleanliness. If no contaminants are evident through visual inspection, the HVAC system shall be considered clean. If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.
- D. Additional Verification:
  1. Perform surface comparison testing or NADCA vacuum test.
  2. Conduct NADCA vacuum gravimetric test analysis for nonporous surfaces.
- E. Verification of Coil Cleaning:
  1. Measure static-pressure differential across each coil.
  2. Coil will be considered clean if cleaning restored the coil static-pressure differential within 10 percent of, the differential measured when the coil was first installed.
  3. Coil will be considered clean if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection.
- F. Prepare a written cleanliness verification report. At a minimum, include the following:
  1. Written documentation of the success of the cleaning.
  2. Site inspection reports, initialed by supervisor, including notation on areas of inspection, as verified through visual inspection.
  3. Surface comparison test results if required.
  4. Gravimetric analysis (nonporous surfaces only).
  5. System areas found to be damaged.
- G. Photographic Documentation: Comply with requirements in Division 01 Section "Photographic Documentation."

### **3.06 RESTORATION**

- A. Restore and repair HVAC air-distribution equipment, ducts, plenums, and components according to NADCA ACR 2006, "Restoration and Repair of Mechanical Systems" Section.
- B. Restore service openings capable of future reopening. Comply with requirements in Division 23 Section "Metal Ducts." Include location of service openings in Project closeout report.
- C. Replace fibrous-glass materials that cannot be restored by cleaning or resurfacing. Comply with requirements in Division 23 Sections "Metal Ducts" and "Nonmetal Ducts."
- D. Replace damaged insulation according to "Division 23 Section "HVAC Insulation."
- E. Ensure that closures do not hinder or alter airflow.
- F. New closure materials, including insulation, shall match opened materials and shall have removable closure panels fitted with gaskets and fasteners.
- G. Reseal fibrous-glass ducts. Comply with requirements in Division 23 Section "Nonmetal Ducts."

### **END OF SECTION**

**SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Mechanical Materials and Methods."
  - 3. Division 23 Section "Common Work Results for HVAC."

**1.02 SUMMARY**

- A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:
  - 1. Air Systems:
    - a. Constant-volume air systems.
    - b. Dual-duct systems.
    - c. Variable-air-volume systems.
    - d. Multizone systems.
    - e. Induction-unit systems.
  - 2. Hydronic Piping Systems:
    - a. Constant-flow systems.
    - b. Variable-flow systems.
    - c. Primary-secondary systems.
  - 3. HVAC equipment quantitative-performance settings.
  - 4. Laboratory fume hood airflow balancing.
  - 5. Exhaust hood airflow balancing.

6. Existing systems TAB.
  7. Verifying that automatic control devices are functioning properly.
  8. Reporting results of activities and procedures specified in this Section.
- B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

### **1.03 DEFINITIONS**

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. AHJ: Authority having jurisdiction.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.
- G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- H. RC: Room criteria.
- I. Report Forms: Test data sheets for recording test data in logical order.
- J. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.
- K. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.
- L. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.
- M. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- N. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- O. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- P. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- Q. TAB: Testing, adjusting, and balancing.
- R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- S. Test: A procedure to determine quantitative performance of systems or equipment.
- T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

### **1.04 SUBMITTALS**

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of the Contract Documents review report as specified in Part 3.

- C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 4 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

#### **1.05 QUALITY ASSURANCE**

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- B. Smoke Control System Testing: Additional Qualifications: The TAB firm shall be a qualified special inspector for the smoke control systems. The TAB firm for the smoke control system shall have expertise in fire protection engineering, mechanical engineering, and certification as air balancers.
- C. Approved Balancing Agencies.
  - 1. The TAB firm selected shall be from the following list:
    - a. Absolut Balance Company, Inc.; South Lyon, MI.
    - b. Airflow Testing Inc.; Lincoln Park, MI.
    - c. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
    - d. Ener-Tech Testing; Holly, MI.
    - e. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
    - f. International Test & Balance Inc.; Southfield, MI.
- D. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
  - 1. Agenda Items: Include at least the following:
    - a. Submittal distribution requirements.
    - b. The Contract Documents examination report.
    - c. TAB plan.
    - d. Work schedule and Project-site access requirements.
    - e. Coordination and cooperation of trades and subcontractors.
    - f. Coordination of documentation and communication flow.
- E. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
  - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
  - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- F. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." TAB firm's forms approved by Architect.
- G. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
  - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

#### **1.06 PROJECT CONDITIONS**

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

### 1.07 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

### 1.08 WARRANTY

- A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
  - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
  - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
  - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

## PART 2 PRODUCTS (NOT APPLICABLE)

## PART 3 EXECUTION

### 3.01 EXAMINATION

- A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- B. Examine system and equipment test reports.
- C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine equipment for installation and for properly operating safety interlocks and controls.
- L. Examine automatic temperature system components to verify the following:
  - 1. Dampers, valves, and other controlled devices are operated by the intended controller.
  - 2. Dampers and valves are in the position indicated by the controller.
  - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
  - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.

5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
  6. Sensors are located to sense only the intended conditions.
  7. Sequence of operation for control modes is according to the Contract Documents.
  8. Controller set points are set at indicated values.
  9. Interlocked systems are operating.
  10. Changeover from heating to cooling mode occurs according to indicated values.
- M. 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.

### **3.02 PREPARATION**

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Perform the following field tests and inspections to new and renovated portions of duct systems according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
  1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  2. Maximum Allowable Leakage: Leakage rates are scheduled on the Drawings.
- C. Complete system readiness checks and prepare system readiness reports. Verify the following:
  1. Permanent electrical power wiring is complete.
  2. Hydronic systems are filled, clean, and free of air.
  3. Automatic temperature-control systems are operational.
  4. Equipment and duct access doors are securely closed.
  5. Balance, smoke, and fire dampers are open.
  6. Isolating and balancing valves are open and control valves are operational.
  7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  8. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.03 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 Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- C. Take and report testing and balancing measurements in inch-pound (IP) units.

### **3.04 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.
- 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. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

- F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.
- G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- H. Verify that motor starters are equipped with properly sized thermal protection.
- I. Check dampers for proper position to achieve desired airflow path.
- J. Check for airflow blockages.
- K. Check condensate drains for proper connections and functioning.
- L. Check for proper sealing of air-handling unit components.
- M. Check for proper sealing of air duct system.

### **3.05 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 fan static pressures to determine actual static pressure as follows:
    - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
  - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
  - 4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
  - 5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 23 Section "Common Work Results for HVAC" for additional requirements.
  - 6. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.
    - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
  - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.



1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.06 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
  2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  3. Measure total system airflow. Adjust to within indicated airflow.
  4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
  5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
  7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
  8. Record the final fan performance data.

### **3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check expansion tank liquid level.
  3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation and set at indicated flow.
  5. Set system controls so automatic valves are wide open to heat exchangers.
  6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

### **3.08 PROCEDURES FOR HYDRONIC SYSTEMS**

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
  1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
  1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.
- G. Chilled beams do not require individual hydronic balancing. Verify proper flow is achieved through balancing or control device serving chilled beam control zone. Report discrepancies.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

### **3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS**

- A. Balance variable-flow hydronic systems by following the "Proportional Balancing Procedure" in accordance with NEBB.
- B. 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.

### **3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS**

- A. Balance the primary system crossover flow first, then balance the secondary system.

### **3.11 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer, model, and serial numbers.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Power factor.
  6. Nameplate and measured voltage, each phase.
  7. Nameplate and measured amperage, each phase.
  8. Starter size.

9. Starter thermal-protection-element rating.
  10. Fuse number and size.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

### **3.12 PROCEDURES FOR HEAT-TRANSFER COILS**

- A. Water Coils: Measure the following data for each coil:
1. Entering- and leaving-water temperature.
  2. Water flow rate.
  3. Water pressure drop.
  4. Dry-bulb temperature of entering and leaving air.
  5. Wet-bulb temperature of entering and leaving air for cooling coils.
  6. Airflow.
  7. Air pressure drop.
- B. Electric-Heating Coils: Measure the following data for each coil:
1. Nameplate data.
  2. Airflow.
  3. Entering- and leaving-air temperature at full load.
  4. Voltage and amperage input of each phase at full load and at each incremental stage.
  5. Calculated kilowatt at full load.
  6. Fuse or circuit-breaker rating for overload protection.
- C. Refrigerant Coils: Measure the following data for each coil:
1. Dry-bulb temperature of entering and leaving air.
  2. Wet-bulb temperature of entering and leaving air.
  3. Airflow.
  4. Air pressure drop.
  5. Refrigerant suction pressure and temperature.

### **3.13 PROCEDURES FOR TEMPERATURE MEASUREMENTS**

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

### **3.14 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS**

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
1. Measure and record the operating speed, airflow, and static pressure of each fan.
  2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  3. Check the condition of filters.
  4. Check the condition of coils.
  5. Check the operation of the drain pan and condensate drain trap.
  6. Check bearings and other lubricated parts for proper lubrication.
  7. 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.
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, filter, and coil face velocity.
  - 2. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
  - 3. Air balance each air outlet.

### **3.15 TOLERANCES**

- A. Set HVAC system airflow and water flow rates within the following tolerances:
  - 1. Air handling equipment and outlets: Plus or minus 5 percent.
    - a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
  - 2. Heating-Water Flow Rate: 0 to minus 10 percent.
  - 3. Cooling-Water Flow Rate: 0 to plus 5 percent.

### **3.16 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: As Work progresses, prepare 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.

### **3.17 FINAL REPORT**

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
  - 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. 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, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
  - 1. Title page.
  - 2. Name and address of TAB firm.
  - 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 firm 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. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:
  - a. Settings for outside-, 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.
- E. 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 outside, supply, return, and exhaust airflows.
  2. Water flow rates.
  3. Terminal units.
  4. Balancing stations.
- F. Air-Handling Unit - Test Reports: For air-handling units with coils, include the following:
  1. Unit Data: Include the following:
    - 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - j. Number of belts, make, and size.
    - k. Number of filters, type, and size.
  2. Motor Data:
    - a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
    - g. Power factor efficiency.
  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. Outside airflow in cfm.
    - j. Return airflow in cfm.
    - k. Outside-air damper position.
    - l. Return-air damper position.
    - m. Vortex damper position.

- G. 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. Outside-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.
- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
  - 1. Unit Data:
    - a. System identification.
    - b. Location.
    - c. Coil identification.
    - d. Capacity in Btuh.
    - e. Number of stages.
    - f. Connected volts, phase, and hertz.
    - g. Rated amperage.
    - h. Airflow rate in cfm.
    - i. Face area in sq. ft..
    - j. Minimum face velocity in fpm.
  - 2. Test Data (Indicated and Actual Values):
    - a. Heat output in Btuh.
    - b. Airflow rate in cfm.
    - c. Air velocity in fpm.
    - d. Entering-air temperature in deg F.
    - e. Leaving-air temperature in deg F.
    - f. Voltage at each connection.
    - g. Amperage for each phase.
- I. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
  - a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
  - g. Number of belts, make, and size.
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.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  1. Report Data:
    - a. System and air-handling unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - 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.
- K. Air-Terminal-Device Reports:
  1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Test apparatus used.
    - d. Area served.
    - e. Air-terminal-device make.
    - f. Air-terminal-device number from system diagram.
    - g. Air-terminal-device type and model number.
    - h. Air-terminal-device size.
    - i. Air-terminal-device 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.
- L. 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.
- M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Unit make and model number.
    - d. Compressor make.
    - e. Compressor model and serial numbers.
  2. Test Data (Indicated and Actual Values):
    - a. Inlet-duct static pressure in inches wg.
    - b. Outlet-duct static pressure in inches wg.
    - c. Entering-air, dry-bulb temperature in deg F.
    - d. Leaving-air, dry-bulb temperature in deg F.
    - e. Condenser entering-water temperature in deg F.
    - f. Condenser leaving-water temperature in deg F.
    - g. Condenser-water temperature differential in deg F.
    - h. Condenser entering-water pressure in feet of head or psig.
    - i. Condenser leaving-water pressure in feet of head or psig.
    - j. Condenser-water pressure differential in feet of head or psig.
    - k. Control settings.
    - l. Voltage at each connection.
    - m. Amperage for each phase.
    - n. Kilowatt input.
    - o. Crankcase heater kilowatt.
    - p. Number of fans.
    - q. Condenser fan rpm.
    - r. Condenser fan airflow rate in cfm.
    - s. Condenser fan motor make, frame size, rpm, and horsepower.
    - t. Condenser fan motor voltage at each connection.
    - u. Condenser fan motor amperage for each phase.
- N. 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 and serial numbers.
    - f. Water flow rate in gpm.
    - g. Water pressure differential in feet of head or psig.
    - h. Required net positive suction head in feet of head or psig.
    - i. Pump rpm.
    - j. Impeller diameter in inches.
    - k. Motor make and frame size.
    - l. Motor horsepower and rpm.
    - m. Voltage at each connection.
    - n. Amperage for each phase.
    - o. Full-load amperage and service factor.



- p. Seal type.
- 2. Test Data (Indicated and Actual Values):
  - a. Static head in feet of head or psig.
  - b. Pump shutoff pressure in feet of head or psig.
  - c. Actual impeller size in inches.
  - d. Full-open flow rate in gpm.
  - e. Full-open pressure in feet of head or psig.
  - f. Final discharge pressure in feet of head or psig.
  - g. Final suction pressure in feet of head or psig.
  - h. Final total pressure in feet of head or psig.
  - i. Final water flow rate in gpm.
  - j. Voltage at each connection.
  - k. Amperage for each phase.
- O. Vibration Measurement Reports:
  - 1. Date and time of test.
  - 2. Vibration meter manufacturer, model number, and serial number.
  - 3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
  - 4. Diagram of equipment showing the vibration measurement locations.
  - 5. Measurement readings for each measurement location.
  - 6. Calculate isolator efficiency using measurements taken.
  - 7. Description of predominant vibration source.
- P. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:
  - 1. Date and time of test. Record each tested location on its own NC curve.
  - 2. Sound meter manufacturer, model number, and serial number.
  - 3. Space location within the building including floor level and room number.
  - 4. Diagram or color photograph of the space showing the measurement location.
  - 5. Time weighting of measurements, either fast or slow.
  - 6. Description of the measured sound: steady, transient, or tonal.
  - 7. Description of predominant sound source.
- Q. Indoor-Air Quality Measurement Reports for Each HVAC System:
  - 1. HVAC system designation.
  - 2. Date and time of test.
  - 3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
  - 4. Room number or similar description for each location.
  - 5. Measurements at each location.
  - 6. Observed deficiencies.
- R. Instrument Calibration Reports:
  - 1. Report Data:
    - a. Instrument type and make.
    - b. Serial number.
    - c. Application.
    - d. Dates of use.
    - e. Dates of calibration.

### 3.18 INSPECTIONS

- A. Initial Inspection:
  - 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
  - 2. Randomly check the following for each system:
    - a. Measure airflow of at least 10 percent of air outlets.
    - b. Measure water flow of at least 5 percent of terminals.

- c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Measure sound levels at two locations.
  - e. Measure space pressure of at least 10 percent of locations.
  - f. Verify that balancing devices are marked with final balance position.
  - g. Note deviations to the Contract Documents in the Final Report.
- B. Final Inspection:
1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.
  2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
  3. Architect shall randomly select measurements documented in the final report to be rechecked. The 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.
  4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  5. 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.
  6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
  7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

### **3.19 ADDITIONAL TESTS**

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

### **END OF SECTION**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 20 Section "Basic Mechanical Materials and Methods."
  - 3. Division 23 "Testing, Adjusting, and Balancing."

**1.02 SUMMARY**

- A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

**1.03 DEFINITIONS**

- A. BAS: Building Automation System
- B. CAD: Computer Aided Design.
- C. DDC: Direct-digital controls.
- D. TC: Temperature Control.

**1.04 SYSTEM DESCRIPTION**

- A. DDC Temperature Control System consisting of direct digital control system panels, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring

and raceway systems. The new temperature controls shall interface with the existing Andover Building Automation System.

- B. BAS/DDC system programming, database and graphic display generation at the existing operator workstation.
- C. Vertical Unit Ventilator DDC Controllers where shown and scheduled on the plans.
- D. Electric and electronic control accessories and other control system devices.

#### **1.05 SEQUENCE OF OPERATION**

- A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

#### **1.06 SUBMITTALS**

- A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.
- B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valve and automated dampers shall be incorporated with the complete temperature controls submittal.
- C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
  - 1. Each control device labeled with setting or adjustable range of control
- D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
- E. Shop Drawings:
  - 1. Shop drawings shall be done on CAD. Minimum size 11" x 17".
  - 2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
  - 3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
  - 4. Details of control panel faces and interior, including controls, instruments, and termination blocks and labeling.
  - 5. Written sequence of operation for each controlled system.
  - 6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
  - 7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
  - 8. Complete bill of materials to identify and quantify all control components
  - 9. Overall system schematic showing communication trunk cabling to DDC panels, peripheral devices, modems including component locations and wire termination details.
  - 10. DDC panel layouts showing connected data points and LAN connections. DDC panel terminations including power supply and remote-control component termination details shall be provided.
  - 11. Point list for each DDC panel including point descriptions and addresses. This information may be incorporated with DDC panel layouts.
- F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:
  - 1. None.
- G. Samples: Temperature sensor cover for each color required and guards if required.
- H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.
- I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
- J. Project Record Documents: Include the following:
  - 1. Revise Shop Drawings to reflect actual installation and operating sequences.
  - 2. Record actual locations of control components, including control units and sensors.
  - 3. Submit the electronic files for all as-built shop drawings on diskette in pdf format.
- K. Software and Firmware Operational Documentation: Include the following:

1. DDC panel keypad operating instructions and DDC panel control override features where applicable.
2. Device address list.
3. Program Software Backup: On a magnetic media or compact disc, complete with data files.
- L. Maintenance Manuals: Include the following:
  1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
  2. Keypad illustrations and step-by-step procedures indexed for each operator function where applicable.
  3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
  4. Calibration records and list of set points.

#### **1.07 REFERENCES**

- A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- B. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
- D. NEMA DC 3 - Low-Voltage Room Thermostats.
- E. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
- F. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.

#### **1.08 QUALITY ASSURANCE**

- A. Installer Qualifications: An experienced installer who is an approved installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
- B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

#### **1.09 DELIVERY, STORAGE, AND HANDLING**

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

#### **1.10 COORDINATION**

- A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
- B. Coordinate location of space temperature sensors and other exposed control sensors with plans and room details before installation.
- C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
- D. Ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
- F. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.
- G. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.
- H. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

### **1.11 WARRANTY**

- A. Provide warranty per Division 20 Section "General Mechanical Requirements" and as supplemented in this section.
- B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.
- C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight-hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.
- D. Provide any software or firmware revisions for controllers provided with project which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

### **1.12 POSTED OPERATING INSTRUCTIONS**

- A. Provide panel related as-built documents in protective binder or clear plastic display envelope for each control panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

### **1.13 SPECIAL TOOLS**

- A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, not including PC Laptop.

### **1.14 PROTECTION OF PROPRIETARY INFORMATION**

- A. All proprietary manuals and software non-disclosure agreement, where applicable, shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

## **PART 2 PRODUCTS**

### **2.01 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)**

- A. The district-wide Andover building automation system (BAS) shall be a fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems.
- B. Microprocessor based DDC panels shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between existing and new DDC panels and each building's existing Network Controller (Andover Controls). Each building's existing Network Controller is connected to the owner's Ethernet and communicates with the owner's existing central BAS server.
- C. Provide revisions to existing graphics to include new work. Refer to Section 3.
- D. Approved Manufacturer – System / Installer (Location):
  - 1. Andover Controls Corp. / Mechanical Controls & Maintenance, Inc. aka MCMI (Sterling Heights, MI).

### **2.02 DDC DATA COMMUNICATIONS NETWORK**

- A. Re-use existing data communication network shall be provided to allow data transmission between all DDC panels and between the DDC panels and the DDC Network Controller.

### **2.03 DDC NETWORK CONTROLLER (EXPAND EXISTING AS REQUIRED)**

- A. Field-verify the existing DDC Network Controller capability for each building, as required to accommodate integration to new HVAC equipment per project scope.
- B. If network controller is near memory capacity, provide a new DDC Network Controller to accommodate integration to new HVAC equipment per project scope.

### **2.04 DIRECT DIGITAL CONTROL (DDC) PANELS**

- A. Control Panels: Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface

equipment and power surge protection. DDC panels shall be connected directly to sensors, controlled devices and the communication network.

- B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48-hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.
- C. Provide fully functional communication interface ports for communication between processor, other processors, existing Building Network Controller, portable operator unit and portable programmer terminal.
- D. Panel enclosure shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

## **2.05 DDC PANEL SOFTWARE**

- A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC panel to DDC panel as well as DDC panel to existing Building Network Controller communications, scan inputs and outputs, and contain built-in diagnostics.
- B. Input/output point processing shall include the following:
  - 1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
  - 2. Assignment of proper engineering units and status condition identifiers to all points.
  - 3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.
- C. Command control software shall manage the receipt of commands from the existing Building Network Controller, portable programmer's terminal, and from control programs.
  - 1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the DDC network, not just within the DDC panel. Delays shall be assignable on an individual per point basis.
  - 2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
  - 3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
  - 4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.
- D. Provide self-test procedure. Notify existing Building Network Controller for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.
- E. Provide Alarm Processing:
  - 1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
  - 2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying

values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.

3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.
5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization

1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC panel resident run time limits assignable through the portable programmer's terminal, portable operator's unit or the existing Building Network Controller.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. Custom DDC Programs

1. All DDC programs shall be fully custom programmable. DDC panels or systems which require remote or factory programming are not acceptable. DDC panels or systems with programs which may not be custom modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. Custom DDC programs shall be provided to meet the control strategies as called for in the sequences of operation on the drawings.
3. All DDC setpoints, gains, parameters, time constants, etc., associated with DDC programs shall be available to the operator for display and modification via the existing Building Network Controller and/or portable operator's unit.
4. The execution interval of each DDC control loop shall be adjustable from two to 30 seconds.
5. Each DDC panel shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
  - a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
  - b. Logic: OR, AND, compare, negate.
  - c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
  - d. Data Manipulation: Store, file and set.
  - e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.



## 2.06 DDC INPUT/OUTPUT SENSORS

- A. Current Switches:
1. Split-core donut transformer type for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
  2. Current switches with digital output shall have adjustable trip settings. Field adjust all current switches to trip at approximately 90% of normal motor operating amperage.
  3. Manufacturers:
    - a. NK Technologies.
    - b. Senva.
    - c. Setra.
    - d. Veris Industries.
- B. Temperature Sensors:
1. Resistance temperature detectors (RTD) with platinum, nickel or balco element. Accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
  2. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20° F - 120° F.
  3. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20° F - 120° F.
  4. Liquid immersion sensors shall have welded stainless steel thermowell for ferrous pipe, and brass wells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have a calibrated span of 20° F - 120° F. Sensors for heating hot water and domestic hot water application shall have a calibrated span of 100° F - 240° F.
  5. Room sensors shall have locking cover and a minimum span of 40° F - 90° F. Sensors shall be mounted on extra-large, stainless steel, back-plate for coverage to eliminate patch/paint issues. Room sensor shall be flat-plate type. Provide insulating base on exterior walls.
  6. Outside air sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun.
  7. Manufacturers:
    - a. Specified BAS product where available.
    - b. TCS.
    - c. Minco.
    - d. ACI.
    - e. MAMAC.

## 2.07 CONTROL PANELS

- A. Unitized cabinet type for each system under automatic control with DDC Controller and/or relays, devices, and related controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
- B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.
- C. Panels shall be sized for a maximum fill of 50% capacity and shall not be smaller than 24" X 24".

## 2.08 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

- A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.
- B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.
- C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated

cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

- D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.
- E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.
- F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.
- G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION - CONTROL SYSTEMS**

- A. Install in accordance with manufacturer's instructions.
- B. Check and verify location of temperature sensors and other exposed control sensors with plans and room details before installation. Locate room temperature sensors 48 inches above floor unless noted otherwise.
- C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.
- D. Mount control panels adjacent to associated equipment on vibration free walls or free-standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC panel as the associated output signal.
- E. Provide conduit and electrical wiring where required.
- F. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.
- G. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.
- H. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.
- I. Coil and conceal excess capillary on remote element instruments.
- J. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.
- K. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.
- L. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.
- M. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

#### **3.02 TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS**

- A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request for Information (RFI) process.
- B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop

drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.

- C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include
1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
  2. Graphics generation requirements including special Owner requirements and schedule for completion.
  3. Owner training agenda and scheduling.
  4. TC/BAS system acceptance procedures.

### **3.03 IDENTIFICATION AND MARKING**

- A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.
- B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.
- C. Identify each wire as to ID number at each control panel, field device, and splice.
- D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached identifying it as control panel number, system served, area served, fed from receptacle panel number, circuit number, etc.
- E. Temperature control conduit and junction box covers shall be painted Andover INFINET "orange" to signify that it is used for temperature controls. All junction box covers shall be painted orange and the conduit shall be painted with an orange mark (approximately 6 inches long) every 36" to 48", and on both sides of all penetrations.

### **3.04 GRAPHIC DISPLAY GENERATION**

- A. Provide the following graphic displays as a minimum for operator interface to the networked systems, arranged in logical penetration paths. Modify, copy, or expand the existing graphics associated with building as required to allow operator interface to newly installed equipment. Remove graphics associated with equipment that may have been eliminated with project scope of work:
1. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
  2. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
    - a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
    - b. System name.
    - c. Area served.
    - d. Present value or status of all inputs, along with present setpoint.
    - e. Present percent open for each damper, valve, etc. based on commanded position.
    - f. Reset schedule parameters for all points, where applicable.
    - g. Present occupancy mode.
    - h. Present economizer mode, where applicable.
    - i. Present outside air temperature.
    - j. Associated space conditions and setpoints, where applicable.
    - k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).

- I. Color coding to indicate normal and abnormal values, alarms, etc.
3. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.
4. Sequence of operation in written (text) format for each HVAC system.
5. Overall BAS system schematic.
6. System management graphic for each network device and/or DDC panel.

### **3.05 OWNER INSTRUCTION AND TRAINING**

- A. Provide a minimum of four (4) hours of on-site instruction and training to the Owner on the operation of the control systems for the initial installation. Instruction and training hours shall not include travel time to and from the site.
- B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.
- C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.
- D. Provide 5 sets of computer training & tutorial material on USB Flash Drives describing operator's BAS graphical interface capabilities and functions.
- E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

### **3.06 CALIBRATION AND START-UP**

- A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.
- B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

### **3.07 ACCEPTANCE PROCEDURE**

- A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.
- B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.
- C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.
- D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

### **END OF SECTION**

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  1. Division 20 Section "Mechanical General Requirements."
  2. Division 23 Section "Nonmetal Ducts" for fabric ducts, fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
  3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
  4. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

#### 1.02 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems in pressure classes from minus 6- to plus 6-inch wg.
- B. Products Installed but Not Furnished Under This Section:
  1. Terminal boxes which are to be furnished by the Laboratory Airflow Controls Contractor shall be installed by the Mechanical Contractor. Refer to Division 23 Section "Laboratory Airflow Controls."

#### 1.03 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.
- E. FRP: Fiberglass-reinforced plastic.
- F. PVC: Polyvinyl Chloride.

#### **1.04 SYSTEM DESCRIPTION**

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

#### **1.05 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 Application Schedule" Article.

#### **1.06 SUBMITTALS**

- A. Shop Drawings: Drawn to 1/4 inch equals 1 foot scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Duct layout indicating sizes and pressure classes.
  - 3. Elevations of top and bottom of ducts.
  - 4. Dimensions of main duct runs from building grid lines.
  - 5. Fittings.
  - 6. Reinforcement and spacing.
  - 7. Seam and joint construction.
  - 8. Penetrations through fire-rated and other partitions.
  - 9. Equipment installation based on equipment being used on Project.
  - 10. Duct accessories, including access doors and panels.
  - 11. Hangers and supports, including methods for duct and building attachment, vibration isolation.
- B. Delegated-Design Submittal:
  - 1. Sheet metal thicknesses.
  - 2. Joint and seam construction and sealing.
  - 3. Reinforcement details and spacing.
  - 4. Materials, fabrication, assembly, and spacing of hangers and supports.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Other systems installed in same space as ducts.
  - 3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
  - 4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Welding certificates.
- E. Field quality-control test reports.

### **1.07 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.
- B. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.

### **1.08 COORDINATION**

- A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.
- B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in part. Refer to Division 23 Section "Testing, Adjusting and Balancing."
  - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- C. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### **2.02 SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on exterior sheet metal surfaces of ducts and fittings exposed to corrosive conditions and minimum 1 mil thick on interior surfaces.
- D. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 4 mils thick on opposite surfaces.
- E. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 coating designation. Factory-applied PVC coatings shall be 4 mils thick on interior sheet metal surfaces of ducts and fittings exposed to corrosive conditions and minimum 1 mil thick on exterior surfaces.

- F. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- G. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.
- H. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- I. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- J. Tie Rods: For rectangular ducts having a side dimension of 48 inches or greater. Galvanized steel, 3/8-inch minimum diameter.

**2.03 DUCT LINER**

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
  - 1. Manufacturers:
    - a. CertainTeed Corp.; Insulation Group.
    - b. Johns Manville International, Inc.
    - c. Knauf Fiber Glass GmbH.
  - 2. Materials: ASTM C 1071, Type I, flexible; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
    - a. Thickness: [1 inch] [1-1/2 inches] [2 inches].
    - b. Density: 1-1/2 pounds per cubic foot.
    - c. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
    - d. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
    - e. Maximum Operating Temperature: 250 deg F when tested according to ASTM C 411.
    - f. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - g. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
      - 1) Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
      - 2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
      - 3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
  - 3. Noise reduction coefficient (NRC): Sound absorption coefficients shall not be less than those in the table below as tested by ASTM C423 using an ASTM E795 Type A mounting.

		Sound absorption coefficients at octave band center frequencies, Hz						
Thickness Inches (mm)		125	250	500	1000	2000	4000	NRC
1	(25)	.08	.31	.59	.84	.91	.90	.70
1-1/2	(38)	.10	.47	.83	.93	.97	.96	.80
2	(51)	.24	.64	.96	1.03	1.00	.99	.90

**2.04 SEALANTS 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. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
  - 1. Manufacturers:
    - a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.



- C. Water-Based Joint and Seam Sealant:
1. Manufacturers:
    - a. Hardcast; Flex-Grip 550 and Versa-Grip 181.
    - b. Polymer Adhesives; No. 11.
    - c. United McGill.
  2. Application Method: Brush on.
  3. Solids Content: Minimum 65 percent.
  4. Shore A Hardness: Minimum 20.
  5. Water resistant.
  6. Mold and mildew resistant.
  7. VOC: Maximum 75 g/L (less water).
  8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  9. Service: Indoor or outdoor.
  10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
1. Manufacturers:
    - a. Hardcast; Sure-Grip 404.
    - b. United McGill.
  2. Application Method: Brush on.
  3. Base: Synthetic rubber resin.
  4. Solvent: Toluene and heptane.
  5. Solids Content: Minimum 60 percent.
  6. Shore A Hardness: Minimum 60.
  7. Water resistant.
  8. Mold and mildew resistant.
  9. VOC: Maximum 395 g/L.
  10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  11. Service: Indoor or outdoor.
  12. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
- F. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## **2.05 HANGERS AND SUPPORTS**

- A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
1. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
  2. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  3. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

4. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials. Attachments for stainless steel and PVC-coated duct shall be stainless steel.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
  1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
- E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
  1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.
    - a. Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
    - b. Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
  2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.
  3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.
  4. Manufacturers:
    - a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
    - b. Duro Dyne Corp.; Dyna-Tite System.
    - c. Gripple Inc.; Hang-Fast System.
- F. Stainless Steel Load Rated Cable Suspension System for Corrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.
  1. Cable: Aircraft quality stainless steel 7 x 7 and 7 x 19 wire rope.
    - a. Stainless steel complying with ASTM A 492.
  2. Fastener: One-piece, stainless steel housing with Type 302 S26 stainless steel hardened and tempered springs, and ceramic locking wedges.
  3. End Fixings:
    - a. Loop End: Type 316L/A4 stainless steel.
    - b. Stud or Toggle End: Type 304L/A2 stainless steel.
    - c. Plain end suitable for stainless steel wire rope beam clamp.
  4. Manufacturers:
    - a. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
    - b. Duro Dyne Corp.; Dyna-Tite System.
    - c. Gripple Inc.; Hang-Fast System.
- G. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.

## **2.06 ROOF MOUNTED DUCT SUPPORTS**

- A. General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted duct.
- B. Support: Assembly of bases, and vertical and horizontal members, for roof installation without membrane penetration.
  1. Manufacturer:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. ERICO/Michigan Hanger Co.
    - c. MIRO Industries.
    - d. Portable Pipe Hangers.
  2. Bases: Two or more plastic, stainless steel, or recycled rubber.
  3. Vertical Members: Two or more protective-coated-steel channels.
  4. Horizontal Member: Protective-coated-steel channel.

## 2.07 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
  - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  - 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
  - 3. Internal Tie Rod: Ducts having a side dimension of 48 inches or greater only.
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
  - 1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Nexus Inc.
    - c. Ward Industries, Inc.
- C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

## 2.08 APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- B. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- E. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.
- F. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm or greater.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
  - 1. Fan discharges.
  - 2. Intervals of lined duct preceding unlined duct.
  - 3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.
- H. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
  - 1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- I. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.09 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round and Flat-Oval, Spiral Lock-Seam Ducts:
  - 1. Manufacturers:

- a. Eastern Sheet Metal (ESM).
  - b. LaPine Metal Products.
  - c. Lindab Inc.
  - d. McGill AirFlow Corporation.
  - e. SEMCO Incorporated.
  - f. SET Duct Manufacturing, Inc.
  - g. Tangent Air, Inc.
  - h. Universal Spiral Air.
- C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- D. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.
1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.
- E. Duct Joints:
1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
  4. Bolts and fasteners for galvanized steel duct shall be carbon steel, zinc coated per ASTM A153. Bolts and fasteners for stainless steel and polyvinyl chloride coated steel duct shall be stainless steel.
  5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
    - a. Manufacturers:
      - 1) AccuDuct Mfg. Inc.
      - 2) Ductmate Industries, Inc.
      - 3) Eastern Sheet Metal (ESM).
      - 4) Lindab Inc.
      - 5) Universal Spiral Air.
  6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
    - a. Manufacturers:
      - 1) AccuDuct Mfg. Inc.
      - 2) Ductmate Industries, Inc.
      - 3) Eastern Sheet Metal (ESM).
      - 4) McGill AirFlow Corporation.
      - 5) SEMCO Incorporated.
      - 6) Universal Spiral Air.
- F. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
  2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- G. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)

1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.
2. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.
3. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- H. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- I. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- J. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
    - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
  5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
  9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
  10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
  12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

## 2.10 DOUBLE-WALL DUCT AND FITTING FABRICATION

- A. Manufacturers:
1. Eastern Sheet Metal (ESM).
  2. LaPine Metal Products.
  3. Lindab Inc.
  4. McGill AirFlow Corporation.
  5. SEMCO Incorporated.
  6. SET Duct Manufacturing, Inc.
  7. Tangent Air Inc.
  8. Universal Spiral Air.
- B. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.
1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.
  2. Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
    - a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
  3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
    - a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
    - b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
    - c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
    - d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.
  4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.
    - a. Provide 1 mil mylar liner between acoustical insulation and perforated inner liner.
  5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.
- C. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Inner Ducts: Use the following sheet metal thicknesses:
    - a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
    - b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
    - c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
  2. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.

## PART 3 EXECUTION

### 3.01 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

### 3.02 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

### 3.03 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories."
- O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.
- P. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."
  - 1. Intermediate level.

### **3.04 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.

### **3.05 DUCT SEALING**

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards-- Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer's instructions.
  - 1. Seal Class: Refer to Application Schedule on the Drawings.
  - 2. Seal ducts before external insulation is applied.
  - 3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

### **3.06 HANGING AND SUPPORTING**

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install concrete inserts before placing concrete.
- D. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

- E. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.
- F. Install roof mounted duct supports in accordance with manufacturer's instructions. Provide additional membrane layer or walkpads under support bases as required.
- G. Use load rated cable suspension system for round duct in exposed locations.

**3.07 CONNECTIONS**

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

**3.08 PAINTING**

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

**3.09 FIELD QUALITY CONTROL**

- A. Duct System Cleanliness Tests:
  - 1. Visually inspect duct system to ensure that no visible contaminants are present.
- B. Duct system will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

**3.10 START UP**

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

**END OF SECTION**



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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section "Mechanical General Requirements."
  - 2. Division 23 Section "Testing, Adjusting, and Balancing" for duct test holes.
  - 3. Division 23 Section "Temperature Controls" for motorized control dampers.
  - 4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

#### 1.02 DEFINITIONS

- A. NVLAP: National Voluntary Laboratory Accreditation Program.
- B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.
- C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

#### 1.03 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For turning vanes, include data for pressure loss generated sound power levels.

2. For duct silencers, include pressure drop and dynamic insertion loss data.
- 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, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Duct security bars.
    - f. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

#### **1.04 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

#### **1.05 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed for each temperature rating.

### **PART 2 PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

#### **2.02 SHEET METAL MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Aluminum Sheets: 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: 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.
- H. Tie Rods: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches for use in ducts in humid or corrosive atmospheres.

- I. Bird Screens: No. 2 mesh, 0.063 inch diameter galvanized wire screen with open area of not less than 72 percent. Conceal sharp edges by adding metal edging consisting of rod, flat or angle iron, or 16 gage galvanized sheet steel turned over at least 3/4 inch on both sides.

### **2.03 BACKDRAFT DAMPERS**

- A. Manufacturers:
  1. American Warming and Ventilating.
  2. Greenheck.
  3. Ruskin Company.
- B. Description: Multiple-blade, parallel action counterbalanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.
- C. Performance: Based on tests in accordance with AMCA Standard 500:
  1. Pressure drop not to exceed 0.15 inch wg at face velocity of 2500 fpm.
  2. Leakage not to exceed 9.2 cfm per square foot at 1 inch wg differential and temperature of 70 deg F.
- D. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
- E. Blades: 0.025-inch- thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet.
- F. Blade Seals: Manufacturer's standard seal material.
- G. Blade Axles: Nonferrous or galvanized steel.
- H. Tie Bars and Brackets: Aluminum or galvanized steel.

### **2.04 LOW PRESSURE MANUAL VOLUME DAMPERS**

- A. Manufacturers:
  1. American Warming and Ventilating.
  2. Arrow United Industries.
  3. Greenheck.
  4. Krueger.
  5. Louvers and Dampers.
  6. Nailor Industries Inc.
  7. Ruskin Company.
  8. Vent Products Company, Inc.
  9. Young Regulator Company.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.
- F. Damper Materials:
  1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.

3. Blade Axles: Galvanized steel.
  4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
  5. Tie Bars and Brackets: Galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- H. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

## **2.05 MEDIUM OR HIGH PRESSURE MANUAL VOLUME DAMPERS**

- A. Manufacturers:
1. American Warming and Ventilating.
  2. Greenheck.
  3. Louvers and Dampers.
  4. Nailor Industries Inc.
  5. Ruskin Company.
  6. Vent Products Company, Inc.
- B. General Description: Factory fabricated, galvanized steel or extruded aluminum construction, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade, or multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.
- F. Damper Materials:
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
  2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized sheet steel.
  3. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  4. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
  5. Blade Axles: Galvanized steel or stainless steel.
  6. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
  7. Tie Bars and Brackets: Aluminum or galvanized steel.
- G. Jackshaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

- H. Damper Hardware: 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. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

## **2.06 LOW LEAKAGE MANUAL VOLUME DAMPERS**

- A. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers:
    - a. American Warming and Ventilating.
    - b. Greenheck.
    - c. Louvers and Dampers; a division of Mestek, Inc.
    - d. Nailor Industries Inc.
    - e. Ruskin Company.
    - f. Vent Products Company, Inc.
  2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  3. Suitable for horizontal or vertical applications.
  4. Frames:
    - a. Angle shaped.
    - b. Galvanized-steel channels, 0.064 inch thick.
    - c. Mitered and welded corners.
    - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized, roll-formed steel, 0.064 inch thick.
  6. Blade Axles: Galvanized steel.
  7. Bearings:
    - a. Stainless-steel sleeve.
    - 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. Blade Seals: Neoprene.
  9. Jamb Seals: Cambered aluminum.
  10. Tie Bars and Brackets: Galvanized steel.
  11. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- B. Low-Leakage, Aluminum, Manual Volume Dampers:
1. Manufacturers:
    - a. American Warming and Ventilating.
    - b. Greenheck.
    - c. Louvers and Dampers; a division of Mestek, Inc.
    - d. Nailor Industries Inc.
    - e. Ruskin Company.
    - f. Vent Products Company, Inc.
  2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  3. Suitable for horizontal or vertical applications.
  4. Frames: Angle-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. Opposed-blade design.
    - c. Roll-Formed Aluminum Blades: 0.10-inch-thick aluminum sheet.
    - d. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
  6. Blade Axles: Galvanized steel.

7. Bearings:
    - a. Stainless-steel sleeve.
    - 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. Blade Seals: Neoprene.
  9. Jamb Seals: Cambered aluminum.
  10. Tie Bars and Brackets: Galvanized steel.
  11. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- 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.

#### **2.07 MANUAL VOLUME DAMPERS (IRIS STYLE)**

- A. Manufacturers:
1. Continental Fan Manufacturing, Inc.; IRIS Series.
  2. Fantech; Systemair Group; IR Series.
  3. Ruskin Company; VFBD35.
- B. Description: Round manual volume damper complete with pressure ports, constructed of galvanized steel, fitted with a neoprene gasket, and using interlocking steel plates and calibrated control lever to form an adjustable aperture.

#### **2.08 MOTORIZED CONTROL DAMPERS**

- A. Refer to Division 23 Section "Temperature Controls."

#### **2.09 BLAST GATES**

- A. Manufacturers:
1. Dixie Sheet Metal.
  2. LaPine Metal Products.
  3. Semco.
- B. Full-body style, factory fabricated of minimum 18 gage, galvanized sheet metal.

#### **2.10 FIRE DAMPERS (CURTAIN STYLE)**

- A. Manufacturers:
1. Air Balance, Inc.
  2. Greenheck.
  3. NCA Manufacturing, Inc.
  4. Nailor Industries Inc.
  5. Ruskin Company.
- B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.
- C. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
  2. 3 hours for 4 hour rated walls.
- D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
  2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. 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.
- H. Fusible Links: Replaceable, 165 deg F rated.

## **2.11 FIRE DAMPERS (MULTIPLE BLADE TYPE)**

- A. Manufacturers:
1. Greenheck.
  2. NCA Manufacturing, Inc.
  3. Nailor Industries Inc.
  4. Ruskin Company.
- B. Dynamic fire dampers with multiple blades, and labeled according to UL 555, maximum velocity of 2000 fpm, maximum static pressure 4 inches w.g.
- C. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
  2. 3 hours for 4 hour rated walls.
- D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.
- E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
  2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.
- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.
- H. Axles: 1/2 inch plated steel hex.
- I. Bearings: Stainless steel, or oil-impregnated bronze sleeve type, pressed into frame.
- J. Linkage: Concealed in frame.
- K. Fusible Links: Replaceable, 165 deg F rated.

## **2.12 SMOKE DAMPERS**

- A. Manufacturers:
1. Air Balance, Inc.
  2. Greenheck.
  3. Nailor Industries Inc.
  4. NCA Manufacturing, Inc.
  5. Ruskin Company.
- B. General Description: Smoke dampers with airfoil blades, labeled according to UL 555S, with minimum Class II leakage rating.
- C. Smoke Detector: Integral, factory wired for single-point connection.
- D. Frame and Blades: 16 gage, galvanized sheet steel.
- E. Mounting Sleeve: Factory-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
- F. Rated pressure and velocity to exceed design airflow conditions.
- G. Damper Actuators: Electric modulating or two-position action as required.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  2. Size for torque required for damper seal at load conditions.
  3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
  4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac.
  6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
  7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
  8. Actuator timing shall meet 15 sec.
  9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.
- H. Damper Actuators: Pneumatic modulating or two-position action.
1. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing.
  2. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  3. Actuator Degradation Temperature: Not to exceed 250 deg F .
- I. Damper blade position end switches: Factory installed damper position switch package for both full open and full closed indication (equivalent to Ruskin SP100 switch package).
- J. Test Switch: Damper Remote mounted momentary "test" push-button mounted 3-position "normal/closed/override" toggle switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.
1. For pneumatic actuators, include factory installed electric/pneumatic (EP) switch for testing function.
  2. Include damper remote mounted "open" and "closed" indication lights on switch plate for connection to factory installed damper blade position end switches.

### **2.13 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers:
1. Air Balance, Inc.
  2. Greenheck.
  3. Nailor Industries Inc.
  4. NCA Manufacturing, Inc.
  5. Ruskin Company.
- B. General Description: Combination fire and smoke dampers shall be labeled according to UL 555 and UL 555S. Leakage shall not exceed 10 cfm per square foot at 1 inch WG differential pressure (Leakage Class II).
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
  2. 3 hours for 4 hour rated walls.
- E. Smoke Detector: Integral, factory wired for single-point connection.
- F. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.
- G. Mounting Sleeve: Factory-installed, galvanized sheet steel.



1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
- H. Rated pressure and velocity to exceed design airflow conditions.
- I. Damper Actuators: Electric modulating or two-position action as required.
  1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
  2. Size for torque required for damper seal at load conditions.
  3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
  4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac.
  6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
  7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
  8. Actuator timing shall meet 15 sec.
  9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.
- J. Damper Actuators: Pneumatic modulating or two-position action.
  1. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing.
  2. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
  3. Actuator Degradation Temperature: Not to exceed 250 deg F.
- K. Manual Heat Responsive Fuse Link with Reset and Damper Blade Position End Switches: Factory installed manual heat responsive fuse link with reset switch / damper position switch package for both full open and full closed indication (equivalent to Ruskin TS150 switch package).
- L. Test Switch: Damper Remote mounted momentary "test" push-button mounted 3-position "normal/closed/override" toggle switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.
  1. Include damper remote mounted "open" and "closed" indication lights on switch plate for connection to factory installed damper blade position end switches.

## 2.14 TURNING VANES

- A. Manufactured Turning Vanes:
  1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
  2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.
  3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.
  4. Manufacturers:
    - a. Aero/Dyne Company; H-E-P Turning Vanes.
    - b. Ductmate Industries, Inc.
    - c. Duro Dyne Corp.
    - d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Manufactured Acoustic Turning Vanes:

1. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.
3. Manufacturers:
  - a. Ductmate Industries, Inc.
  - b. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

#### **2.15 DUCT-MOUNTING ACCESS DOORS**

- A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.
- B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.
  1. Manufacturers:
    - a. Air Balance, Inc.
    - b. Greenheck.
    - c. Nailor Industries Inc.
    - d. Ruskin Company.
  2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  3. Provide number of hinges and locks as follows:
    - a. Less Than 12 Inches Square: Secure with two sash locks.
    - b. Up to 18 Inches Square: Two hinges and two compression locks.
    - c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
    - d. Sizes 24 by 48 Inches and Larger: One additional hinge.
- C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.
  1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Flexmaster U.S.A., Inc.
  2. Frame: Galvanized sheet steel, with spin-in notched frame.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

#### **2.16 DUCT ACCESS PANEL ASSEMBLIES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.

#### **2.17 FLEXIBLE CONNECTORS**

- A. Manufacturers:
  1. ADSCO Manufacturing LLC.
  2. Duro Dyne Corp.
  3. Senior Flexonics Pathway.
  4. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- D. 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.
- E. 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.
- F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.
  - 1. Minimum Weight: 16 oz./sq. yd.
  - 2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
  - 3. Service Temperature: Minus 67 to plus 500 deg F.
- G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
  - 1. Minimum Weight: 14 oz./sq. yd.
  - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
  - 3. Service Temperature: Minus 67 to plus 500 deg F.

**2.18 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE**

- A. Manufacturers:
  - 1. Flexmaster Type 8M, UL 181, Class 1.
  - 2. Automation Industries Thermaflex.
  - 3. Hart & Cooley.
- B. Flexible Ducts: Interlocking spiral of galvanized steel or aluminum construction or fabric supported by helically wound spring steel wire or flat steel bands; rated to 6 inches WG positive and 4 inches WG negative for low and medium pressure ducts.
- C. Insulated Flexible Ducts: Flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F .
- D. Acoustical performance tested in accordance with the Air Diffusion Council's *Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties* shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	8	32	38	35	39	25
8" diameter	13	32	36	35	36	21
12" diameter	15	29	28	33	26	14

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	6	8	7	8	9	13
8" diameter	9	6	6	7	8	10
12" diameter	9	7	6	6	8	11

The self generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band Hz.	2	3	4	5	6	7
6" diameter	42	31	23	18	17	21
8" diameter	41	34	27	19	18	21
12" diameter	53	44	36	27	21	22

- E. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
- F. Flexible Duct 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.

## 2.19 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
  - 1. Automation Industries Thermaflex; FlexFlow Elbow.
  - 2. Smart Air & Energy Solutions; SMART Flow Elbow.
- B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.
- C. Elbow supports shall be UL listed for use in return air plenum spaces.

## 2.20 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## 2.21 FINISHES

- A. Chemical Resistant Coating: P-403 manufactured by Heresite Chemical Company.

## PART 3 EXECUTION

### 3.01 APPLICATION AND 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. Provide 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 PVC coated ducts; and aluminum accessories in aluminum ducts.
- C. Install control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers in ducts with liner in a manner that avoids damage to and erosion of duct liner.
- E. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- F. Install fire and smoke dampers according to UL listing.
- G. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch- diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.
- H. Install duct silencers rigidly to ducts.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.

3. At outdoor-air intakes and mixed-air plenums.
  4. At drain pans and seals.
  5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  7. Control devices requiring inspection.
  8. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.
- L. Install pressure relief doors vertically and level in accordance with manufacturer's instructions, between the fan and first operable damper.
- M. Label access doors according to Division 20 Section "Mechanical Identification."
- N. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- O. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- P. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- Q. Connect diffusers or light troffer boots to low pressure ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- R. Connect flexible ducts to metal ducts with draw bands.
- S. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- T. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
1. Use manufactured double-vane turning vanes unless otherwise specified.
  2. Seat outboard-most vane in heel of duct elbow.
  3. Provide vanes for all runner punchings, practice of eliminating every other vane is prohibited.
  4. Use single-vane turning vanes in low pressure square elbows.

### **3.02 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
  2. Inspect locations of access doors and verify that purpose of access door can be performed.
  3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  4. Inspect turning vanes for proper and secure installation.
  5. Operate remote damper operators to verify full range of movement of operator and damper.

### **3.03 ADJUSTING**

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

### **END OF SECTION**

TMP Architecture, Inc.  
Peter Basso Associates, Inc.

TMP13172G & 13174H  
PBA2013.0406.01 & 2013.0408.01

**SECTION 23 3443 – HIGH-VOLUME, LOW-SPEED DESTRATIFICATION FANS**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 20 Section “Mechanical General Requirements.”
  - 2. Division 20 Section “Motors.”

**1.02 DEFINITIONS**

- A. HVLS: High-volume, low-speed.
- B. Free Air: Air within a given space at a constant static pressure.
- C. LEC: Light-emitting diode.
- D. VFC: Variable frequency controller. Variable frequency controllers may also be referred to as variable speed drives, variable frequency drives, VSDs, or VFDs in other Specification Sections or on the Drawings.

**1.03 PERFORMANCE REQUIREMENTS**

- A. Classify according to AMCA 99.

**1.04 SUBMITTALS**

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
  - 1. Certified fan performance data with system operating conditions indicated.
  - 2. Certified fan sound-power ratings.
  - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
  - 4. Material thickness.
  - 5. Fan speed controllers.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 1. Wiring Diagrams: Power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Roof framing and support members relative to duct penetrations.
  - 2. Ceiling suspension assembly members.
  - 3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For HVLS destratification fans to include in operation and maintenance manuals.

#### **1.05 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.
- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

#### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

#### **1.07 COORDINATION**

- A. Coordinate size and location of structural-steel support members.

### **PART 2 PRODUCTS**

#### **2.01 LARGE SPACE HVLS FANS (INDUSTRIAL GRADE)**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Delta T Corp.; dba the Big Ass Fan Company; ESSENCE Series.
  2. Greenheck; DS-6.
  3. Entrematic Group AB; Entrematic I-Class.
  4. GFY; Z-Tech.
- B. Airfoils:
  1. Material: Precision extruded 6063 aluminum alloy, weighing no more than 5.1 pounds per foot of length. Airfoils shall be heat treated for strength.
  2. Fan shall have 6 or more low speed airfoils, depending on fan size.
  3. Each airfoil shall incorporate a wickerbill or Gurney flap molded along the trailing edge of the airfoil. Airfoils may also incorporate winglets, and air fences.
  4. The foils shall be connected to the hub section of the fan by means of 2 locking bolts per foil, providing no less than 7257 lbs. of shear strength.
  5. Airfoils shall be interlocked with a safety strap constructed of 14 gage galvanized A36 steel to prevent individual airfoils from becoming accidentally disconnected from the hub.
- C. Motors: Comply with requirements in Division 20 Section "Motors."
- D. Drive Train: Gearless direct drive or gear reducer.
  1. Gear Reducer:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Baldor Electric Company; Dodge Power Transmission.
      - 2) Baldor Electric Company; Reliance; C-Style MGS Helical Gear Reducer.
      - 3) Nord Drivesystems.
    - b. Gear Reducer: Precision finished for low noise and long service life with double lip seals to keep oil in and contaminants out, and lubricated for life. Gear reducer shall have a standard backlash of less than 20 arc minutes and be equipped with a 17-4 stainless steel shaft of 1-inch diameter conditioned to 1150.



- c. Gears: Hardened to 58-62 Rockwell C.
- E. Fan Motor Frame and Mount: Constructed of 1/4-inch powder-coated steel. The mount shall be designed so that both guy wires and safety cables can be securely attached.
- F. Hub Assembly: Precision cast of prime 713 aluminum alloy or equivalent. The hub shall incorporate four safety clips made of 1/4-inch steel to provide a physical brake for the motor in case of shaft failure.
- G. Fan Mount: Designed for secure mounting of the fan from a structure's support beams. Mounting system shall allow easy removal and relocation, if required. Fan mount shall be lightweight and constructed of 1/4-inch powder coated steel.
- H. Guy Wires: Four sets of self-locking wire rope and grip locks of sufficient length shall be provided to guy the fan to the building structure. Guy wires shall be of stranded galvanized steel of 0.20-inch diameter with a minimum breaking load of not less than 1000 pounds.
- I. Safety Cables: Safety cable shall consist of a 7 x 19 class stranded galvanized steel of 0.20-inch diameter with 4 clamps to secure the motor frame to the structural member from which the fan is attached. The safety cable shall have a breaking strength of not less than 14,200 pounds.
- J. Fan Controller: UL listed as Enclosed Industrial Control Panels and built in accordance with construction guidelines set forth by Underwriters Laboratories Article 508A, and the National Electrical Code.
  - 1. Each fan controller shall include a factory programmed VFC to provide a soft-start for the fan as well as infinite speed control capability for the fan(s). The VFC will be sized based on the motor's maximum current requirements under locked rotor torque demands. When more than one fan motor is controlled by a VFC, the size of the VFC will be based on the maximum current requirements of the total peak currents of all motor loads under the worst operating conditions. Multiple motor systems will also include a solid state overload relay for each motor.
  - 2. Each fan controller built for 480 volt power shall be equipped with a properly rated load reactor for handling voltage irregularities. Load reactors shall be minimum 3 percent impedance per unit and shall be provided integral to the VFC as a part of the fan controller package.
  - 3. Equip each fan controller with an ON/OFF switch, speed control potentiometer, safety disconnect, and properly sized fuse block. Controls shall be housed in NEMA 250, Type 1 enclosure to prevent accidental contact with the enclosed equipment, and to preclude entry of unwanted substances.
  - 4. Controller shall provide the following DDC controls:
    - a. Remote Enable/Disable
    - b. Remote Speed Signal
    - c. Fire Alarm Shutdown
- K. Fan Controller Program: Controller shall be factory programmed to minimize fan starting torque to approximately 15 ft-lbs to extend operating life by minimizing stress on components. Additionally, controller shall allow fan speed to be easily altered to optimize fan use in any conditions.

### **PART 3 EXECUTION**

#### **3.01 INSTALLATION**

- A. Install destratification fans level and plumb.
- B. Support suspended units from structure.
- C. Install units with clearances for service and maintenance.
- D. Fans with bamboo airfoils shall not be installed outdoors or in damp environments.
- E. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

### **3.02 CONNECTIONS**

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

### **3.03 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. Verify that shipping, blocking, and bracing are removed.
  - 2. Verify that unit is secure on mountings and supporting devices, and connections to 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. Verify lubrication for bearings and other moving parts.
  - 5. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

### **3.04 ADJUSTING**

- A. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- B. Lubricate bearings.

### **END OF SECTION**

## SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 10 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  - 2. Division 20 Section "Mechanical General Requirements."
  - 3. Division 23 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

#### 1.02 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.

### PART 2 PRODUCTS

#### 2.01 AIR DIFFUSION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. Anemostat; a Mestek Company.
  - 2. Krueger; Tomkins PLC.
  - 3. Nailor Industries of Texas Inc.
  - 4. Price Industries.
  - 5. Titus; Tomkins PLC.
  - 6. Tuttle & Bailey; Tomkins PLC.
- B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.
- C. Provide plaster frames for units installed in plaster ceilings.
- D. Provide gaskets for supply terminal air devices mounted in finished surfaces.
- E. Air diffusion devices shall be standard off white baked enamel finish unless noted otherwise. Provide air diffusion device interior surfaces, including blank-offs, with black matte finish.
- F. Air pattern adjustments shall be made from the face of the device.
- G. Refer to drawings and schedules for quantities, types, and finishes.

- H. Coordinate frame types with Architectural Reflected Ceiling Plan.

## **2.02 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."
- B. Acoustical Applications and Sound Evaluation: Based on ARI Standard 885-98, "Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.
- D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### **3.03 ADJUSTING**

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

## **END OF SECTION**

**SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

**1.02 SUMMARY**

- A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

**1.03 REFERENCES**

- A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:
  1. ANSI - American National Standards Institute; [www.ansi.org](http://www.ansi.org).
  2. ASTM - ASTM International; [www.astm.org](http://www.astm.org).
  3. CSI - Construction Specifications Institute (The); [www.csiresources.org](http://www.csiresources.org).
  4. ICEA - Insulated Cable Engineers Association, Inc.; [www.icea.net](http://www.icea.net).
  5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); [www.ieee.org](http://www.ieee.org).
  6. NEC - National Electrical Code
  7. NECA - National Electrical Contractors Association; [www.necanet.org](http://www.necanet.org).

- a. NECA 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."
8. NEMA - National Electrical Manufacturers Association; [www.nema.org](http://www.nema.org).
9. NETA - InterNational Electrical Testing Association; [www.netaworld.org](http://www.netaworld.org).
10. UL - Underwriters Laboratories Inc.; [www.ul.com](http://www.ul.com).

#### **1.04 QUALITY ASSURANCE**

- A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
  1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
  2. The Contractor understands that the work herein described shall be complete in every detail.
- B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
  1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.
- C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.
- D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.
- E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.
- F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner's Representatives causes interference.

#### **1.05 CODES, PERMITS AND FEES**

- A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.
- B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.
- C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

#### **1.06 DRAWINGS**

- A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.
- B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.
- C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

- D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.
- E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

#### **1.07 MATERIAL AND EQUIPMENT MANUFACTURERS**

- A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.
- B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.
- C. Where existing equipment is modified to include new switches, circuit breakers, metering or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

#### **1.08 INSPECTION OF SITE**

- A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

#### **1.09 ITEMS REQUIRING PRIOR APPROVAL**

- A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.
  - 1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
  - 2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

- B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

#### **1.10 SHOP DRAWINGS/SUBMITTALS**

- A. Submit project-specific submittals for review in compliance with Division 1.
- B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.
- C. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
- E. Submit for approval shop drawings for electrical systems or equipment indicated in other sections of electrical specs. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures).

#### **1.11 COORDINATION DRAWINGS**

- A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

#### **1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

- A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
- B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
- C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
  - 1. Routine maintenance procedures.
  - 2. Trouble-shooting procedures.
  - 3. Contractor's telephone numbers for warranty repair service.
  - 4. Submittals.
  - 5. Recommended spare parts list.
  - 6. Names and telephone numbers of major material suppliers and subcontractors.
  - 7. System schematic drawings on 8-1/2" x 11" sheets.

#### **1.13 RECORD DRAWINGS**

- A. Submit record drawings in compliance with Division 01.
- B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be clearly marked with a contrasting color so the marks are readily apparent.
- C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request during the course of construction.

#### **1.14 INSTRUCTION OF OWNER PERSONNEL**

- A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.
- B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.



- C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
- D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

#### **1.15 WARRANTY**

- A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner's satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.
- B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.
- C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

#### **1.16 USE OF EQUIPMENT**

- A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
- B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

#### **1.17 COORDINATION**

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

### **PART 2 PRODUCTS (NOT APPLICABLE)**

### **PART 3 EXECUTION**

#### **3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to raceways and piping systems installed at a required slope.

### **3.02 DEMOLITION WORK**

- A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures, conduit, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work.
- B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.
- C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.
- D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.
- E. Reroute signal wires, lighting and power wiring as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or at the panels.
- F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.
- G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where approved by the Architect/Engineer.

### **3.03 INSTALLATION OF EQUIPMENT**

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
  - 1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

### **3.04 WORK IN EXISTING BUILDINGS**

- A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.
- B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

- C. Consult with the Owner's Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

### **3.05 TEMPORARY SERVICES**

- A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

### **3.06 DISPOSAL**

- A. Fluorescent Lamps
  1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
  2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.
  3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
  4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.
- B. Ballasts
  1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
  2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
  3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
  4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.

### **3.07 CHASES AND RECESSES**

- A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

### **3.08 CUTTING, PATCHING AND DAMAGE TO OTHER WORK**

- A. Refer to General Conditions for requirements.
- B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

### **3.09 EQUIPMENT CONNECTIONS**

- A. Make connections to equipment and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

### **3.10 CLEANING**

- A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.
- B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

### **3.11 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS**

- A. Equipment and materials shall be protected from theft, injury or damage.

- B. Protect conduit openings with temporary plugs or caps.
- C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.

### **3.12 EXTRA WORK**

- A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 1/2", 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, I.G. receptacle, data box, V4000 wiremold, fire alarm combination visual/audible notification appliance, fire alarm visual notification appliance, clock, or other devices which may be required for any proposed extra work.

### **3.13 DRAWINGS AND MEASUREMENTS**

- A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor's responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

**END OF SECTION**

## SECTION 26 0519 - CONDUCTORS AND CABLES

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. Section includes:
  - 1. Building wires and cables rated 600V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.

#### 1.03 SUBMITTALS

- A. Field Quality-Control Test Reports
- B. Submit letter of compliance (intent) for general building wire and cable. Provide product data for the following:
  - 1. Metal-Clad Cable, Type MC

#### 1.04 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

### PART 2 PRODUCTS

#### 2.01 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  - 2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- D. Conductor Insulation:
  - 1. Type THHN/THWN-2: Comply with UL 83.
  - 2. Type THW/THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.

3. Type XHHW-2: Comply with UL 44.

## **2.02 METAL-CLAD CABLE, TYPE MC**

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Manufacturers:
  1. AFC Cable Systems
  2. Alpha Wire Company
  3. American Bare Conductor
  4. Belden
  5. Encore
  6. General Cable
  7. Okonite
  8. Service Wire Co.
  9. Southwire Company
- C. Standards:
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
  2. Comply with UL 1569.
  3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Circuits:
  1. Single circuit and multi-circuit with color-coded conductors for branch circuit distribution.
  2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- E. Conductors:
  1. Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.
- F. Ground Conductor: Insulated. Ground conductor sized as indicated on drawings (reduced ground conductor is not acceptable).
- G. Conductor Insulation:
  1. Type TFN/THHN/THWN-2: Comply with UL 83.
  2. Type XHHW-2: Comply with UL 44.
- H. Armor: Aluminum, interlocked.

## **2.03 CONNECTORS AND SPLICES**

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## **PART 3 EXECUTION**

### **3.01 CONDUCTOR MATERIAL APPLICATIONS**

- A. Refer to application schedule on the drawings
- B. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
- C. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).
- D. Use conductor not smaller than 14 AWG for control circuits,
- E. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

### **3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Refer to application schedule on the drawings
- B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.
- C. Fire Alarm Circuits: Power-limited, fire-protective, signaling circuit cable.
- D. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

- E. Class 2 Control Circuits: Type THHN/THWN-2, in raceway.

### **3.03 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 26 0533 "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 Division 26 Section "Hangers and Supports for Electrical Systems."
- G. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.
- H. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- I. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.
- J. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable. Neutral conductors shall be considered current carrying conductors.
- K. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction
- L. MC cable shall not be used for home runs to receptacle or distribution panels.
- M. Where MC cable is permitted by the specifications, MC cable shall not be bundled.
- N. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.
- O. Do not route conductors across roof without prior approval from engineer.

### **3.04 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Clean conductor surfaces before installing lugs and connectors.
- E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
- G. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
- H. Use insulated spring wire connectors with plastic caps (wire nuts) for copper conductor splices and taps, 10 AWG and smaller. Push-in style connectors are not permitted.
- I. Provide lugs suitable for bussing and conductor material used.

### **3.05 IDENTIFICATION**

- A. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."

- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### **3.06 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 26 0533 "Raceways and Boxes."

### **3.07 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

### **3.08 FIELD QUALITY CONTROL**

- A. Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
  - 1. Description: Test all feeders rated 100 A and above.
  - 2. Visual and Mechanical Inspection
    - a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.
    - b. Test cable mechanical connections with an infrared survey.
    - c. Check cable color-coding against project Specifications and N.E.C. requirements.
  - 3. Electrical Tests
    - a. Perform continuity test to insure proper cable connection.
- B. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

**END OF SECTION**



**SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.

**1.03 DEFINITIONS**

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

**1.04 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

**1.05 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.

**1.06 QUALITY ASSURANCE**

- A. Comply with NFPA 70.

**1.07 COORDINATION**

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

**PART 2 PRODUCTS**

**2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS**

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International..

- b. B-Line, by Eaton..
  - c. GS Metals Corp.
  - d. Pentair Electrical & Fastening Solutions.
  - e. Thomas & Betts Corporation.
  - f. Unistrut; a part of Atkore International.
  - g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  4. 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. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  2. Mechanical-Expansion Anchors: Insert-wedge-type, 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) B-Line by Eaton.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.
  3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  6. Toggle Bolts: All-steel springhead type.
  7. Hanger Rods: Threaded steel.

### **PART 3 EXECUTION**

#### **3.01 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 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:
    - a. Two-bolt conduit clamps
    - b. Single-bolt conduit clamps
    - c. Single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

### 3.02 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.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel:
    - a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
    - b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
    - c. Spring-tension clamps.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.
- E. Slotted support systems applications:
  - 1. Indoor dry and damp Locations: Painted Steel
  - 2. Outdoors and interior wet locations: Galvanized Steel
  - 3. Corrosive Environments, including pool equipment rooms: Nonmetallic
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.
- H. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- I. Obtain permission from Architect/Engineer before drilling or cutting structural members.
- J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

- K. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.
- M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

**3.03 PAINTING**

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION**

## SECTION 26 0533 - RACEWAYS AND BOXES

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Related Sections include the following:
1. Division 07 Section, "Penetration Firestopping" for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
  2. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
  3. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

#### 1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. PVC: Polyvinyl Chloride.
- F. HDPE: High Density Polyethylene.

#### 1.04 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

#### 1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

#### 1.06 COORDINATION

- A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

## **PART 2 PRODUCTS**

### **2.01 METAL CONDUIT AND TUBING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Alflex Inc.
  - 3. Allied Tube Triangle Century.
  - 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 5. International Metal Hose.
  - 6. Electri-Flex Co
  - 7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
  - 8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
  - 9. Maverick.
  - 10. O-Z Gedney; unit of General Signal.
  - 11. Wheatland.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. EMT: ANSI C80.3.
- E. FMC: Zinc-coated steel or aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket.
- G. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: Steel, compression type.
  - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

### **2.02 FIRE ALARM EMT**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Tube Triangle Century.
- B. EMT conduit with bright red topcoat; Fire Alarm EMT.
- C. EMT and Fittings: ANSI C80.3.

### **2.03 NONMETALLIC CONDUIT AND TUBING**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American International.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. Arco Corp.
  - 4. Cantex Inc.
  - 5. Certainteed Corp.; Pipe and Plastics Group.
  - 6. Condux International.
  - 7. ElecSys, Inc.
  - 8. Electri-Flex Co.
  - 9. Integral.
  - 10. Kor-Kap.
  - 11. Lamson and Sessions: Carlon Electrical Products.
  - 12. Manhattan/CDT/Cole-Flex.
  - 13. RACO; Division of Hubbell, Inc.
  - 14. Scepter.
  - 15. Spiralduct, Inc./AFC Cable Systems, Inc.
  - 16. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

- D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.
- E. LFNC: UL 1660.
- F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.
- G. RTRC: Comply with UL 2515A and NEMA TC 14.

#### **2.04 SURFACE RACEWAYS**

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).
    - b. Thomas & Betts Corporation.
    - c. Walker Systems, Inc.; Wiremold Company (The).
    - d. Wiremold Company (The); Electrical Sales Division.
    - e. Mono-Systems, Inc.
- B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

#### **2.05 BOXES, ENCLOSURES, AND CABINETS**

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
- B. Floor Boxes: Cast metal, fully adjustable, rectangular.
- C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

### **PART 3 EXECUTION**

#### **3.01 RACEWAY APPLICATION**

- A. Provide raceways in interior and exterior locations in accordance with the "Raceway Application Matrix" included on the drawings.
- B. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch 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.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
  - 3. EMT: Use setscrew or compression, cast-metal 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. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

#### **3.02 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 away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter from entering raceways.
- F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

- G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
- H. Install no more than the equivalent of four 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
  - 1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
- J. Support conduit within 12 inches of enclosures to which attached.
- K. Raceways Embedded in Slabs:
  - 1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
  - 2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
  - 3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
  - 4. Space raceways laterally to prevent voids in concrete.
  - 5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
  - 6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 7. Conduits shall run flat. Do not allow conduits to cross.
  - 8. Change from non-metallic raceway to EMT before turning up out of the concrete and rising above the floor.
- L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. 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.
- S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.
- T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- U. Provide pull string and 25% spare capacity in every branch circuit conduit.



- V. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.
  - 1. Electrical conduit (LB's) are not permitted.
  - 2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
  - 3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
  - 4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
  - 5. Conduit for copper cabling less than 2" shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2" and larger shall have a bend radius of at least 10 times the internal diameter.
  - 6. All conduit ends shall have an insulated bushing.
- W. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.
- X. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.
- Y. 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.
- Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- AA. Locate boxes so that cover or plate will not span different building finishes.
- BB. 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.
- CC. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- DD. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.
- EE. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

### **3.03 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS**

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

### **3.04 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Through-Penetration Firestop Systems."

### **3.05 PROTECTION**

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

### **3.06 CLEANING**

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

### **END OF SECTION**

## SECTION 26 0553 - ELECTRICAL IDENTIFICATION

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. This Section includes the following:
1. Identification for raceway and metal-clad cable.
  2. Identification for conductors and communication and control cable.
  3. Warning labels and signs.
  4. Instruction signs.
  5. Equipment identification labels.
  6. Miscellaneous identification products.

#### 1.03 QUALITY ASSURANCE

- A. Comply with NFPA 70.  
B. Comply with 29 CFR 1910.145.

#### 1.04 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

### PART 2 PRODUCTS

#### 2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
1. Power Circuits: Black letters on an orange field.
  2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

## **2.02 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

## **2.03 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  - 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."

## **2.04 EQUIPMENT IDENTIFICATION LABELS**

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.
- B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## **2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength: 50 lb, minimum.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **2.06 WIRING DEVICE IDENTIFICATION**

- A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

# **PART 3 EXECUTION**

## **3.01 APPLICATION**

- A. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
  - 1. Fire Alarm System: Red.
  - 2. Security System: Blue and yellow.
  - 3. Telecommunication System: Green and yellow.
  - 4. Control Wiring: Green and red.
- B. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.
- C. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- D. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
  2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- G. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
    - b. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
  2. Equipment to Be Labeled: If included on project. All items may not be on project.
    - a. Panelboards, electrical cabinets, and enclosures.
    - b. Access doors and panels for concealed electrical items.
    - c. Emergency system boxes and enclosures.
    - d. Disconnect switches.
    - e. Push-button stations.
    - f. Power transfer equipment.
    - g. Remote-controlled switches, dimmer modules, and control devices.
- H. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

### **3.02 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location:
  1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
  2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.
- C. Apply identification devices to surfaces after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side.

Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

- G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
  2. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.
    - d. Grounded Conductor (Neutral): White.
  3. Colors for 480/277-V Circuits:
    - a. Phase A: Brown.
    - b. Phase B: Orange.
    - c. Phase C: Yellow.
    - d. Ground Conductor (Neutral): Grey.
  4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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.
- H. Label information arrangement for 3 lines of text.
1. Line one shall describe the panel or equipment. Line one example: "DP-XX," RP-XX," "T-XX," "EF-XX," etc.
  2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
  3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
  4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.
- I. Examples:

RP-1A FED FROM DP-1A ELECTRICAL ROOM A100 VIA T-1A	EF-1 FED FROM MCC-1A MECHANICAL ROOM F101	LP-1A LOCATED IN ELECTRICAL ROOM A100
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- J. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.
- K. Degrease and clean surface to receive nameplates.
- L. Install nameplate and labels parallel to equipment lines.
- M. Secure nameplate to equipment front using screws.
- N. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- O. Identify conduit using field painting where required.
- P. Paint bands 10 feet on center, and 4 inches minimum in width.

**END OF SECTION**

## SECTION 26 0923 - LIGHTING CONTROL DEVICES

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. This Section includes the following lighting control devices:
1. Indoor photoelectric control.
  2. Occupancy sensors.
- B. Related Sections include the following:
1. Division 26 Section "Electrical General Requirements".
  2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.
  3. Division 26 Section "Lighting Control Systems" for programmable lighting systems.

#### 1.03 REFERENCES

- A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.
- B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
- C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- D. NFPA 70: National Electrical Code.
- E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- F. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.
- H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.
- I. UL 917: Clock Operated Switches.
- J. UL 1449: Surge Protective Devices.
- K. UL 1598: Luminaires.
- L. NECA 130-2010: Installing and Maintaining Wiring Devices.

#### 1.04 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

- C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.
- D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.
- E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

#### **1.05 SUBMITTALS**

- A. Product Data: For each type of product indicated including physical data and electrical performance.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Lighting plan showing location, orientation, and coverage area of each sensor.
  - 2. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
  - 1. Description of operation and servicing procedures.
  - 2. List of major components.
  - 3. Recommended spare parts.
  - 4. Programming instructions and system operation procedures.

#### **1.06 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

#### **1.07 COORDINATION**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

#### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver products to the site under provisions of Division 26 Section "Electrical General Requirements".
- B. Store and protect products under provisions of Division 26 Section "Electrical General Requirements".

### **PART 2 PRODUCTS**

#### **2.01 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS**

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

#### **2.02 INDOOR PHOTOELECTRIC CONTROL**

- A. Manufacturers:
  - 1. Wattstopper LS-101.
  - 2. Sensorswitch CM-PC.
- B. Photoelectric Sensor: Solid-state, light-level sensor unit utilizing an internal photoconductive cell to detect changes in lighting levels and capable of controlling any lighting source.
  - 1. Housing: White, thermoplastic, tamper resistant, ceiling mount.
  - 2. Sensor shall operate on 24V DC power through a control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
  - 3. Light-Level Monitoring Range: 10 to 200 footcandle, with an adjustment for turn-on and turn-off levels within that range.
  - 4. Deadband: Adjustable range of 10 to 300%.
  - 5. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
  - 6. Indicator: Two LEDs to indicate the beginning of on and off cycles.



7. Manual override function.
  8. Provide indoor photoelectric switches and control units from single manufacturer.
  9. Provide indoor photoelectric switches from same manufacturer as occupancy sensors.
  10. Provide all control units and relays required to interface with occupancy sensors as required.
- C. Indoor Photoelectric Sensor Control Units:
1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
    - a. Control units shall be provided as required to power indoor photoelectric sensor, control lighting loads and provide a minimum of one auxiliary contact.
    - b. Sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and photoelectric switch shall be plenum rated.
    - c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
    - d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
    - e. It is acceptable to provide controls and auxiliary contacts as required integral to the sensor, provided all required contacts are provided.
    - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

### 2.03 OCCUPANCY SENSORS

- A. General
1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer's recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
  2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
  3. Provide occupancy sensors with a bypass switch to override the "ON" function in the event of sensor failure.
  4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
  5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.
- B. 360° Ceiling Mounted Dual Technology Occupancy Sensor
1. Manufacturers:
    - a. Perfect Sense CDS.
    - b. Wattstopper DT 300
    - c. Hubbell Building Automation "OMNI-DT" Series.
    - d. Greengate OMC-DT-2000-R.
    - e. Sensorswitch CM-PDT-R.
    - f. Philips LRM2255.
    - g. Leviton OSC10-MOW.
  2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
    - a. Housing: White, thermoplastic, tamper resistant ceiling mount.
    - b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
    - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
    - d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
    - e. Manual override function.
- C. 110° Wall Mounted Dual Technology Occupancy Sensor
1. Manufacturers:

- a. Perfect Sense DTC.
    - a. Wattstopper DT-200
    - b. Hubbell Building Automation "LO-DT" Series.
    - c. Sensorswitch WV-PDT-R/WV-BR.
    - d. Philips LRM2265.
    - e. Leviton OSW12-M0W.
  2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
    - a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
    - b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
    - c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
    - d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
    - e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
    - f. Manual override function.
- D. Occupancy Sensor Control Units:
1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
    - a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.
    - b. Occupancy sensor control units shall mount external to 4" sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.
    - c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
    - d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
    - e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.
    - f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

### **PART 3 EXECUTION**

#### **3.01 OCCUPANCY SENSOR INSTALLATION**

- A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.
- B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.
- C. Locate sensors such that motion through open doors will not falsely activate sensors.
- D. Do not locate ultrasonic sensors within six feet of supply air diffusers.
- E. Locate infrared sensors to avoid obstructions.
- F. Provide the services of a manufacturer's representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.
- G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

### **3.02 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Section "Conductors and Cables".
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### **3.03 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- B. Label time switches and contactors with a unique designation.

### **3.04 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify actuation of each sensor and adjust time delays.
- B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.
- C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

### **3.05 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

### **END OF SECTION**



## SECTION 26 0943 - LIGHTING CONTROL SYSTEMS

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. This Section includes the design and installation programmable automatic lighting controls with all input and control devices necessary to meet the performance indicated on the contract drawings and this specification
- B. Related Sections include the following:
1. Division 26 Section "Lighting Control Devices" for time switches, photoelectric switches, occupancy sensors, and multi-pole contactors.
  2. Division 26 Section "LED Interior Lighting" for luminaire specifications and accessories.

#### 1.03 DEFINITIONS

- A. BACnet: A networking communication protocol that complies with ASHRAE 135.
- B. Lon Works: A control network technology platform for designing and implementing interoperable control devices and networks.
- C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.
- D. RS-485: A serial network protocol, like RS-232, complying with TIA/EIA-485-A.

#### **1.04 SUBMITTALS**

- A. Product Data: Indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature for all sensors, relays, dimming modules, control stations and other devices necessary for complete operation of the system
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on this Project.
  - 1. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements for all system components requiring field installation.
  - 2. Riser Diagram: Show interconnection between all system components.
    - a. Identify complete data communication backbone and interconnection between sensors, relays, dimming modules control stations and other components.
    - b. Identify typical room/area type configurations.
    - c. Indicate interconnections with emergency egress lighting relays and transfer devices required.
  - 3. Information Technology (IT) connection: Provide information pertaining to interconnection with facility IT networking equipment and third-party systems.
  - 4. Other Diagrams and Operational Descriptions – as needed to indicate system operation or interaction with other system(s).
  - 5. Contractor startup and commissioning worksheet.
- C. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.
- D. Submit qualifications of commissioning agent and draft functional test plans for review and approval.
- E. Field quality-control test reports and commissioning reports at project closeout.
- F. Software licenses and upgrades required by and installed for operation and programming of digital devices.
- G. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals. Include the following:
  - 1. Software manuals.
  - 2. Operation of adjustable zone controls.
  - 3. Description of operation and servicing procedures.
  - 4. List of major components and recommended parts.
  - 5. System operation and integration instructions.
- H. Warranty: Special warranty specified in this Section.

#### **1.05 QUALITY ASSURANCE**

- A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer with total responsibility for compatibility of lighting control system components specified in this Section.
- 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 47 CFR, Subparts A and B, for Class A digital devices.
- D. Comply with NFPA 70.
- E. Listed as qualified under Design Lights Consortium (DLC) Networked Lighting Control System Specification V2.0.
- F. System luminaires and controls are certified by manufacturer to have been designed, manufactured and tested for interoperability.
- G. Comply with ASHRAE 90.1 - 2013

### **1.06 COORDINATION**

- A. Coordinate lighting control components specified in this Section and with systems and components specified in other Sections to form an integrated interconnection of compatible components.
- B. Match components and interconnections for optimum performance of lighting control functions.
- C. Provide open protocol interface for interoperability with building automation system including status of each occupancy/vacancy sensor, control station, dimming module, relay, time schedule, display graphics and status of lighting controls by zone.
- D. Coordinate lighting controls with devices specified in Division 26 Section "Lighting Control Devices".

### **1.07 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

### **1.08 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. Batteries for all sensors and switches: Quantity equal to 10% percent of each type and size, but no fewer than 3 of each type and size.

### **1.09 SOFTWARE SERVICE AGREEMENT**

- A. Technical Support: Beginning with Substantial Completion, provide software support for five years.
- B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revise licenses for use of the software.
  - 1. Provide 30-day notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment, if necessary.

### **1.10 SYSTEM COMMISSIONING**

- A. Provide the services of a third party, independent agent to perform functional testing and verification of the lighting control system to comply with the requirements of ASHRAE 90.1 – 2013.
- B. Perform functional testing of all lighting control system operations.

## **PART 2 PRODUCTS**

### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Acuity nLight Air
  - 2. Lutron Vive
  - 3. WaveLinx – Eaton

### **2.02 SYSTEM PERFORMANCE REQUIREMENTS**

- A. System Architecture
  - 1. System shall have an architecture that is based upon three main concepts: (a) networkable intelligent lighting control devices, (b) standalone lighting control zones using distributed intelligence, (c) system backbone for remote, time based and global operation between control zones.
    - a. Intelligent lighting control devices shall have individually addressable network communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming,

- and/or scene control. Combining one or more of these components into a single device enclosure shall be permissible to minimize overall device count of system.
- b. Lighting control zones consisting of one or more networked luminaires and intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence.”
  - c. System must be capable of interfacing directly with networked luminaires such that either low voltage network cabling or wireless RF communication is used to interconnect networked luminaires with control components such as sensors, switches and system backbone.
2. The system shall provide individually addressable switching and dimming control of the following: networked luminaires, control zones to include multiple switch legs or circuits, and relay and dimming outputs from centralized panels to provide design flexibility appropriate with sequence of operations required in each project area or typical space type. A single platform shall be used for both indoor and outdoor lighting controls.
  3. Lighting control zones shall be networked with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
  4. All system devices shall support remote firmware update, such that physical access to each device is not necessary, for purposes of upgrading functionality later.
  5. System shall be capable of “out of box” sequence of operation for each control zone. Standard sequence is:
    - a. All switches control all fixtures in a zone
    - b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.
- B. Wired Networked Control Zone Characteristics
1. All networked devices connected with low voltage network cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
  2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.
  3. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    - a. Low-Voltage power sensing: These devices shall automatically provide 100% light level upon detection of loss of power sensed via the low voltage network cable connection.
    - b. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss of power sensed via line voltage connections.
    - c. Emergency egress devices shall be provided, and UL labeled by the lighting control manufacturer.
- C. Wireless Networked Control Zone Characteristics
1. All wireless networked devices paired, meshed or grouped together shall automatically follow the “out of box” default sequence of operations.
  2. Wireless network communication shall support uniform and instant response such that all luminaires in a lighting control zone respond immediately and synchronously in response to a sensor or wall station signal.
  3. To support the system architecture requirement for distributed intelligence, wireless network communication shall support communication of control signals from sensors and wall stations to networked luminaires and wireless load control devices, without requiring any communication, interpretation, or translation of information through a backbone device such as a wireless access point, communication bridge or gateway.



4. All wireless communication shall be encrypted using at least 128-bit Advanced Encryption Standard (AES).
  5. The following types of wired networked control devices shall be provided for egress and/or emergency light fixtures:
    - a. UL924 Listed Line-Voltage power sensing: These devices shall be listed as emergency relays under the UL924 standard and shall automatically close the load control relay(s) and provide 100% light output upon detection of loss or interruption of power sensed via line voltage connections.
- D. System Integration Capabilities
1. The system shall be capable of interface with third party building management systems (BMS) to support two-way communication using the industry standard BACnet/IP or BACnet/MSTP protocols.
    - a. Systems utilizing a third-party converter or systems that require a dedicated server to achieve integration are not acceptable.

### **2.03 SYSTEM SOFTWARE INTERFACES**

- A. Management Interface
1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.
  2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.
  3. All system software updates must be available for automatic download and installation via the internet.
- B. Historical Database and Analytics Interface
1. System shall provide a browser-based trending and monitoring interface that stores historical data for all occupancy/daylight sensors and lighting loads. Additionally, the system shall optionally upload that data to a cloud-based server.
- C. Visualization Interfaces
1. System shall provide an optional web-based visualization interface that displays a graphical floorplan. System data, to include status of occupancy sensors, daylight sensors and light output shall be overlaid to the floorplan to provide a graphical status page.
- D. Portable Programming Interface for Standalone Control Zones
1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
  2. Programming capabilities through the application shall include, but not be limited to, the following:
    - a. Switch, occupancy and photo sensor group configuration
    - b. Manual/automatic on modes
    - c. Turn-on dim level
    - d. Occupancy sensor time delays
    - e. Dual technology occupancy sensors sensitivity
    - f. Photo-sensor calibration adjustment and auto-setpoint
    - g. Trim level settings

### **2.04 SYSTEM BACKBONE AND SYSTEM INTEGRATION EQUIPMENT**

- A. System Controller
1. System Controller shall be a multi-tasking, real-time digital control processor consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
  2. System Controller shall perform the following functions:
    - a. Facilitation of global network communication between different areas and control zones.
    - b. Time-based control of downstream wired and wireless network devices.
    - c. Linking into an Ethernet network.
    - d. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.

- e. Connection to various software interfaces, including management interface, historical database and analytics interface, visualization interface, and personal control applications.
3. System Controller shall not require a dedicated PC or a dedicated cloud connection.
4. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.
5. Device shall have a standard and astronomical internal time clock.
6. Shall be capable of connecting to the customers Local Area Network (LAN) via IEEE 802.11.x Wireless and IEEE 802.3 Wired connection.
7. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
  - a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
  - b. BACnet/MSTP shall support 9600 to 115200 baud.
  - c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
  - d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

## 2.05 WIRED NETWORKED DEVICES

- A. Wired Networked Wall Switches, Dimmers, Scene Controllers
  1. Wall switches & dimmers shall support the following device options:
    - a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.
    - b. Control Types Supported: On/Off or On/Off/Dimming
  2. Scene controllers shall support the following device options:
    - a. Number of scenes: 1, 2 or 4
    - b. Control Types Supported:
      - 1) On/Off or On/Off/Dimming
      - 2) Preset Level Scene Type
      - 3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
      - 4) Selecting a lighting profile to be run by the system's upstream controller to implement a selected lighting profile across multiple zones
  3. Match color specified in Division 26 Section "Wiring Devices."
  4. Integral green LED pilot light to indicate when circuit is on.
  5. Internal white LED locator light to illuminate when circuit is off.
  6. Networked switch stations shall have backlit buttons.
  7. Wall Plates:
    - a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."
    - b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.
    - c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.
    - d. Verify back box requirements for multiple control points with manufacturer.
  8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.
- B. Wired Networked Auxiliary Input / Output (I/O) Devices
  1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:
    - a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
    - b. 0-10V analog input: Programmable to function as a daylight sensor.

- c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.
  - d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.
- C. Wired Networked Occupancy and Photosensors
1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
  2. Sensing technologies that are acoustically passive, meaning they do not transmit sound waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.
  3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
  4. Sensor mounting type shall match project design requirements as shown on plans.
    - a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
  5. The system shall support the following types of photocell-based control:
    - a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.
    - b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.
- D. Wired Networked Embedded Sensors
1. Embedded sensors shall support the following device options:
    - a. Occupancy Sensing technology: PIR only or Dual Tech
    - b. Daylight Sensing Option: Occupancy only, Daylight only, or combination Occupancy/Daylight sensor
- E. Distributed System Power, Switching and Dimming Controls
1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
  2. Device programming parameters shall be available and configurable remotely from the software and locally via the device push-button.
  3. Device shall be plenum rated.
  4. Devices shall be UL Listed for load and load type as specified on the plans.
- F. Wired Networked Luminaires
1. Networked luminaire shall have a factory installed mechanically integrated control device and carry a UL Listing as required.
  2. Networked LED luminaire shall provide low voltage power to other networked control devices.
  3. System shall be able to maintain constant lumen output over the specified life of the LED luminaire (also called lumen compensation) by automatically varying the dimming control signal to account for lumen depreciation.
  4. System shall be able to provide control of network luminaire intensity, in addition to correlated color temperature of specific LED luminaires.
  5. Controls manufacturer is responsible for primary troubleshooting and tech support of complete fixture.

## 2.06 WIRELESS NETWORKED DEVICES

- A. Wireless Networked Sensor Interface
1. The device shall be capable of broadcasting the following manual wall control commands: on, off, and adjust dim level.
- B. Wireless Networked Light Controllers (No Sensor)

1. The wireless light controller shall be capable of providing continuous dimming and on/off control of one commercial light fixture including fluorescent, HID, induction and LEDs.
  2. An external antenna attached to the luminaire shall not be allowed.
    - a. Each wireless light controller shall provide measurement capability of the amperage, voltage, wattage, and watt-hours of its controlled lighting.
- C. Wireless Networked Digital Sensors
1. In addition to providing Wireless Networked Light Controllers functionality, also provides:
    - a. Integrated digital occupancy sensing and digital photocell sensor.
    - b. Sensor shall connect directly to the wireless light controller and shall be suitable for embedding into the enclosure of a luminaire.
    - c. Sensor shall have software-adjustable settings
    - d. Photocell shall be suitable for closed and open loop applications.
- D. Wireless Network Communication Bridge
1. A communication bridge device shall be provided that interfaces with the System Controller via Owner's LAN connection and interfaces with wireless network.
  2. Device shall be capable of communicating with a group of a minimum of 250 wireless networked devices and luminaires, to reduce the amount of communication bridges required in the system.

## **2.07 CONDUCTORS AND CABLES**

- A. General: All conductors and cables shall comply with the requirements of Division 26 Section "Conductors and Cables." Where cable is permitted to be installed exposed in ceiling space, provide plenum rated cable.
- B. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG.
- C. Classes 2 and 3 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 22 AWG.
- D. Class 1 Control Cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
- E. Digital and Multiplexed Signal Cables: As required by system manufacturer. Provide plenum rated cables where installed exposed in ceiling space.

## **PART 3 EXECUTION**

### **3.01 WIRING INSTALLATION**

- A. The lighting control system shall be installed and connected as shown on the plans and as directed by the manufacturer.
- B. Comply with NECA 1.
- C. Wiring Method: Install wiring in raceways except where installed in accessible ceilings. Comply with Division 26 Sections "Conductors and Cables" and "Raceways and Boxes".
- D. Where cables are installed in finished areas with exposed construction, conceal cables from view. Route at top of structural systems and conceal on top of structural members where possible. Where cable is exposed to view, provide raceway. As an alternative to raceway, provide cable that is factory colored to match exposed ceiling. Submit sample to Architect for approval.
- E. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.
- F. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.
- G. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- H. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes as per manufacturers' recommendations.

- I. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."
- J. Label each relay with a unique designation.

### **3.02 FIELD QUALITY CONTROL**

### **3.03 INSTALLATION REQUIREMENTS**

- A. Review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
- B. Install and connect the networked lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals, plans and specifications.
- C. Coordination with Owner's IT Network Infrastructure to secure all required network connections to the owner's IT network infrastructure. Provide the owner's representative with all network infrastructure requirements of the networked lighting control system. Provide the manufacturer's representative with all necessary contacts pertaining to the owner's IT infrastructure, to ensure that the system is properly connected and started up.
- D. Verify integration and interoperability scope with the Mechanical Contractor prior to submittal phase and provide all necessary schedules to the Lighting Control manufacturer.

### **3.04 SYSTEM STARTUP**

- A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.
  1. Low voltage network cable testing shall be performed prior to system startup at the discretion of the manufacturer.
- B. System start-up and programming shall include:
  1. Verifying operational communication to all system devices.
  2. Programming the network devices into functional control zones to meet the required sequence of operation.
  3. Programming and verifying all sequence of operations.
  4. Customization of owner's software interfaces and applications.
- C. Initial start-up and programming are to occur on-site. Additional programming may occur on-site or remotely over the Internet as necessary.

### **3.05 DOCUMENTATION**

- A. Submit software database file with desired device labels and notes completed.
- B. Document the installed location of all networked devices, including networked luminaires. Provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

### **3.06 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections and assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  1. Test for circuit continuity.
  2. Verify that the control module features are operational.
  3. Check operation of local override controls.
  4. Test system diagnostics by simulating improper operation of several components selected by Architect.

### **3.07 SYSTEM COMMISSIONING**

- A. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent.
- B. Perform commissioning in the presence of the Owner's representative.

- C. Submit functional test plan checklist signed by the commissioning agent.

**3.08 SOFTWARE INSTALLATION**

- A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

**3.09 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting programming functions and other system parameters and to assist Owner's personnel in making program changes to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

**3.10 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to program, adjust, operate, and maintain lighting controls.  
B. Demonstration shall be done only after initial system start-up setup has occurred and system is functioning properly.  
C. Demonstration shall consist of a four-hour minimum session.

**3.11 MANUFACTURER SUPPORT**

- A. Manufacturer telephone support shall be available at no cost to the Owner during the warranty period and shall include the following:
1. Assistance in solving programming or other application issues pertaining to the control equipment.
  2. The manufacturer shall provide a toll-free number for direct technical support available 7 days a week, 24 hours a day.
  3. A factory authorized technician shall be located within a 100-mile radius of the project site.

**END OF SECTION**

## SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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### PART 1 GENERAL

#### 1.01 RELATED DOCUMENTS

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

#### 1.02 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
  - 1. Nonfusible switches.
  - 2. Molded-case circuit breakers.
- B. Related Sections:
  - 1. Division 26 "Hangers and Supports for Electrical Systems" for concrete bases.

#### 1.03 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. HD: Heavy duty.
- D. RMS: Root mean square.
- E. SPDT: Single pole, double throw.

#### 1.04 REFERENCES

- A. NECA 1: Practices for Good Workmanship in Electrical Contracting.
- B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).
- D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.
- E. NEMA FU 1: Low Voltage Cartridge Fuses.
- F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- I. NFPA 70: National Electrical Code.

### 1.05 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current rating.
  - 4. UL listing for series rating of installed devices.
  - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Qualification Data: For testing agency.
- D. Field quality-control test reports including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

### 1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

### 1.07 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

### 1.08 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 PRODUCTS

### 2.01 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## **2.02 TOGGLE DISCONNECT SWITCH**

- A. Manufacturers:
  1. Double Pole:
    - a. Hubbell 1372.
    - b. Leviton 6808G-DAC.
    - c. Pass & Seymour 7812.
    - d. Bryant 30102.
  2. Three Pole:
    - a. Hubbell 1379.
    - b. Leviton 7810GD.
    - c. Pass & Seymour 7813.
    - d. Bryant 30103.
- B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

## **2.03 MOLDED-CASE CIRCUIT BREAKERS**

- A. Manufacturers:
  1. Eaton Corporation; Cutler-Hammer Products.
  2. General Electric Co.; Electrical Distribution & Control Division.
  3. Siemens Industries, Inc.
  4. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
  1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
  2. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
  3. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as required.
- C. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
  1. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
  2. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
  3. Enclosure: Provide handle capable of being locked in the open position with padlock.
  4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

## **2.04 ENCLOSURES**

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  1. Indoor Dry Locations: NEMA 250, Type 1.
  2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 INSTALLATION**

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

- C. Install switches with off position down.
- D. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.
- E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.
- F. Install fuses in fusible disconnect switches.
- G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" whip.
- H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.
- I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- J. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.
- K. Support enclosures independent of connecting conduit or raceway system.
- L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

### **3.03 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."
- C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

### **3.04 FIELD QUALITY CONTROL**

- A. Prepare for acceptance testing as follows:
  - 1. Inspect mechanical and electrical connections.
  - 2. Verify switch and relay type and labeling verification.
  - 3. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### **3.05 CLEANING**

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

### **END OF SECTION 26 2816**

**SECTION 26 5119 - LED INTERIOR LIGHTING**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

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

**1.02 SUMMARY**

- A. Section Includes:
  - 1. Interior solid-state luminaires that use LED technology.
  - 2. Lighting fixture supports.
- B. Related Requirements:
  - 1. Division 26 "Lighting Control Devices."
  - 2. Division 26 "Lighting Control Systems"

**1.03 DEFINITIONS**

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lamp: LED and substrate as a replaceable assembly.
- F. LED: Light-emitting diode.
- G. Lumen: Measured output of lamp and luminaire, or both.
- H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

**1.04 SUBMITTALS**

- A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.
  - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.
- B. Shop Drawings: For nonstandard or custom luminaires.
  1. Include plans, elevations, sections, and mounting and attachment details.
  2. Include details of luminaire 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.
- C. Qualification Data: For testing laboratory providing photometric data for luminaires.
- D. Sample warranty.

#### **1.05 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
  1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

#### **1.06 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: 5% attic stock of each type and rating installed. Furnish at least one of each type.
  2. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.
  3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.

#### **1.07 QUALITY ASSURANCE**

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- E. Comply with:
  1. NFPA 70 - National Electrical Code.
  2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
  3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
  4. Code of Federal Regulations (47 CFR 37342).
  5. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.
- F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

### **1.08 DELIVERY, STORAGE, AND HANDLING**

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

### **1.09 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.

### **1.10 WARRANTY**

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) or manufacturer's standard warranty length (whichever is longer) from date of Substantial Completion.

## **PART 2 PRODUCTS**

### **2.01 PERFORMANCE REQUIREMENTS**

- A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.

### **2.02 LUMINAIRES (LIGHTING FIXTURES)**

- A. Acceptable alternate manufacturers are indicated. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.
- B. Provide Luminaires as included in Luminaire schedule shown on the drawings. The requirements of this section.

### **2.03 LUMINAIRE REQUIREMENTS**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.
- D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 4000 K.
- E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.
- F. Driver
  - 1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
  - 2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

### **2.04 EXIT SIGNS**

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

### **2.05 EMERGENCY AUTOMATIC LOAD CONTROL RELAY**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. [Bodine](#) BLCD Series.
  - 2. [Nine-24, Inc.](#): ELCR Series.
  - 3. LVS, EPC Series
  - 4. IOTA, ETS-20 Series
  - 5. Functional Devices, Inc., ESR Series
  - 6. ETC, ALCR Series
  - 7. Wattstopper, ELCU series

B. Description:

1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.
  2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device.
  3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
  4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.
  5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
  6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
  7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
  8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
  9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
  10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
  11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
  12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
  13. Plenum rated housing equipped with compression flying leads.
  14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.
- C. Provide device with proper rating for total load and load type being transferred
- D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.
- E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.

**2.06 MATERIALS**

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. 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.

C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

- D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage, and coating.
    - c. CCT and CRI for all luminaires.

### **2.07 METAL FINISHES**

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

### **2.08 LUMINAIRE FIXTURE SUPPORT COMPONENTS**

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 TEMPORARY LIGHTING**

- A. Do not use permanent luminaires for temporary lighting.

### **3.03 INSTALLATION**

- A. Install in accordance with manufacturer's instructions and N.E.C.A./I.E.S.N.A. 500-2006 and 502-2006.
- B. Locate ceiling luminaires as indicated on reflected ceiling plan.
- C. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
  - 1. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 2. 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 metal channels spanning and secured to ceiling tees.
- D. Support luminaires independent of ceiling framing. Support recessed grid luminaires from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- E. Install recessed luminaires to permit removal from below.
- F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- H. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.

- I. Supports:
  - 1. Sized and rated for luminaire weight.
  - 2. Able to maintain luminaire position after cleaning and relamping.
  - 3. Provide support for luminaire without causing deflection of ceiling or wall.
  - 4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
- J. Flush-Mounted Luminaire Support:
  - 1. Secured to outlet box.
  - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
  - 3. Trim ring flush with finished surface.
- K. Ceiling-Mounted Luminaire Support:
  - 1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports 120 inches in length.
- L. Suspended Luminaire Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
  - 3. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.
- M. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.
- N. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.
- O. Locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

### **3.04 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- C. Bond products and metal accessories to branch circuit equipment grounding conductor.
- D. Connect luminaires to branch circuit outlet boxes provided under Division 26 Section "Raceways and Boxes" using 1/2" flexible conduit.

### **3.05 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

### **3.06 FIELD QUALITY CONTROL**

- A. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.
- D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

### **3.07 STARTUP SERVICE**

- A. Comply with requirements for startup specified in Section 26 0943 "Lighting Control Systems."

### **3.08 ADJUSTING**

- A. Adjust exit sign directional arrows as indicated on Drawings.



- B. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner's representative and Architect/Engineer.

**3.09 CLEANING**

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures and lenses.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

**END OF SECTION**



**SECTION 28 3100 - FIRE ALARM**

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**PART 1 GENERAL**

**1.01 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
  - 1. Division 26 Section "Electrical General Requirements."

**1.02 SUMMARY**

- A. This Section includes design and installation of new devices onto an existing National Time and signal fire alarm system.

**1.03 DEFINITIONS**

- A. FACP: Fire alarm control panel.
- B. LED: Light-emitting diode.
- C. NICET: National Institute for Certification in Engineering Technologies.
- D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

**1.04 SYSTEM DESCRIPTION**

- A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.
  - 1. Interface with existing fire alarm system.
- B. Fire alarm system shall consist of the following:
  - 1. System smoke detection in areas identified on plans
  - 2. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.

3. Audible and visual notification appliances in newly renovated public and common areas of the building.

#### **1.05 PERFORMANCE REQUIREMENTS**

- A. Comply with NFPA 72.
- B. Comply with NFPA 70.
- C. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.
- D. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.
- E. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.
- F. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.
- G. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM's. Provide smoke detection as required by applicable codes.
- H. Premises protection includes Group E Type building use group.
  1. Refer to drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.

#### **1.06 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
  1. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire alarm system design.
    - b. Fire alarm certified by NICET, minimum Level III.
  2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.
  3. Device Address List: Include address descriptions that will appear on the FACP display.
  4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.
  5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.
  6. Batteries: Provide battery sizing calculations. Battery size shall be a minimum of 125% of the calculated requirement.
  7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  8. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show device layout, size and route of cable and conduits.
- C. Qualification Data: For Installer.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.
- F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain

approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

G. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
  - a. Hard copies on paper to Owner, Architect, and Authorities Having Jurisdiction.
  - b. Electronic media may be provided to Architect.

**1.07 QUALITY ASSURANCE**

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- 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.

**1.08 SEQUENCING AND SCHEDULING**

- A. Existing Fire Alarm Equipment: Maintain fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.
- B. Equipment Removal: After acceptance of the new fire alarm system, remove existing disconnected fire alarm equipment.

**1.09 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
  2. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
  3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
  4. Keys and Tools: One extra set for access to locked and tamperproofed components.
  5. Audible and Visual Notification Appliances: One of each type installed.
  6. Fuses: Two of each type installed in the system.

**PART 2 PRODUCTS**

**2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. FACP and Equipment:
    - a. National Time & Signal. (Expand the existing system as required)

**2.02 EXISTING FIRE ALARM SYSTEM**

- A. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.

**2.03 MANUAL FIRE ALARM BOXES**

- A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. 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 the FACP. Double action pull stations shall meet ADA guidelines.

2. Station Reset: Key- or wrench-operated switch.

## **2.04 SYSTEM SMOKE DETECTORS**

### **A. General Description:**

1. UL 268 listed, operating at 24-V dc, nominal.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

### **B. Photoelectric Smoke Detectors:**

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

### **C. Duct Smoke Detectors:**

1. Photoelectric Smoke Detectors:
  - a. Sensor: LED or infrared light source with matching silicon-cell receiver.
  - b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.
2. UL 268A listed, operating at 24-V dc, nominal.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
  - a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

## **2.05 NOTIFICATION APPLIANCES**

### **A. Description: Equipped for mounting as indicated and with screw terminals for system connections.**

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.
2. Finishes:
  - a. Wall mounted appliances: Provide red finish with white lettering.
  - b. Ceiling Mounted Appliances: Provide white finish with red lettering.

### **B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.**

### **C. Voice/Tone Speakers:**

1. UL 1480 listed.

2. High-Range Units: Rated 2 to 15 W.
  3. Low-Range Units: Rated 1 to 2 W.
  4. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.
- D. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
1. Rated Light Output: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.
  2. Strobe Leads: Factory connected to screw terminals.

#### **2.06 REMOTE STATUS AND ALARM INDICATORS**

- A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

#### **2.07 ADDRESSABLE INTERFACE DEVICE**

- A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

#### **2.08 ADDRESSABLE CONTROL MODULE**

- A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:
1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
  2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

#### **2.09 WIRE AND CABLE**

- A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.
- B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.
- C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):
1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
  2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
  3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Fire Alarm Circuits (NPLFA):
1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
    - a. Low-Voltage Circuits: No. 16 AWG, minimum.
    - b. Line-Voltage Circuits: No. 12 AWG, minimum.
  2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
  3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI

## **PART 3 EXECUTION**

### **3.01 EQUIPMENT INSTALLATION**

- A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.
  - 1. Connect new equipment to the existing control panel in the existing part of the building.
  - 2. Connect new equipment to the existing monitoring equipment at the Supervising Station.
  - 3. Expand, modify, and supplement the existing control and/or monitoring equipment as necessary to extend the existing control and/or monitoring functions to the new points.
  - 4. New components shall be capable of merging with the existing configuration without degrading the performance of either system.
- B. Smoke Detector Spacing:
  - 1. Smooth ceiling spacing shall not exceed 30 feet or the listed spacing of the detectors, whichever is less.
- C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
- D. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.
- E. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector that is above 10'-0" aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.
- F. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.
- G. Visible Alarm Notification Appliances: Install wall mounted appliances at 96" AFF or 6 inches below the ceiling, whichever is less.
- H. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.
- I. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.
- J. Install notification appliances on existing CMU walls on surface back-boxes matching the dimensions and finish of the notification appliance.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- L. Provide all 120V branch circuits for all control panels, sub panels, and ancillary equipment required for the system.

### **3.02 WIRING INSTALLATION**

- A. Install wiring according to the following:
  - 1. NECA 1.
  - 2. TIA/EIA 568-A.
- B. Wiring Method:
  - 1. Fire alarm circuits shall consist of multi-conductor cables installed in accessible ceiling spaces.
  - 2. Where ceilings consist of exposed construction, fire alarm multi-conductor cable shall be installed on top of joists, beams etc. and shall be concealed from view. Where the structural elements do not allow for the cable to be installed in a concealed fashion, then install the cable in conduit.
  - 3. Install fire alarm cable in conduit in mechanical rooms, loading docks and similar service spaces.
  - 4. Drops to surface mounted devices shall be installed in conduit or surface raceway. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
  - 5. Drops to devices recessed in partition walls shall be installed in conduit.
  - 6. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.



7. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits, if the system manufacturer permits it.
- 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 a different color-code 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 conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### **3.03 IDENTIFICATION**

- A. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Electrical Identification."
- B. Install instructions frame in a location visible from the FACP.
- C. Paint power-supply disconnect switch red and label "FIRE ALARM."

### **3.04 GROUNDING**

- A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

### **3.05 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
- B. Perform the following field tests and inspections and prepare test reports:
  1. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.
    - a. Include the existing system in tests and inspections.
  2. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.
  3. Testing: Follow procedure and record results complying with requirements in NFPA 72.
  4. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

### **3.06 PROGRAMMING**

- A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

**3.07 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.
- B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

**3.08 WARRANTY**

- A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

**END OF SECTION**