

PROJECT MANUAL

PROJECT:

TROY HIGH SCHOOL KITCHEN REMODEL

OWNER:

TROY SCHOOL DISTRICT
4400 Livernois Road
Troy, Michigan 48098

TMP PROJECT NO.: 22104G

BID PACKAGE NO.: 6

DATE: October 25, 2024

ISSUED FOR: CONSTRUCTION DOCUMENTS

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Troy High School Kitchen Remodel
TMP22104G

This Document has been prepared under the supervision of the Architect and/or Professional Engineer as indicated by their individual License Seals affixed hereon.

Professional License Seals

<div>Seal</div>	<div>Seal</div>	<div>Seal</div>
TMP Architecture, Inc. Architect	Peter Basso Associates, Inc. Mechanical Engineer	Peter Basso Associates, Inc. Electrical Engineer

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Not Used

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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 TROY HIGH SCHOOL KITCHEN REMODEL, dated 10-25-2024 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 00 8200.02 - TMP ELECTRONIC FILES RELEASE FORM (FREE)**RE: AUTHORIZATION FORM FOR CAD FILE TRANSFERS****PROJECT NAME:** _____**TMP PROJECT NO. :** _____ **BID PACK NO.**

Dear Sir/Madam:

Per your request, TMP Architecture, Inc. will electronically transmit requested CAD files upon receipt of an original signed copy of this form which states the conditions of agreement and the receipt of the required compensation fee.

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 items 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 for providing this material will be as follows: **\$0.00 / No Charge**
7. A signed copy of this form must be provided before files will be released. Please remit to [Construction Manager] to be forwarded to the Project Manager at TMP Architecture, Inc. and allow five working days for processing.

REQUESTED DRAWINGS: __________
_____**FIRM REQUESTING FILES:**

Company: _____

Address: _____

Signed: _____ Date: _____

Printed Name / Title: _____

Email: _____

TO BE COMPLETED BY TMP ARCHITECTURE, INC.

Released(signed by): _____ TMP Architecture, Inc.

Printed Name/Title: _____ Date: _____

END OF SECTION

SECTION 01 2200 - UNIT PRICES**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.02 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.03 MEASUREMENT OF QUANTITIES

- A. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect.
- B. Assist by providing necessary equipment, workers, and survey personnel as required.

1.04 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products remaining on hand after completion of the Work.

1.05 SCHEDULE OF UNIT PRICES

- A. Unit Price 1 - Remedial Floor Coating
 - 1. Description: Provide a unit cost for concrete slab remedial floor coating work as specified in Section 09 0561 Common Work Results for Flooring Preparation.
 - 2. Unit of Measurement: Square Feet.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION - NOT USED****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.
- B. Substitutions: Any proposed substitution to be evaluated by the Architect and accepted as stipulated below.

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. Submittal Time Restrictions:
- B. 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.
- C. 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 within 14 days of 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.
 - 4. Submit RFIs through Procore, email, or other approved method agreed to by the Architect and Owner.
 - a. RFIs submitted via an internet-based submittal service are to send electronic documents to the Architect via email with a downloadable link.
- 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 Procore, email, or other approved method agreed to by the Architect and Owner.
 - a. Submittals via an internet-based submittal service are to send electronic documents to the Architect via email with a downloadable link.
 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 calendardays.

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.

2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit", "Not Approved - Resubmit", or language with the same legal meaning.
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.
3. Not Authorizing manufacturer:
 - a. Rejected - Resubmit, or language with the same legal meaning.
- 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 3000.01

CONST. MANAGER / CONTRACTOR		PROJECT	TMP PROJECT NO.		DATE SUBMITTED		SUBMITTAL NO.						
Name and Address:		Title:	22104G										
		Troy High School Kitchen Remodel	* ACTION CODES				Initial Submittal <input type="checkbox"/>						
			R	Reviewed – No Exceptions Taken			Resubmittal <input type="checkbox"/>						
			RN	Reviewed with Corrections Noted									
			RR	Revise and Resubmit									
Email:		Location:	X	Not Approved – Resubmit			REVIEWED BY						
		Troy School District Troy, Michigan	NA	No Action Taken – Not Reviewed			TMP <input type="checkbox"/>						
Phone:			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"													
<i>Submittal Stamps may be placed on subsequent blank page.</i>													
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.									
									CONTRACTOR NAME				
									SIGNATURE				

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

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

1.02 REFERENCE STANDARDS

- A. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- B. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- C. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

1.03 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.

1.04 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.

1.05 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.

1.06 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.

1.07 REFERENCES AND STANDARDS

- A. Comply with reference standard of date of issue current on date of Contract Documents, except where a specific date is established by applicable code.
- B. Obtain copies of standards where required by product specification sections.
- C. Maintain copy at project site during submittals, planning, and progress of the specific work, until Substantial Completion.

1.08 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. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- J. 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; 2021.
 - 5. Mechanical Code: Michigan Mechanical Code; 2021.
 - 6. Electrical Code: NFPA 70 - National Electric Code; 2023.
 - a. Includes 2023 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; 2016.
 - b. ASME A18.1- Safety Standard for Platform Lifts and Stairway Chairlifts; 2017.
 - c. 2023 Michigan Elevator Safety Board General Rules.
 - 8. Boiler Code: Michigan Boiler Code.
 - a. Includes the following:
 - 1) ASME Boiler and Pressure Vessel Codes; 2019.
 - 2) National Board Inspection Code; 2019.
 - 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; 2023.

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 01 7800 - CLOSEOUT SUBMITTALS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 - 2. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED**PART 3 EXECUTION****3.01 PROJECT RECORD DOCUMENTS**

- A. General:
 - 1. Project Record Documents include:
 - a. Complete set of Record Drawings.
 - b. Complete set of Record Submittals.
 - c. Complete set of Specifications.
 - 2. Project Record Documents shall be submitted in electronic form.
 - a. File Format: Portable Document Format (PDF).
 - b. Files shall be named and organized in a searchable, easy to understand, system.
 - 3. Ensure entries are complete and accurate, enabling future reference by Owner.
 - 4. Record information concurrent with construction progress.
- B. Record Drawings: Record Drawings shall include the following:
 - 1. Complete set of Drawings.
 - a. Indicate and record actual construction including, but not limited to, the following:
 - 1) Show all systems and assemblies as they exist at completion of the Work.
 - 2) Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - 3) Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 - 4) Field changes of dimension and detail.
 - 5) Details not on original Contract drawings.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.

- C. Record Submittals: Record Submittals shall include the following:
 - 1. Complete set of Submittals, including resubmittals.
 - 2. Shop Drawings shall indicate all field changes and other variations from the Submittal as originally reviewed by Architect.
- D. Specifications: Specifications shall include the following:
 - 1. Complete Project Manual including all specifications, front end material, reports, and information available to bidders, as originally bid.
 - 2. Addenda.
 - 3. Change Orders and other modifications to the Contract.

3.02 OPERATION AND MAINTENANCE DATA

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

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Additional information as specified in individual product specification sections.
- D. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.

- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- M. Include test and balancing reports.
- N. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

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

3.06 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.
- E. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- F. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
- G. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- H. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

END OF SECTION

SECTION 01 7900 - DEMONSTRATION AND TRAINING**PART 1 GENERAL****1.01 SUMMARY**

- A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.

1.02 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures; except:
- B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit not less than four weeks prior to start of training.
 - 2. Revise and resubmit until acceptable.
 - 3. Provide an overall schedule showing all training sessions.
 - 4. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.03 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.
- B. Coordination: Coordinate demonstration and training of this section with project commissioning requirements.

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

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.
- C. Demonstration may be combined with Owner personnel training if applicable.
- D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.

- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

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

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.
- D. Salvaged items.
- E. 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**PART 3 EXECUTION****3.01 SCOPE**

- A. Remove portions of existing building as indicated on Drawings including, but not limited to, the following:
 - 1. Doors, ceilings, flooring, and equipment as indicated..
 - 2. Remove other items indicated, for salvage and relocation.

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, 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. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI (RWP). Do not use methods requiring solvent-based adhesive strippers.
- D. 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 scraper, 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 SECTION INCLUDES**

- A. Concrete formwork.
- B. Elevated concrete slabs.
- C. Floors and slabs on grade.
- D. Concrete foundation walls.
- E. Concrete reinforcement.
- F. Joint devices associated with concrete work.
- G. Miscellaneous concrete elements, including equipment pads, light pole bases, flagpole bases, and other items as indicated on Drawings.
- H. Concrete curing.
- I. Products installed under this section:
 - 1. Manufactured reglets cast in concrete; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.

1.02 RELATED REQUIREMENTS**1.03 REFERENCE STANDARDS**

- A. ACI 117 - Specification for Tolerances for Concrete Construction and Materials; 2010 (Reapproved 2015).
- B. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- C. ACI 301 - Specifications for Concrete Construction; 2020.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- E. ACI 308R - Guide to External Curing of Concrete; 2016.
- F. ACI 347R - Guide to Formwork for Concrete; 2014 (Reapproved 2021).
- G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2018.
- H. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
- I. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- J. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2018.
- K. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2019a.
- L. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- M. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- N. ASTM C150/C150M - Standard Specification for Portland Cement; 2018.
- O. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2020.
- P. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2023.
- Q. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- R. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
- S. ASTM C618 - Standard Specification for Coal Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2023, with Editorial Revision.

- T. ASTM C1059/C1059M - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete; 2013.
- U. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- V. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- W. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.
- X. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).
- Y. ASTM D8139 - Standard Specification for Semi-Rigid, Closed-Cell Polypropylene Foam, Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction; 2023.
- Z. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- AA. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
- BB. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
- CC. NSF 372 - Drinking Water System Components - Lead Content; 2022.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix designs.
 - 1. Indicate where each mix design will be used.
- D. Samples: Submit samples of underslab vapor retarder to be used.
- E. Concrete jointing plan, if not indicated on Drawings.
- F. Test Reports: Submit report for each test or series of tests specified.
- G. Field Quality Control Reports: Provide the following:
 - 1. F(F) Floor Flatness and F(L) Floor Levelness measurements as specified.
- H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Slabs with Moisture Vapor Reducing Admixture (MVRA): Provide warranty to cover the cost of flooring failures due to moisture migration from slabs for life of the concrete.
 - 1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.
- C. Stained and Polished Finish Systems:
 - 1. Provide 10 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI 347R to provide formwork that will produce concrete complying with tolerances of ACI 117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.

1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
2. Form Release Agent: Capable of releasing forms from hardened concrete without staining or discoloring concrete or forming bugholes and other surface defects, compatible with concrete and form materials, and not requiring removal for satisfactory bonding of coatings to be applied.
 - a. Composition: Water-based, reactive, natural organic chemicals.
 - b. VOC Content: None; water-based.
 - c. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
 - 1) SpecChem, LLC; Bio Strip WB: www.specchemllc.com.
 - 2) The Euclid Chemical Company; Formshield WB: www.euclidchemical.com.
 - 3) W. R. Meadows, Inc; Duogard II: www.wrmeadows.com.
3. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.02 REINFORCEMENT MATERIALS

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi).
 1. Type: Deformed billet-steel bars.
 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
 1. Form: Flat Sheets.
 2. WWR Style: As indicated on drawings.
- C. Reinforcement Accessories:
 1. Tie Wire: Annealed, minimum 16 gauge, 0.0508 inch.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.03 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type. Provide _____ manufactured by _____.
- B. Fine and Coarse Aggregates: ASTM C33/C33M.
- C. Fly Ash: ASTM C618, Class C or F.
- D. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

2.04 ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Air Entrainment Admixture: ASTM C260/C260M.
- C. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- D. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- E. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- F. Retarding Admixture: ASTM C494/C494M Type B.
- G. Water Reducing Admixture: ASTM C494/C494M Type A.
- H. Moisture Vapor Reduction Admixture (MVRA): ASTM C494/C494M, Type S; liquid, inorganic admixture free of volatile organic compounds (VOCs) and formulated to permanently close capillary systems formed during curing to reduce moisture vapor emission and transmission with no adverse effect on concrete properties or finish flooring.
 1. Products:
 - a. Barrier One, Inc; CPS Admix - Moisture Vapor Reduction Admixture (MVRA): www.barrierone.com.
 - b. ISE Logik Industries, Inc; MVRA 900: www.iselogik.com.

- c. Specialty Products Group; Vapor Lock 20/20: www.spggogreen.com.
- d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Underslab Vapor Retarder:
 - 1. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
 - 2. Minimum Thickness: 15 mil.
 - 3. Products:
 - a. Fortifiber Building Systems Group: www.fortifiber.com.
 - b. Inteplast Group; Barrier-Bac VB-350: www.barrierbac.com.
 - c. ISI Building Products; Viper VaporCheck II 15-mil (Class A): www.isibp.com.
 - d. Poly-America; Husky Yellow Guard 15-mil Vapor Barrier: www.yellowguard.com.
 - e. Stego Industries, LLC; 15 mil: www.stegoindustries.com.
 - f. W. R. Meadows, Inc; PERMINATOR Class A - 10 mils (0.25 mm): www.wrmeadows.com.
 - g. Substitutions: See Section 01 6000 - Product Requirements.
- B. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Grout: Comply with ASTM C1107/C1107M.
 - 2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
 - 3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.
 - 4. Low-Slump, Dry Pack Products:
 - a. Euclid Chemical Company; DRY PACK GROUT: www.euclidchemical.com/#sle.
 - b. Five Star Products, Inc; Five Star Grout: www.fivestarproducts.com/#sle.
 - c. Substitutions: See Section 01 6000 - Product Requirements.

2.06 BONDING AND JOINTING PRODUCTS

- A. Latex Bonding Agent: Non-redispersable acrylic latex, complying with ASTM C1059/C1059M, Type II.
- B. Waterstops: Bentonite and butyl rubber, complying with NSF 61 and NSF 372.
 - 1. Configuration: As indicated on drawings.
 - 2. Size: As indicated on drawings.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
 - 2. Material: ASTM D1752, recycled PVC (Type IV).
 - 3. Material: ASTM D8139, semi-rigid, closed-cell polypropylene foam.
 - 4. Products:
 - a. Oscoda Plastics, Inc; Proflex Vinyl Expansion Joints: www.oscodaplastics.com.
 - b. W. R. Meadows, Inc; Fiber Expansion Joint Filler with Snap-Cap: www.wrmeadows.com/#sle.
 - c. W. R. Meadows, Inc; Deck-O-Foam Joint Filler with pre-scored top strip: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
- D. Dowel Sleeves: Plastic sleeve for smooth, round, steel load-transfer dowels.

2.07 CURING MATERIALS

- A. Moisture-Retaining Sheet: ASTM C171.
 - 1. Polyethylene film, white opaque, minimum nominal thickness of 4 mil, 0.004 inch.
 - 2. White-burlap-polyethylene sheet, weighing not less than 3.8 ounces per square yard.
- B. Water: Potable, not detrimental to concrete.

2.08 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
 - 1. Provide moisture vapor reduction admixture in slabs to receive adhesively applied flooring.
- C. Normal Weight Concrete:
 - 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: 4,000 pounds per square inch.
 - 2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
 - 3. Cement Content: Minimum 470 pounds per cubic yard.
 - 4. Water-Cement Ratio: Maximum 45 percent by weight.
 - 5. Total Air Content: Determined in accordance with ASTM C173/C173M.
 - a. Concrete exposed to freeze thaw cycle: 6 percent, plus or minus 1 percent at point of delivery.
 - b. Hard troweled interior concrete: Do not exceed 3 percent.
 - 6. Maximum Slump: 4 inches (without admixtures).
 - 7. Maximum Aggregate Size: 1 inch.
- D. Concrete mix design requirements for concrete floor slabs to be stained and polished as specified in Section 03 3511 - Concrete Floor Finishes.
 - 1. Aggregates: Uniformly graded mix of not less than 3 aggregate sizes; fine, intermediate and large.
 - 2. Admixtures: Less than 1 to 2 percent of total mix weight.
 - 3. Materials replacing portions of portland cement shall not exceed 10 percent of the portland cement volume and should not be calcium chloride based. Includes, but is not limited to, the following:
 - a. Plasticizers.
 - b. Slag
 - c. Fly ash.
 - 4. Compressive Strength: 4,000 psi, minimum, at 28 days.
 - 5. Water-Cement Ratio: Maximum 45 percent by weight.

2.09 MIXING

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

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify lines, levels, and dimensions before proceeding with work of this section.

3.02 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning and applying bonding agent in according to bonding agent manufacturer's instructions.
 - 1. Use latex bonding agent only for non-load-bearing applications.

- E. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.
- F. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Comply with ASTM E1643. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
 - 1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings. Do not use sand.

3.03 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

3.04 CONCRETE REQUIREMENTS AT HARD TILE FLOOR FINISHES

- A. Hard tile specified in Section 09 3000 - Hard Tiling shall be installed on concrete floor slabs without control joints and slab jointing.
- B. Unless more stringent requirements are indicated, provide the following minimum requirements at concrete floor slabs where hard tile finishes shall be installed:
 - 1. Concrete Floor Slab Thickness: 5 inches.
 - 2. Reinforcement: No. 4 reinforcing steel (rebars) at 12 inches on center each way.
 - a. Fiber reinforcement is not permitted.
 - 3. Control Joints and Slab Jointing: None permitted.

3.05 PLACING CONCRETE

- A. Place concrete in accordance with ACI 304R.
- B. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- C. Ensure reinforcement, inserts, waterstops, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- D. Place concrete continuously without construction (cold) joints wherever possible; where construction joints are necessary, before next placement prepare joint surface by removing laitance and exposing the sand and sound surface mortar, by sandblasting or high-pressure water jetting.

3.06 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide finish as follows:
 - 1. Grout Cleaned Finish: Wet areas to be cleaned and apply grout mixture by brush or spray; scrub immediately to remove excess grout. After drying, rub vigorously with clean burlap, and keep moist for 36 hours.
- D. In areas with floor drains, maintain floor elevation at walls; pitch surfaces uniformly to drains as indicated on drawings.
- E. Exterior concrete platforms, steps, and ramps, and elsewhere as indicated shall have broom finish.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 - 2. Coordinate required final finish with Architect before application.
- F. Concrete polishing and staining See Section 03 3511.
- G. Concrete liquid densifier/hardener: See Section 03 3511 - Concrete Floor Finishes.

3.07 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than seven days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.

3.08 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of concrete operations.
- D. Tests of concrete and concrete materials may be performed at any time to ensure compliance with specified requirements.
- E. Compressive Strength Tests: ASTM C39/C39M, for each test, mold and cure three concrete test cylinders. Obtain test samples for every 100 cubic yards or less of each class of concrete placed.
- F. Take one additional test cylinder during cold weather concreting, cured on job site under same conditions as concrete it represents.
- G. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C143/C143M.

3.09 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not complying with required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect. The cost of additional testing shall be borne by Contractor when defective concrete is identified.
- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect for each individual area.

3.10 PROTECTION

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

END OF SECTION

SECTION 03 5400 - CAST UNDERLAYMENT**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Liquid-applied self-leveling floor underlayment.
 - 1. Use cementitious type at locations indicated.

1.02 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- B. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
- C. ASTM C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars; 2019.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data sheets documenting physical characteristics and product limitations of underlayment materials. Include information on surface preparation, environmental limitations, and installation instructions.
- C. Manufacturer's Instructions.

1.04 QUALITY ASSURANCE

- A. Applicator Qualifications: Company specializing in performing the work of this section, and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Keep dry and protect from direct sun exposure, freezing, and ambient temperature greater than 105 degrees F.

1.06 FIELD CONDITIONS

- A. Do not install underlayment until floor penetrations and peripheral work are complete.
- B. Maintain minimum ambient temperatures of 50 degrees F 24 hours before, during and 72 hours after installation of underlayment.
- C. During the curing process, ventilate spaces to remove excess moisture.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Cementitious Underlayment:
 - 1. ARDEX Engineered Cements; ARDEX K 15: www.ardexamericas.com.
 - 2. Custom Building Products; TechLevel 150 Self-Leveling Underlayment: www.custombuildingproducts.com.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Cementitious Underlayment: Blended cement mix, that when mixed with water in accordance with manufacturer's directions will produce self-leveling underlayment with the following properties:
 - 1. Compressive Strength: Minimum 4000 pounds per square inch after 28 days, tested per ASTM C109/C109M.
 - 2. Flexural Strength: Minimum 1000 psi after 28 days, tested per ASTM C348.
 - 3. Final Set Time: 1-1/2 to 2 hours, maximum.
 - 4. Thickness: Capable of thicknesses from 1/8 inch to 1-1/2 inch without additional aggregate.
- B. Aggregate: Dry, well graded, washed silica aggregate, approximately 1/4 inch in size and acceptable to underlayment manufacturer.

- C. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to underlayment mix materials.
- D. Primer: Manufacturer's recommended type.
- E. Joint and Crack Filler: Latex based filler, as recommended by manufacturer.

2.03 MIXING

- A. Site mix materials in accordance with manufacturer's instructions.
- B. Add aggregate for areas where thickness will exceed 1-1/2 inch. Mix underlayment and water for at least two minutes before adding aggregate, and continue mixing to assure that aggregate has been thoroughly coated.
- C. Mix to self-leveling consistency without over-watering.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that substrate surfaces are clean, dry, unfrozen, do not contain petroleum byproducts, or other compounds detrimental to underlayment material bond to substrate.

3.02 PREPARATION

- A. Concrete: Mechanically prepare steel troweled concrete to create a textured surface necessary to achieve the best bond; acceptable methods include bead blasting and scarifying. Do not use acid etching.
- B. Remove substrate surface irregularities. Fill voids and deck joints with filler. Finish smooth.
- C. Vacuum clean surfaces.
- D. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- E. Close floor openings.

3.03 APPLICATION

- A. Install underlayment in accordance with manufacturer's instructions.
- B. Pump or pour material onto substrate. Do not retemper or add water.
 - 1. Pump, move, and screed while the material is still highly flowable.
 - 2. Be careful not to create cold joints.
 - 3. Wear spiked shoes while working in the wet material to avoid leaving marks.
- C. Place to indicated thickness, with top surface level to 1/8 inch in 10 ft.
- D. For final thickness over 1-1/2 inches, place underlayment in layers. Allow initial layer to harden to the point where the material has lost its evaporative moisture. Immediately prime and begin application of the subsequent layer within 24 hours.
- E. Where additional aggregate has been used in the mix, add a top layer of neat mix (without aggregate), if needed to level and smooth the surface.
- F. If a fine, feathered edge is desired, steel trowel the edge after initial set, but before it is completely hard.

3.04 CURING

- A. Once underlayment starts to set, prohibit foot traffic until final set has been reached.
- B. Air cure in accordance with manufacturer's instructions.

3.05 PROTECTION

- A. Protect against direct sunlight, heat, and wind; prevent rapid drying to avoid shrinkage and cracking.
- B. Do not permit traffic over unprotected floor underlayment surfaces.

END OF SECTION

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

- A. Shop fabricated steel items, including:
 - 1. Steel framing supports for the following:
 - a. Roof openings.
 - b. Mechanical and electrical equipment.
 - c. Applications where framing and supports are not specified in other Sections.
 - d. Other items as indicated on Drawings.
 - 2. Other items as indicated on Drawings.
- B. Slotted channel framing.

1.02 REFERENCE STANDARDS

- A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- I. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
- J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2022).
- L. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- M. SSPC-SP 2 - Hand Tool Cleaning; 2018.

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. Pipe: ASTM A53/A53M, Grade B Schedule 40, black and hot-dip galvanized finish, as indicated.
- E. Slotted Channel Framing:
 - 1. Slotted Channel Framing: ASTM A653/A653M Grade 33.
 - a. Channel Size: 1-5/8 by 1-5/8 inches.
 - b. Thickness: 0.060 inch (16 gage), minimum.
 - c. Finish: Galvanized, G90 coating.
 - 2. Fittings and Fasteners: Manufacturer's standard fittings and fasteners; finished to match slotted channel framing.
- F. Bolts, Nuts, and Washers: ASTM A307, Grade A, galvanized to ASTM A153/A153M where connecting galvanized components.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- I. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, complying with VOC limitations of authorities having jurisdiction.
- J. 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 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
 - 1. Fabricate units from slotted channel framing where indicated.
- C. Finish: Prime painted unless otherwise indicated or at an exterior location.

- D. Fabricate support for suspended toilet partitions as follows:
 - 1. Beams: Continuous steel shapes of size required to limit deflection to L/360 between hangers, but use not less than C8x11.5 channels or another shape with equivalent structural properties.
 - 2. Hangers: Steel rods, 1/2 inch in diameter, spaced not more than 36 inches o.c.
 - a. Thread rods to receive anchor and stop nuts.
 - b. Fit hangers with wedge shape washers for full bearing on sloping flanges of support beam.
 - 3. Braces and Angles: Steel angles of size required to rigidly brace and support beams.
- E. Roof Openings: Unless otherwise indicated, provide steel support framing for roof openings as follows:
 - 1. Provide steel support framing around entire perimeter of roof opening; span support framing between primary framing or purlins.
 - 2. Size steel framing not less than the following for spans indicated:
 - a. Up to 5 feet: C4x5.4 or L4x4x1/4.
 - b. 5 to 7 feet: C5x6.7 or L5x3-1/2x1/4 (LLV).
 - c. 7 to 10 feet: C6x8.2 or L6x3-1/2x5/16 (LLV).
 - d. Refer to Drawings for conditions other than those listed above.
 - 3. Limit deflection to L/240.

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 BENT METAL RESTRAINTS

- A. Space restraints 24 inches on center at top of masonry walls, staggered each side of wall.
- B. Secure restraints to substrates with appropriate anchors.

3.05 MISCELLANEOUS FRAMING AND SUPPORTS

- A. Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.06 BOLLARDS

- A. Standard Fixed Bollards:
 - 1. Anchor bollards in place with concrete footings.
 - a. Center and align bollards in holes 3 inches above bottom of excavation.
 - b. Place concrete and vibrate or tamp for consolidation.
 - c. Support and brace bollards in position until concrete has cured.
 - d. Hold top of concrete 8 inches below finish grade, unless otherwise indicated.
 - 2. Fill bollards solidly with concrete, mounding top surface to shed water.
 - 3. Refer to Section 03 3000 "Cast-in-place Concrete" for concrete.
- B. Surface Mounted Bollards:
 - 1. Anchor bollard baseplate to existing construction with expansion anchors. Provide four anchors per baseplate, unless otherwise indicated.
- C. Install sleeve covers according to manufacturer's written instructions.

3.07 PREFABRICATED STAIR NOSINGS

- A. Install stair nosings in one piece for full width of nosing less 1 inch on each side; where possible.
- B. Coordinate installation of stair nosings with installation of cast-in-place concrete; refer to Section 03 3000 - Cast-in-Place Concrete.
- C. Apply protective coating to concealed surfaces of prefabricated metal stair nosings in contact with concrete.

3.08 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 06 1000 - ROUGH CARPENTRY**PART 1 GENERAL****1.01 SECTION INCLUDES**

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

1.02 REFERENCE STANDARDS

- A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
- 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; 2018a.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
- G. PS 1 - Structural Plywood; 2009.
- H. PS 20 - American Softwood Lumber Standard; 2015.

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, 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. Communications and Electrical Room Mounting Boards: PS 1 A-D plywood, or medium density fiberboard; 3/4 inch thick; flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- 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. 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.
 - b. Liquid Nails, a brand of PPG Industries, Inc.; LN-903 Heavy Duty Construction Adhesive (Low VOC): 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 AWPA 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 AWPA standards.
- B. Fire Retardant Treatment:
 - 1. Manufacturers:
 - a. Lonza Group: www.wolmanizedwood.com.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com.
 - c. Koppers, Inc: www.koppersperformancechemicals.com.

- d. Viance, LLC: www.treatedwood.com.
- e. Substitutions: See Section 01 6000 - Product Requirements.
- 2. Exterior Type: AWP A 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: 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.
 - b. Interior rough carpentry items are to be fire retardant treated.
- C. Preservative Treatment:
 - 1. Manufacturers:
 - a. Lonza Group: www.wolmanizedwood.com.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com.
 - c. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
 - d. Viance, LLC: 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 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: 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 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: 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.

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 ROOF-RELATED CARPENTRY

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

3.07 INSTALLATION OF CONSTRUCTION PANELS

- A. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.

2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
3. Install adjacent boards without gaps.
4. Size and Location: As indicated on drawings.

3.08 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.
- B. Allow preservative to dry prior to erecting members.

3.09 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.

3.10 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 07 8400 - FIRESTOPPING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Firestopping systems.
 - 1. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2020a.
- D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2020a.
- E. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- F. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.
- G. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Schedule of Firestopping: List each type of penetration, each type of joint, fire rating of the penetrated assembly, firestopping test or design number, and illustration of each firestopping system.
- C. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- D. Installer's qualification statement.

1.04 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD) will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Verification of minimum 5 years documented experience installing work of this type.

1.05 MOCK-UPS

- A. Install one firestopping assembly representative of each fire rating design required on project.
 - 1. Where one design may be used for different penetrating items or in different wall or floor constructions, install one assembly for each different combination.
 - 2. Where firestopping is intended to fill a linear opening, install at least 1 linear foot of firestopping.
- B. If accepted, mock-up will represent minimum standard for this work.
- C. If accepted, mock-up may remain as part of this work. Remove and replace mock-ups not accepted.

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
1. 3M Fire Protection Systems; www.3m.com.
 2. A/D Fire Protection Systems; www.adfire.com.
 3. Hilti Firestop; www.hilti.com.
 4. RectorSeal Firestop; www.rectorseal.com.
 5. Specified Technologies, Inc. (STI); www.stifirestop.com.
 6. Tremco Fire Protection Systems; www.tremcofirestop.com.
 7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Firestopping Materials: Any materials complying with firestopping assembly design requirements including, but not limited to, the following:
1. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
 2. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.
 3. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
 4. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.
 5. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.
 6. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
 7. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
 8. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.
 9. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
 10. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants
- B. Accessory Materials: For each firestopping assembly, provide all primers, forming/damming/backing materials, collars, sleeves, and related materials for a complete installation.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. General:
1. Provide firestopping assemblies indicated, or, if not indicated, as required to comply with fire ratings indicated.
 2. Fire Ratings: As indicated on Drawings.
 3. Joint Firestopping:
 - a. Nominal Widths: As indicated on Drawings.
 - b. Movement Capabilities: Class 1, 50 percent compression or extension, unless otherwise indicated or required.

- B. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
 - a. Temperature Rise: Provide systems that have been tested to show T Rating as indicated or required.
 - b. Air Leakage: Provide systems that have been tested to show L Rating as indicated, at Smoke Barriers, and elsewhere as indicated or required.
 - c. Watertightness: Provide systems that have been tested to show W Rating as indicated or required.
- C. Joint Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which joint firestopping systems are installed. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
1. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
 - a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
 - b. Temperature Rise: Provide systems that have been tested to show T Rating as indicated or required.
 - c. Air Leakage: Provide systems that have been tested to show L Rating as indicated or required..
 - d. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated or required..
 2. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
 - a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
 3. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
 - a. Movement: Provide systems that have been tested to show movement capability as indicated or required.
 - b. Air Leakage: Provide systems that have been tested to show L Rating as indicated or required.
 - c. Watertightness: Provide systems that have been tested to show W Rating as indicated or required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by Owner's Independent Testing Agency.
- C. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 IDENTIFICATION

- A. General: Install labeling required by code.
- B. Wall Identification:
 - 1. Permanently label walls containing penetration firestopping systems with the words "FIRE /SMOKE BARRIER - PROTECT ALL OPENINGS."
 - a. Use lettering not less than 3 inches high and with minimum 0.375-inch strokes.
 - 2. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- C. Penetration Identification:
 - 1. Identify each penetration firestopping system with legible metal or plastic labels.
 - 2. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems.
 - 3. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed.
 - 4. Include the following information on labels:
 - a. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - b. Manufacturer's name.
 - c. Installer's name, address, and phone number.
 - d. Designation of applicable testing and inspecting agency.
 - e. Date of installation.

3.05 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Inspection agency employed and paid by Owner, may examine penetration firestopping in accordance with ASTM E2174, and ASTM E2393.
- B. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.06 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.07 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.
- D. Section 07 8400 - Firestopping: Firestopping sealants.
- E. Section 07 9100 - Preformed Joint Seals: Precompressed foam, gaskets, and strip seals.
- F. Section 08 8000 - Glazing: Glazing sealants and accessories.
- G. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.02 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- H. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- I. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- J. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.03 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.
- G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.04 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.
 2. Otherwise, if Owner does not employ an independent testing agency, Contractor shall perform its own field quality control measures including the following:
 - a. Field Quality Control Plan and Log.
 - b. Field Adhesion Test Procedures.
- E. Field Quality Control Plan:
 1. Visual inspection of entire length of sealant joints.
 2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 120 inches thereafter.
 - b. If any failures occur in the first 10 linear feet, continue testing at 48 inch intervals at no extra cost to Owner.
- F. Field Adhesion Test Procedures:
 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 2. Have a copy of the test method document available during tests.
 3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
 5. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
 - a. Record results on Field Quality Control Log.

- b. Repair failed portions of joints.

1.05 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.
 - 1. Control and Expansion Joints in Concrete Paving: Self-leveling silicone traffic-grade sealant.
- 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. Control Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
 - 3. Column Isolation Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
 - 4. Floor Joints in Wet Areas: Self-leveling silicone "traffic grade" sealant; not for continuous liquid immersion
 - 5. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
 - 6. 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

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, M and O; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 50 percent, minimum.

2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. 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.
 5. Color: Custom color(s) to match Architect's sample(s).
 6. Cure Type: Single-component, neutral moisture curing.
 7. Service Temperature Range: Minus 40 to 250 degrees F.
 8. Products:
 - a. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: www.siliconeforbuilding.com.
 - b. Pecora Corporation; 890NST: www.pecora.com.
 - c. Sika Corporation; Sikasil WS-295 FPS: www.usa.sika.com.
 - d. Tremco, Inc.; Spectrem 3: www.tremcosealants.com.
 - e. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- B. Traffic Grade Silicone Sealant: ASTM C920, Grade NS, Type S, Uses T, M, and O; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum
 2. Hardness Range: Comply with one of the following:
 - a. 5 to 15, Shore A, when tested in accordance with ASTM C661.
 - b. 85, Shore 00, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's full range.
 4. Cure Type: Single-component, neutral moisture curing.
 5. Service Temperature Range: Minus 40 to 250 degrees F.
 6. Products:
 - a. Dow Corning; NS Parking Structure Sealant: www.dowcorning.com.
 - b. Pecora Corporation; 311NS: www.pecora.com.
 - c. Sika Corporation; Sikasil - 728 NS: www.usa.sika.com.
 - d. Tremco, Inc.; Spectrem 800: www.tremcosealants.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.
- C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, and O; mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
 2. 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.
 3. Color: Clear.
 4. Cure Type: Single-component, acetoxy or neutral moisture curing .
 5. Service Temperature Range: Minus 40 to 300 degrees F.
 6. Products:
 - a. Dow Corning; 786 Sealant M: www.dowcorning.com.
 - b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: www.siliconeforbuilding.com.
 - c. Pecora Corporation; 898NST: www.pecora.com.
 - d. Sika Corporation; Sikasil - GP: www.usa.sika.com.
 - e. Tremco, Inc.; Tremsil 200 with fungicide: www.tremcosealants.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- D. 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.
 - b. Pecora Corporation; AC-20 +Silicone: www.pecora.com.
 - c. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
 - d. Tremco, Inc.; Tremflex 834: www.tremcosealants.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SELF-LEVELING SEALANTS

- A. Self-Leveling Silicone Sealant: ASTM C920, Type S, Grade P, Uses T, M and O; single-component, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
 2. Hardness Range: Comply with one of the following:
 - a. 5 to 20, Shore A, when tested in accordance with ASTM C661.
 - b. 40 to 85, Shore 00, when tested in accordance with ASTM D2240.
 3. Color: To be selected by Architect from manufacturer's full range.
 4. Cure Type: Single-component, neutral moisture curing.
 5. Service Temperature Range: Minus 50 to 300 degrees F.
 6. Products:
 - a. Dow Corning; SL Parking Structure Sealant: www.siliconeforbuilding.com.
 - b. Pecora Corporation; 310SL: www.pecora.com.
 - c. Sika Corporation; Sikasil-728 SL: www.usa.sika.com.
 - d. Tremco, Inc.; Spectrem 900SL: www.tremcosealants.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

2.04 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.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.
- I. Installation of Two-Stage Joints at Precast Architectural Concrete Units:
 - 1. Joint system consists of two back-to-back sealant joints at each precast architectural concrete unit joint with a weep at the bottom of the unit joint per Precast/Prestressed Concrete Institute (PCI) recommendations and as follows:
 - a. Inner (Secondary) Seal: Inner secondary backer rod and sealant joint is installed a minimum of 2 to 2-1/2 inches beyond the exposed face of the precast architectural concrete panels within the panel joint itself.
 - b. Exterior (Primary) Seal: Following the installation of the secondary joint, the outer primary backer rod and sealant joint is installed at the face of the precast architectural concrete panels with a weep at the bottom of the joint. Leave open continuous air space between the primary backer rod and inner secondary seal.
 - c. Install 3/8 inch minimum weep openings in the exterior seal to allow water penetrating the exterior seal and contained by the inner seal to exit the cavity between joint seals.
 - 1) Do not install weeps below finish grades.
 - d. Near the junction of horizontal and vertical joints, the inner seal must turn out to the plane of the exterior seal at regular intervals to force water out of the joint.

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. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION

SECTION 08 1416 - FLUSH WOOD DOORS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Flush wood doors; flush and flush glazed configuration; fire-rated and non-rated.

1.02 REFERENCE STANDARDS

- A. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
- B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- D. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- E. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- F. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWI/AWMAC/WI (AWS).
 - 2. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems
- D. Samples: Submit three samples of door veneer, 8 by 10 inch in size illustrating wood grain, stain color, and sheen.
 - 1. Transparent finish Samples shall illustrate typical range of wood color and grain.
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Warranty, executed in Owner's name.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than 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.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges if stored more than one week. Break seal on site to permit ventilation.

1.06 WARRANTY

- A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Wood Veneer Faced Doors:
 - 1. Masonite Architectural; Cendura Standard Wood Veneer Doors: www.architectural.masonite.com/#sle.
 - 2. Mohawk Doors, Masonite Architectural: <https://architectural.masonite.com>.
 - 3. Oshkosh Door Company: www.oshkoshdoor.com.
 - 4. VT Industries, Inc: www.vtindustries.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL) Faced Doors:
 - 1. Eliason Corporation; StyleCraft: www.eliasoncorp.com/#sle.
 - 2. Masonite Architectural; Aspiro Choice Laminate Doors: www.architectural.masonite.com/#sle.
 - 3. Oregon Door: www.oregondoor.com/#sle.
 - 4. VT Industries, Inc; ____: www.vtindustries.com/#sle.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DOORS

- A. Doors: See drawings for locations and additional requirements.
 - 1. Quality Standard: Premium Grade, Extra Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.
 - 2. High Pressure Decorative Laminate (HPDL) Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location.
 - 2. Fire Rated Doors: Tested to ratings indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - 3. Smoke and Draft Control Doors: In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label.
 - 4. High pressure decorative laminate (HPDL) finish as indicated on drawings.

2.03 DOOR CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish:
 - 1. Species and Cut:
 - a. Species: Select White Maple.
 - b. Cut: Plain sliced (flat cut).
 - c. Grade: HPVA Grade A.
 - 2. Veneer Matching:
 - a. Matching of Adjacent Veneer Leaves: Book match.
 - b. Matching Within Door Faces: Center balance match.
 - 3. Vertical Edges: Same species hardwood edge as face veneer.
 - 4. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
 - 5. Transoms: Continuous match to doors.

- B. High Pressure Decorative Laminate (HPDL) Facing for Non-Fire-Rated Doors: NEMA LD 3, HGS;
 - 1. Color: Wilsonart, Phantom Cocoa, 8213K-28.
 - 2. Substitutions: Not Permitted.
- C. Facing Adhesive: Type II - water resistant.

2.05 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
 - 3. Provide solid mid-rail blocking, in doors indicated to have exit devices.
- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.06 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System 5 - Conversion Varnish, System 10 - UV Curable Water-based, or System 11 - Catalyzed Polyurethane.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.
- B. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

- A. Hollow Metal Door Frames: As specified in Section 08 1113 - Hollow Metal Doors and Frames.
- B. Glazing: See Section 08 8000.
- C. Glazing Stops:
 - 1. Non-Rated Doors: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.
 - a. Type: Lipped moldings.
 - 2. Fire-Rated Doors: Rolled steel channel shape, mitered corners; prepared for countersink style tamper proof screws.
 - a. Type: Lipped moldings.
- D. Door Hardware: See Section 08 7100.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.
- F. Install door louvers plumb and level.
- G. Install glass in accordance with Section 08 8000 - Glazing.
- H. Install door hardware as specified in Section 08 7100 - Door Hardware.
- I. Coordinate installation of electrical connections to electrical hardware items.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

SECTION 08 3100 - ACCESS DOORS AND PANELS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Wall- and ceiling-mounted access units.

1.02 DEFINITIONS

- A. Wet Areas: Includes the following:
 - 1. Exterior locations.
 - 2. Showers.
 - 3. Other areas as indicated.
- B. Non-Wet Areas: Areas that are not indicated or listed as wet areas including, but not limited to, the following:
 - 1. Kitchens.
 - 2. Locker rooms.
 - 3. Toilet rooms.
 - 4. Janitor closets.

1.03 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 A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- C. ITS (DIR) - Directory of Listed Products; Current Edition.
- D. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Project Record Documents: Record actual locations of each access unit.

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 work of the type specified and with at least 5 years documented experience.

PART 2 PRODUCTS**2.01 MATERIALS**

- A. Steel: Sheet complying with the following:
 - 1. All areas except wet areas: ASTM A1008/A1008M.
 - 2. Wet areas: ASTM A653/A653M Grade 33; A40 galvannealed.

2.02 WALL- AND CEILING-MOUNTED ACCESS UNITS

- A. Manufacturers:
 - 1. Acudor; www.acudor.com.
 - 2. Babcock-Davis; www.babcockdavis.com.
 - 3. JL Industries/Activar Construction Products Group, Inc; www.activarcpg.com/jl-industries.
 - 4. Karp Associates, Inc; www.karpinc.com.
 - 5. Larsen's Manufacturing Company; www.larsenmfg.com.
 - 6. Milcor / Hart & Cooley Inc; www.milcorinc.com.
 - 7. MIFAB, Inc.; www.mifab.com.
 - 8. Nystrom; www.nystrom.com.

9. Substitutions: See Section 01 6000 - Product Requirements.
- B. General:
 1. Factory fabricate doors and frames.
 2. Fully assemble units with corner joints welded, filled and ground flush; square and without rack or warp.
 3. Coordinate requirements with type of installation assembly being used for each unit.
- C. Flush Access Doors with Exposed Flanges:
 1. Locations: Masonry.
 2. Material: Steel.
 3. Style: Exposed frame with door surface flush with frame surface.
 - a. Masonry Mounting Criteria: Provide masonry anchor straps.
 4. Door Style: Single thickness with rolled or turned in edges.
 5. Doors: 14 gage, 0.0747 inch, minimum thickness.
 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 7. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 8. Door/Panel Size: As indicated on the drawings.
 9. Hardware:
 - a. Hinges: Concealed, constant force closure spring type.
 - b. Handle: No handle.
 - c. Latch/Lock: Screw driver slot for quarter turn cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
- D. Flush Access Doors with Concealed Flanges:
 1. Locations: Gypsum board.
 2. Material: Steel.
 3. Style: Concealed flange for drywall.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 4. Door Style: Single thickness with rolled or turned in edges.
 5. Doors: 14 gage, 0.0747 inch, minimum thickness
 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 7. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 8. Door/Panel Size: As indicated on the drawings.
 9. Hardware:
 - a. Hinges: Concealed, constant force closure spring type.
 - b. Handle: No handle.
 - c. Latch/Lock: Screw driver slot for quarter turn cam latch.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
- E. Fire-Rated, Flush, Uninsulated, Access Doors with Exposed Flanges:
 1. Locations: Masonry.
 2. Material: Steel.
 3. Style: Exposed frame with door surface flush with frame surface.
 - a. Masonry Mounting Criteria: Provide masonry anchor straps.
 4. Door Style: Single thickness with rolled or turned in edges.
 5. Doors: 16 gage, 0.0598 inch, minimum thickness
 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 7. Fire-Rating: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 8. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 9. Door/Panel Size: As indicated on the drawings.
 10. Hardware: Automatic closing, self-latching, with interior latch release.
 - a. Hinges: Exposed, continuous piano hinge.

- b. Handle: No handle.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
 - e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.
- F. Fire-Rated, Flush, Uninsulated, Access Doors with Concealed Flanges:
 - 1. Locations: Gypsum board.
 - 2. Material: Steel.
 - 3. Style: Concealed flange for drywall.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 4. Door Style: Single thickness with rolled or turned in edges.
 - 5. Doors: 16 gage, 0.0598 inch, minimum thickness
 - 6. Frames: 16 gage, 0.0598 inch, minimum thickness.
 - 7. Fire-Rating: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - 8. Steel Finish: Primed; manufacturer's standard rust-inhibitive powder coat.
 - 9. Door/Panel Size: As indicated on the drawings.
 - 10. Hardware: Automatic closing, self-latching, with interior latch release.
 - a. Hinges: Exposed continuous piano hinge.
 - b. Handle: No handle.
 - c. Latch/Lock: Cylinder lock-operated cam latch, two keys for each unit.
 - d. Number of Locks/Latches Required: As recommended by manufacturer for size of unit.
 - e. Inside Latch Release: Mechanism that allows door/panel to be opened from inside.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

3.04 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.

END OF SECTION

SECTION 08 3323 - OVERHEAD COILING DOORS**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Electric operators and control stations.

1.02 REFERENCE STANDARDS

- A. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2023.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
- I. NEMA MG 1 - Motors and Generators; 2017.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- L. UL (DIR) - Online Certifications Directory; Current Edition.
- M. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide general construction, electrical equipment, and component connections and details.
- C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include diagrams for power, signal, and control wiring.
- D. Samples: Submit three slats, 6 inches long in size illustrating shape, color and finish texture.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Field Quality Control: Submit field inspection reports.
- H. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.

1.04 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 type specified and with at least 5 years documented experience and approved by manufacturer.
- C. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

1.05 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

- B. Provide two year manufacturer warranty for defects in workmanship and materials from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Overhead Coiling Doors - Basis of Design: The design for each coiling door specified is based on the product named. Provide either the named product or a comparable product by one of the following:
1. C.H.I. Overhead Doors; www.chiohd.com.
 2. Clopay Building Products; www.clopaydoor.com.
 3. CornellCookson, Inc.; www.cornelliron.com.
 4. McKeon Door Company; www.mckeondoor.com.
 5. Overhead Door Corp.; www.overheaddoor.com.
 6. Raynor Door; www.raynor.com.
 7. Wayne-Dalton; www.wayne-dalton.com.
 8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 COILING DOORS

- A. Fire-Rated Coiling Doors: Stainless steel slat curtain; conform to NFPA 80.
1. Basis of Design Product: Cookson Door; Model ERC11; www.cooksondoor.com.
 2. Operation Cycles: Door components and operators capable of operating for not less than 20,000 cycles.
 - a. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.
 3. Fire-Rating: As indicated on Drawings.
 4. Provide products listed and labeled by ITS (DIR) or UL (DIR) as suitable for purpose specified and indicated on drawings.
 5. Oversized Openings: Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated units and operating hardware assembly.
 6. Single thickness slats.
 7. Nominal Slat Size: 2-1/2 inches wide by required length.
 8. Finish: No. 4 - Brushed.
 - a. Includes slats and hood enclosure.
 9. Guides, Angles: Stainless steel.
 10. Bottom Bar or Angles: Stainless steel.
 11. Hood Enclosure: Manufacturer's standard; stainless steel.
 12. Fire Alarm Release Mechanism: Electric-motor operated from fire alarm system and local heat or smoke detectors.
 13. Electric operation.
 14. Mounting: Surface mounted, unless otherwise indicated on Drawings.

2.03 MATERIALS AND COMPONENTS

- A. Metal Curtain Construction: Interlocking slats.
1. Curtain Bottom for Slat Curtains: Fitted with angles to provide reinforcement and positive contact in closed position.
 - a. Counter Doors: Optionally a tube may be used.
 2. Weatherstripping for Exterior Doors: Moisture and rot proof, resilient type, located at jamb edges, bottom of curtain, and where curtain enters hood enclosure of exterior doors.
- B. Guide Construction: Continuous, of profile to retain door in place, mounting brackets of same metal.
1. Guides:
 - a. Steel Shapes:
 - 1) Steel Angle: ASTM A36/A36M steel, size as recommended by overhead door manufacturer.
 - (a) Hot-dip galvanized in compliance with ASTM A123/A123M where indicated.

- 2) Stainless Steel Angle: ASTM A276/A276M, Type 304, size as recommended by overhead door manufacturer.
- b. Sheet Metal:
 - 1) Formed Steel Sheet: ASTM A653/A653M galvanized steel sheet.
 - (a) Thickness: As recommended by overhead door manufacturer.
 - (b) Galvanizing: Minimum G90 coating.
 - 2) Formed Stainless Steel: ASTM A 666, Type 304, rollable temper.
 - (a) Thickness: As recommended by overhead door manufacturer.
- C. Hood Enclosure and Trim: Internally reinforced to maintain rigidity and shape.
 - 1. Formed Steel Sheet: ASTM A653/A653M galvanized steel sheet.
 - a. Thickness: As recommended by overhead door manufacturer.
 - b. Galvanizing: Minimum G90 coating.
 - 2. Formed Stainless Steel: ASTM A 666, Type 304, rollable temper.
 - a. Thickness: As recommended by overhead door manufacturer.

2.04 ELECTRIC OPERATION

- A. Operator, Controls, Actuators, and Safeties: Comply with UL 325; provide products listed by ITS (DIR), UL (DIR), or testing agency acceptable to authorities having jurisdiction.
 - 1. Provide interlock switches on motor operated units.
- B. Electric Operators:
 - 1. Mounting: Side mounted.
 - 2. Motor Enclosure:
 - a. Exterior Coiling Doors: NEMA MG 1, Type 4; open drip proof.
 - b. Interior Coiling Doors: NEMA MG 1, Type 1; open drip proof.
 - 3. Motor Rating: 1/2 hp; continuous duty, unless otherwise recommended by overhead door manufacturer.
 - 4. Motor Voltage: 120 volts, single phase, 60 Hz.
 - 5. Motor Controller: NEMA ICS 2, full voltage, reversing magnetic motor starter.
 - 6. Controller Enclosure: NEMA 250, Type 4.
 - 7. Opening Speed: 12 inches per second.
 - 8. Brake: Manufacturer's standard type, activated by motor controller.
 - 9. Manual override in case of power failure.
 - 10. Refer to Division 26 for electrical connections.
- C. Automatic-Closing Device:
 - 1. Equip each fire-rated door with an automatic-closing device and governor unit complying with NFPA 80, and an easily tested and reset release mechanism.
 - 2. Release mechanism for motor-operated doors shall allow testing without mechanical release of the door.
 - 3. Automatic-closing device shall be designed for activation by the following:
 - a. Building fire-detection, smoke-detection, and alarm systems.
- D. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated; enclose terminal lugs in terminal box sized to comply with NFPA 70.
- E. Control Station: Provide standard key-operated (Open-Close-Stop) momentary-contact control device for each operator conforming to UL 325.
 - 1. 24 volt circuit.
 - 2. Recess mounted, at location indicated on Drawings.
 - 3. Entrapment Protection Devices: Provide sensing devices and safety mechanisms complying with UL 325.
 - a. Primary Device: Provide electric sensing edge as required with momentary-contact control device.
- F. Safety Edge: Located at bottom of coiling door, full width, electro-mechanical sensitized type, wired to stop and reverse door direction upon striking object, hollow neoprene covered.

PART 3 EXECUTION**3.01 EXAMINATION**

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install fire-rated doors in accordance with NFPA 80.
- C. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- D. Securely and rigidly brace components suspended from structure. Secure guides to structural members only.
- E. Fit and align assembly including hardware; level and plumb, to provide smooth operation.
- F. Coordinate installation of electrical service with Division 26.
- G. Complete wiring from disconnect to unit components.
- H. Complete wiring from fire alarm system.
- I. Install enclosure and perimeter trim.
- J. Test and adjust controls and safety devices.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 feet straight edge.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operate doors to confirm proper operation and door performance.
 - 2. Test controls and safety devices.
 - 3. Test door release, closing, and alarm operations when activated by smoke detector or building's fire-alarm system. Test manual operation of closed door. Reset door-closing mechanism after successful test.
 - 4. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80.
 - 5. Prepare field inspection reports.
- C. Repair or replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.

3.05 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.06 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

3.07 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors.

END OF SECTION

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

- A. Section includes hardware for doors specified in “Hardware Sets”.
- B. 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
 - 6. Division 10 Specialties
 - 7. Division 13 Special Construction
 - 8. Division 14 Elevators
 - 9. Division 25 Integrated Automation
 - 10. Division 26 Electrical
 - 11. Division 27 Communications
 - 12. Division 28 Electronic Safety and Security

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 (2020)
 - 3. ANSI/BHMA A156.4 Door Controls – Closers (2019)
 - 4. ANSI/BHMA A156.5 Cylinders and Input Devices for Locks (2020)
 - 5. ANSI/BHMA A156.6 Architectural Door Trim (2015)
 - 6. ANSI/BHMA A156.7 Template Hinge Dimensions (2016)
 - 7. ANSI/BHMA A156.8 Door Controls – Overhead Stops and Holders (2015)
 - 8. ANSI/BHMA A156.13 Mortise Locks & Latches (2017)
 - 9. ANSI/BHMA A156.15 Closer Holder Release Devices (2015)
 - 10. ANSI/BHMA A156.16 Auxiliary Hardware (2018)
 - 11. ANSI/BHMA A156.18 Materials & Finishes (2020)
 - 12. ANSI/BHMA A156.19 Power Assist & Low Energy Power Operated Doors (2019)
 - 13. ANSI/BHMA A156.21 Thresholds (2019)
 - 14. ANSI/BHMA A156.22 Door Gasketing Systems (2017)
 - 15. ANSI/BHMA A156.25 Electrified Locks (2018)
 - 16. ANSI/BHMA A156.26 Continuous Hinges (2017)
 - 17. ANSI/BHMA A156.28 Keying Systems (2018)
 - 18. ANSI/BHMA A156.35 Power Supplies for Electronic Access Control (2020)
 - 19. ANSI/BHMA A156.36 Auxiliary Locks (2020)
- B. International Code Council/American National Standards Institute (ICC/ANSI)/ADA:
 - 1. ICC/ANSI A117.1 Standards for Accessible and Usable Buildings and Facilities.
- C. Door and Hardware Institute (DHI):
 - 1. DHI Publication – Abbreviations and Symbols (2019).
 - 2. DHI Publication – Installation Guide for Doors and Hardware (2020).
 - 3. DHI Publication – Sequence and Format of Hardware Schedule (2019).
- D. National Fire Protection Agency (NFPA):
 - 1. NFPA 70 National Electrical Code.

2. NFPA 80 Standard for Fire Doors and Other Opening Protectives.
3. NFPA 105 Standard for the Installation of Smoke Door Assemblies.

1.03 SUBMITTALS

- A. Submit in accordance with Conditions of the Contract and Division 01 Administrative Requirements and Submittal Procedures Section.
- B. Shop Drawings:
 1. Schedule hardware in vertical format using the DHI publication Sequence and Formatting for the Hardware Schedule.
 2. Include abbreviations and symbols page to include manufacturers' abbreviations, finish code descriptions, and fastener abbreviations including descriptions according to the DHI publication Abbreviations and Symbols.
 3. Detail headings referencing the Architect's heading, opening number, locations, fire rating, handing, degree of opening, and description of the opening elements. Include Voltage, amperage, and operational descriptions for openings that have electrified hardware.
 4. Coordinate final door hardware schedule with doors, frames, and related work listing proper sizing of hardware, addressing door thickness, handing, function, mounting accessories, and finish of hardware.
 5. List related door devices specified in other Sections for each opening.
 6. 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. Product Data:
 1. Furnish manufacturers' catalog sheets on design, grade, and function of items listed in hardware schedule. Submit only relevant information and circle or highlight the technical information including: model numbers, sizing information, voltage and amperage requirements, options and accessories required, means of fastening, listings of fire-rated applications, and finishes.
- E. Templates:
 1. Within fourteen days of receiving approved door hardware submittals submit complete list of templates for each hardware item to the opening manufacturers and the installers. Include detailed lists of the hardware location requirements for mortised and surface applied hardware.
- F. Wiring Diagrams: Detail a title block for each drawing that includes the project name, project address, architect name, architect's opening number, hardware set, date, and name of the author.
 1. Elevation Riser Drawings:
 - a. Furnish one set of elevation drawings with each hardware schedule submittal for hardware sets that contain electrified hardware. Illustrate the openings with proportional representations of the opening and electrified hardware components and dimension their mounting locations as well as sizes of junction boxes and power supplies. Label the components, wire quantities and gauges, high voltage requirements, as well as other building interfaces. Create a legend that complements the drawings with brand names, model numbers, and include voltage and amperage requirements. Add an operational description that includes the normal state of the door, ingress, egress, and what happens in case of power loss or fire alarm activation and any special conditions.
 - b. Upon receipt of approved hardware correct and resubmit elevation drawings with the point-to-point and system drawings.

2. Point-to-Point and System Drawings: Upon receipt of approved hardware schedule, submit point-to-point per hardware set and a system drawing. Cross-reference all wiring diagrams and the associated drawings to each other.
 - a. Point-to-Point Drawings: Draw each product in a realistic representation including each terminal including those not used, and lines representing wires from component to component, labeling wire colors and gauges.
 - b. System Drawing: illustrate all equipment and building interfaces required for the entire system. Include room labels and locations, opening numbers and locations.
- G. Closeout Submittals: Include the following information as well as highlight and flag fire rated openings for annual inspections:
 1. Cover page with required information:
 - a. Project name
 - b. Hardware supplier's name and contact information.
 - c. Date of substantial completion.
 2. Final record hardware schedule.
 3. Product Data.
 4. Keying Schedule.
 5. Record Wiring Diagrams.
 - a. System Drawing.
 - b. Elevations.
 - c. Point-to-Point Drawings with all final wire colors noted as terminated. (Include network IP and/or MAC addresses of field devices).
 6. Operating and Maintenance Manual.
 7. Warranty Information.
 8. Maintenance service agreement(s).

1.04 QUALITY ASSURANCE

- A. Hardware supplier shall 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.
 1. Electrified Door Hardware Supplier Qualifications: Experienced door hardware supplier who has completed projects with electrified door hardware similar in material, design, and extent to that is indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
 2. Access and Electrified Security Supplier Qualifications: Experienced supplier who has completed projects with access and electrified security door hardware similar in material, design, and extent to that is indicated for this Project, whose work has resulted in construction with a record of successful in-service performance and be a factory authorized distributor.
- B. Where openings are required to be accessible door hardware shall conform to ICC/ANSI A117.1.
- C. Fire Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware complying with NFPA 80 that are listed and/or labeled by a qualified testing agency for fire-protection ratings indicated.
- D. Smoke and Draft Control Door Assemblies: Where smoke and draft control doors are required, provide door hardware that meets requirements of assemblies in compliance with NFPA 105.
- E. Door hardware certified to ANSI/BHMA standards as noted, manufacturer must participate and be listed in BHMA Certified Products Directory.

- F. Substitution requests shall be submitted in compliance with Division 01: 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.
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.
- G. Meetings: Comply with requirements in Division 01 Section "Project Meetings."
1. Low-voltage Coordination Meeting
 - a. Prior to furnishing door hardware submittals, convene a low-voltage coordination meeting. Meeting participants should include all affected trades including the following, but not limited to: Contractor, installer, supplier, electrical contractor, security consultant and installer, Owner's IT representative, and fire alarm consultant.
 - b. Review sequence of operation for each opening with electrified hardware to ensure that every opening functions properly for the Owner's use.
 - c. Discuss the types of electrified door hardware, inspection, and electrical roughing-in and other preparatory work performed by other trades.
 - d. Verify wire quantities, wire types, wire sizes, conduit sizes, and locations including if the power supplies will be centrally located or if they will be located near each opening.
 - e. Coordinate the door hardware, power supplies, back-up power requirements, access control components, fire alarm interfaces, elevator controls, and related building systems have all proper and necessary components to interface and operate correctly.
 2. Keying Meeting
 - a. Within fourteen days of receiving approved door hardware submittals, contact Owner to establish a keying conference. Include keying meeting decisions into final keying schedule submittal after reviewing the following, but not limited to:
 - i. Function of the building, flow of traffic, individual area's purpose, and degree of security.
 - ii. Lock functions and operation.
 - iii. Preliminary key system schematic diagram.
 - iv. Verify existing keyway(s), and/or proposed keyway(s)
 - v. Visual key and cylinder identification
 - vi. Quantity of keys required including master level keys, change keys, and keys per lock.
 - vii. Review the key control system.
 - viii. Determine the recipient and contact information for the delivery of keys and accessories.
 3. Pre-installation Meeting
 - a. Convene meeting within fourteen days of receiving approved door hardware submittals. Participants from all affected buildings trades shall attend. Minimum participants should include: Contractor, installer, material supplier, manufacturer representatives, electrical contractor, security consultant, and fire alarm consultant.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Include in-conference decisions regarding proper installation methods and procedures for receiving and handling hardware.
 - d. Review all system, elevation, and point-to-point drawings to ensure that all necessary components are provided and detailed.
 - e. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - f. Review required testing, inspecting, and certifying procedures.

- H. Installer Qualifications: Specialized in performing installation of this Section and have five years minimum documented experience.

1. Electrified Hardware Supplier Qualifications: Experienced door hardware installer who has installed projects with electrified door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

Access Control and Electrified Security Supplier Qualifications: Experienced installer who has completed projects with access and electrified security door hardware similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance and be a factory authorized to install and commission the system.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Pack each item complete with necessary parts and fasteners in manufacturer's original packaging.
- B. Mark hardware that is not bulk packed with 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. Mark hardware that is bulk packed with manufacturers' part number and reference all hardware sets associated.
- C. Deliver 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.
- D. Deliver permanent keys, cores, access control credentials, software, and related accessories directly to Owner via registered mail or overnight package service. Establish the instructions for delivery to Owner at "Keying Conference."
- E. Provide a clean, dry, and secure room for hardware delivered. Shelf hardware off the floor and with larger items of hardware stored on 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.
- F. Waste Management and Disposal: Separate waste materials for use or recycling in accordance with Division 01.

1.06 WARRANTY

- A. General Warranty: Comply Division 01 for Warranty requirements.
- 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.
 4. One year for electromechanical door hardware.
 5. All access and electrified security equipment and systems will be warranted for a period of one (1) year commencing with the filing date of the Notice of Completion, provided the system has been inspected and signed off by a factory authorized installer and the factory authorized commissioning agent.

1.07 MAINTENANCE

- A. 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 MATERIALS**

- A. General:
1. Produce hardware units of basic metal and forming method using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified within this specification section for applicable hardware units for finish designations indicated.
- B. Fasteners:
1. Furnish screws for installation with each hardware item. Use only fasteners that are furnished by the hardware manufacturer to meet the manufacturer's templating requirements, warranty and NFPA 80 requirements.
 2. Provide Phillips-head screws except as otherwise indicated.
 3. Finish exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.
 4. Use machine screws with lead expansion shields at hardware mounting to masonry walls and floors.
 5. Wood screw with plastic anchors at drywall applications without reinforcement and wood screws at applications with reinforcements.
 6. Provide concealed fasteners for hardware units that are exposed when door is closed except to the extent no standard units of type specified are available with concealed fasteners.
 - a. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless their use is the only means of reinforcing the work adequately to fasten the hardware securely.
 - b. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex nut fasteners.
 7. At exterior openings furnish stainless-steel fasteners for exposed fasteners, for example thresholds and screw-applied weatherstripping.

2.02 CONVENTIONAL 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 over 36" wide up to 48" wide and up to 1-3/4" thick provide hinges with a minimum thickness of .145" and a minimum of 5" in height.

- c. Doors greater than 1-3/4" thick provide hinges with a minimum thickness of .190" and a minimum of 5" in height.
 - d. Width of hinge is to be minimum required to clear surrounding trim.
 - e. Doors considered to be low to medium frequency use would require standard weight hinges and medium to high frequency use would require heavy weight hinges.
 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 or fraction thereof.
 - e. Dutch doors provide 4 hinges up to 120" in height and 1 additional per each additional 30" in height or fraction thereof.
 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 lockable and 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. Acceptable Manufacturers:
1. Hager
 2. Stanley
 3. McKinney

2.03 ALUMINUM GEARED 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. Determine final model numbers and accessories required using the following criteria:
1. Door inset in relation to the frame face.
 2. Door thickness and weight.
 3. 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 and provide studs as required by the manufacturer's listings.
 4. Provide heavy-duty hinges for high frequency and exterior applications.
 5. 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.
 6. 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. 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. Provide factory-cut preparations for concealed electric power transfers.

- E. Acceptable Manufacturers:
 - 1. Hager
 - 2. National Guard Products
 - 3. Select

2.04 POWER TRANSFER

- A. Power transfer of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Products to be certified and listed by the following:
 - 1. UL Listed Miscellaneous Fire Door Accessories.
 - 2. UL 10C Listed for up to 3 hours on fire-rated doors and frames.
 - 3. Classified according to Uniform Building Code (UBC) Standard 7-2, Fire Test of Door Assemblies (1997).
- C. Design:
 - 1. Stainless steel tubular wire transfer and cast housing with steel back boxes to provide weather and tamper resistance when door is open or closed.
 - 2. Mortise door and frame installation
 - 3. Two 18 ga wires, 5 amps @ 12/24 VAC/DC.

- D. Acceptable Manufacturers:

	<u>2 Conductors</u>	<u>10 Conductors</u>
Hager	2-679-0621 US28	2-679-0623 US28
SDC	PTM-2	PTM-10

2.05 FLUSH BOLTS AND COORDINATORS

- A. Flush bolts of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer to be listed by the following: Auxiliary Hardware: ANSI/BHMI A156.16.
- C. Labeled openings: Provide automatic or constant latching flush bolts per hardware schedule for inactive leaf of pairs of doors. Provide dust proof strikes for bottom bolt.
- D. Non-Labeled openings: Provide two flush bolts for inactive leaf of pairs of doors per hardware schedule. Provide extension rods so that the center line of the top flush bolt is not more than 78" above the finish floor. Provide dust proof strike from bottom bolt.

- E. Acceptable Manufacturers:

	<u>Manual Flush Bolt</u>	<u>Auto Flush Bolt</u>	<u>Dust Proof Strike</u>
Hager	282D	292D/295W/296W	280X
Rockwood	555	1942	570
Trimco	3917	3815	3911

- F. Coordinators: Provide for labeled pairs of doors with automatic flush bolts or with vertical rod exit device with a mortise-locking device per hardware schedule. Provide filler piece to extend full

width of stop on frame. Provide mounting brackets for closers and special preparation for latches where applicable.

G. Acceptable Manufacturers:

	<u>Coordinator</u>	<u>Bracket</u>	<u>Bracket for stops greater than 2-1/4."</u>
Hager	297	297B	297B
Rockwood	1600	2601D	2601D
Trimco	3094	3095	3096

2.06 REMOVABLE MULLIONS

- A. Keyed and non-keyed removable mullions of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer to be listed by the following: UL/cUL/Warnock Hersey for fire-rated pairs of doors up to 8 feet tall x 8 feet wide opening.
- C. Material and Design:
1. For use with rim exit devices on non-rated and fire rated pairs of doors. Mullion 2" x 3" x 11 gage steel tube.
 2. Top Fitting:
 - a. Mullion locked in place without use of a key.
 - b. Deadlock on fire-rated device

D. Acceptable manufacturers for keyed removable mullions:

	<u>Keyed Fire-Rated</u>	<u>Keyed Non-Fire-Rated</u>
Hager	4900TF	4900T
Von Duprin	KR9954	KR4954

E. Acceptable manufacturers for removable mullions:

	<u>Fire-Rated</u>	<u>Non-Fire-Rated</u>
Hager	4900UF	4900U
Von Duprin	9954	4954

2.07 HEAVY DUTY MORTISE 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:
- G. Electrified Locks
1. Fail-Safe (power lock): Outside trim is locked when power is applied and unlocked when power is removed. Lockset will unlock in the event of a power failure (EL).
 2. Fail-Secure (power unlock): Outside trim is locked when there is no power and unlocked when power is applied. Lockset will be locked in the event of a power failure (EU).
 3. Latch bolt monitoring: Single switch SPDT mounted inside lockset monitors full extension of latch bolt (LM).
 4. Request to Exit: Monitors inside lever rotation (RX).
- H. Acceptable Manufacturers:
- | | |
|-------|-------------|
| Hager | 3800 Series |
|-------|-------------|

2.08 MORTISE DEADBOLTS

- A. Mortise deadbolts of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Standards: Manufacturer to be certified by the following:
1. ANSI/BHMA A156.13 Series 2000 Grade 1 Operational and Security.
 2. UL/cUL listed for functions up to 3 hours for "A" label.
 3. UL10C/UBC 7-2 Positive Pressure Rated.
 4. ADA – Thumb turn.
- C. Deadbolt function numbers and descriptions of manufacturer's series as listed in hardware sets.
- D. Material and Design:
1. Latch bolt projection 1" throw.
 2. Case steel, zinc dichromate.
 3. Armor front 5-9/16". Case dimension 4-5/16" x 3-9/16" x 1".
- E. Acceptable Manufacturers:
- | | |
|-------|-------------|
| Hager | 3830 Series |
|-------|-------------|

2.09 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.
- 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. Latch bolts:
 - 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:
- | | <u>Wide Stile</u> | <u>Narrow Stile</u> |
|------------|-------------------|---------------------|
| Hager | 4500 Series | 4600 Series |
| Von Duprin | 99 Series | 33 Series |
- F. Electric Modifications:
1. Motorized Latch Retraction (MLR): An electric motor retracts the latch bolt for momentary or maintained periods of time.
 2. Provide Request to Exit (REX) switches as scheduled.
 3. Electrified Trim: Outside trim locked (EL) or unlocked (EU) by electric current.

2.10 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. Manufacturer's seven-pin small format interchangeable core (SFIC).
 3. 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. Owner to provide the permanent cores.
2. Key into Owner's existing key system.
3. 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 the keysets and bittings of the original key system creating one clean version of the entire key system.
4. 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.
5. Stamp large bow key blanks with visual key control (keyset symbol) and "Do Not Duplicate".
6. Provide interchangeable cores with construction cores as required per the keying meeting.

E. Acceptable Manufacturers:

To Be Determined

2.11 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. Push plates: .050" thick, square corner and beveled edges with countersunk screw holes. Width and height as stated in hardware sets.

D. Acceptable Manufacturers:

Hager	30S
Rockwood	70C
Trimco	1001

- E. Pull Plates: .050" thick, square corner and beveled edges. Width and height as stated in hardware sets, 3/4" diameter pull, with clearance of 2-1/2" from face of door.

F. Acceptable Manufacturers:

Hager	H34G
Rockwood	110 x 70C
Trimco	1018-3

- G. Push Pull Bar Sets: 1" round bar stock with 2 –1/2" clearances from face of door. Offset 3", 90-degree standard. Center to center size should be door width less 1 stile width.

H. Acceptable Manufacturers:

Hager	H159D
Rockwood	BF15747
Trimco	1747

- I. Pull Bar Sets: 1" round bar stock with 2 –1/2" clearances from face of door.

J. Acceptable Manufacturers:

Hager	H14J
-------	------

Rockwood
Trimco

BF157
1194

2.12 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

2.13 LOW ENERGY POWER OPERATORS

- A. Low energy power operators of one manufacturer as listed for continuity of design and consideration of warranty.

- B. Products to be certified and listed by the following:
1. Power Assist and Low Energy Power Operated Doors: ANSI/BHMA A156.19.
 2. ADA Complaint ANSI A117.1.
- C. Materials and Design:
1. Self-contained electrical control unit, including necessary transformers, relays, rectifiers, and other electronic components for proper operation, switching and control of door up to 350 lbs. and include time delay for normal cycle.
 2. On pairs of doors, door to be opened manually without the other door opening.
 3. Operates as a mechanical closer if power is disconnected. Forces consistent with ANSI A117.1 and ANSI A156.19.
 4. Provide delay switches for motor activation, exit device latch retraction interfacing, and hold open times. Hold open times to be adjustable from 1 second to continuous seconds.
 5. Adjustable vestibule sequencing input for operation of two or more units. Specify 2-659-0240.
 6. Adjustable powered swing degree from 80 degrees to 110 degrees.
 7. Integral obstruction detection for closing and opening cycle.
 8. Adjustable built-in stop set from 80 degrees maximum to 180 degrees manual swing.
 9. When in "blow open" operation for smoke ventilation, operator will stay in the open position when loss of power.
 10. Boost to close selectable on/off switch.
- D. Signage: Provide signage in according to the requirements of ANSI/BHMA A156.19.
- E. Acceptable Manufacturers:
- | | |
|-------|-------------|
| Hager | 8400 Series |
| LCN | 4640 Series |
- F. Actuators:
1. Opening cycle activated by pressing switches with international symbol of accessibility and "PUSH TO OPEN" engraved on faceplate.
 2. Switches installed in standard 2-gang electrical wall box and placed in a location in compliance with ANSI A117.1.
 3. Wireless actuators optional.
 4. Provide bollards as required where a suitable wall mount is not possible.
- G. Acceptable Manufacturers:
- | |
|----------|
| Hager |
| MS Sedco |
| SDC |

2.14 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 | K0050 |
| Rockwood | K1050 |

2.15 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:
- | | <u>Wall Convex</u> | <u>Wall Concave</u> | <u>Floor Mounted</u> |
|----------|--------------------|---------------------|----------------------------|
| Hager | 232W | 236W | 242F / 248F / 259H / 269F |
| Rockwood | 406 | 409 | 441H / 446 / 480H / 466 |
| Trimco | 1270WX | 1270wv | 1211 / 7280 / 1214H / 1209 |
- E. Overhead Stops and Holders: Provide overhead stops and holders for doors that open against equipment, casework sidelights and other objects that would make wall stops/holders and floor stops/holders inappropriate. Provide sex bolt attachments for mineral core wood door applications.
- F. Products to be certified and listed by the following:
1. Overhead Stops and Holders: ANSI/BHMA A156.8 Grade 1.
- G. Acceptable Manufacturers:
- | | <u>Heavy Duty Surface</u> | <u>Heavy Duty Concealed</u> | <u>Slim Line Concealed</u> |
|---------------|---------------------------|-----------------------------|----------------------------|
| Hager | 7000 SRF Series | 7000 CON Series | |
| Glynn Johnson | 90 SRF Series | 100 Series | |

ABH
Rixon

1000 Series
1 Series

9000 Series
9 Series

1020 SL Series
6 Series

2.16 MODULAR ACCESS CONTROL POWER SUPPLIES

- A. Power supplies of one manufacturer as listed for continuity of design and consideration of warranty.
- B. Products to be certified and listed by the following:
 - 1. UL Listed.
- C. Design:
 - 1. Use with modular access control systems.
 - 2. Field selectable filtered and regulated 12 VDC or 24 VDC constant voltage.
 - 3. 1, 2, 4, and 6 AMP load capacities. Match the power supply amperage to the total load of the opening /system plus an additional thirty percent to cover line drop, as well as possible expansion.
 - 4. Circuit breaker protected AC input voltage; secondary output PTC protected.
 - 5. Fire alarm input provides simultaneous release of fail-safe locks and holders.
 - 6. Interface relay.
 - 7. LED status indicators provide information regarding AC input, DC output, and battery backup status.
 - 8. Separate inputs for activation switch on entry and egress and ingress side of opening.
 - 9. 5-amp hour battery backup.
 - 10. Input 115 VAC (230 VAC optional).
 - 11. Optional dual 12 VDC or 24 VDC output.
 - 12. Optional power supply monitor module to monitor power supply status, A/C power, and D/C output and battery status.
 - 13. Boxes and enclosures containing security system components or cabling, which are easily accessible to employees or to the public, shall be provided with a keyed lock. Boxes above ceiling level in occupied areas of the building will not be considered accessible. Junction boxes and small device enclosures below ceiling level and easily accessible to employees or the public will be covered with a suitable cover plate and secured with tamper-proof screws.
- D. Include optional modules as required to properly interface, control, and sequence the hardware with the access control system.
- E. Acceptable Manufacturer:

Hager	2908	1 Amp
	2909	2 Amp
	2910	4 Amp
	2911	6 Amp

2.17 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 07 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	412S / 413S / 520S
Pemko	171 / 271 / 2005
National Guard Products	425 / 513 / 896

2.18 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. Perimeter Gasketing:

	<u>Stop</u> <u>Applied</u>	<u>Stop</u> <u>Applied</u>	<u>Adhesive Applied</u>
Hager	881S	891S	726
Pemko	700S	303	5050
National Guard Products	290	160	S88

2. Sound Seal:

Hager	864S
Pemko	379
National Guard Products	107

3. Meeting Stile Weatherstrip:

Hager	872S N
-------	--------

	Pemko	305_N
	National Guard Products	9125
4.	Overlapping Astragal:	
	Hager	835S / 874SN
	Pemko	357 / 375_R
	National Guard	139 / 122N
5.	Door Bottom Sweeps:	
	Hager	750S
	Pemko	200N
	National Guard	305_N
6.	Automatic Door Bottoms:	
	Hager	742S / 743S
	Pemko	420 / 434
	National Guard	320 / 422
7.	Overhead Drip Guard	
	Hager	810S
	Pemko	346
	National Guard	17

2.19 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:

	<u>Hollow Metal Frame</u>	<u>Wood Frame</u>
Hager	307D	308D
Rockwood	608	607
Trimco	1229A	1229B

2.20 KEY CABINET

- A. Provide key cabinet; surface mounted to wall.
- B. Key control system:
 - 1. Include two sets of key tags, hooks, labels, and envelopes.
 - 2. Contain system in metal cabinet with baked enamel finish.
 - 3. Capacity will be able to hold actual quantities of keys, plus 50 percent.
 - 4. Provide tools, instruction sheets, and accessories required to complete installation.

- C. Acceptable Manufacturers:
 - Lund Equipment
 - Telkee Incorporated
 - Key Control

2.21 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 construction, wall and floor construction, and other conditions affecting performance.
- B. Where hardware will be installed directly on walls inspect applications for blocking material of sufficient type and size for hardware.
- C. Examine roughing-in and cabling for electrical power systems to verify actual locations of wiring connections and wiring supplied matches the requirements as described in the wiring diagrams before electrified door hardware installation.
- D. Perform a site survey to determine proper mounting locations for all wirelessly communicating devices. Verify that the surrounding construction and equipment will not interfere with the communication between components.
- E. Notify Architect via a prepared written report and endorsed by installer of any discrepancies between the door schedule, door types, drawings, and scheduled hardware. List 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 manufacturers' 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. DHI Publication – Installation Guide for Doors and Hardware
 - 5. Approved shop drawings
 - 6. Approved hardware schedule
- B. Install soffit mounted gaskets prior to other soffit mounted hardware ensuring a continuous seal around the perimeter of the opening without cutting or notching.

- C. Locate surface mounted door closers on stairwell side of stair doors, interior side of exterior openings, or on the room side of openings, unless it is a sterile room.
- D. Locate wall mounted bumper to contact the operating trim. Verify that pushbuttons of locksets do not contact the stop and inadvertently lock the door.
- E. Mount armor, mop, and kick plates flush with the bottom of the door and centered horizontally on the door.
- F. Notch thresholds with no larger than a 1/32-inch gap matching the frame profile. Set in a full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants" forming a tight seal between threshold and mounting surface. Caulk and seal the entire perimeter to prevent water leakage. Remove excess sealants immediately and clean the area thoroughly.
- G. Do not install surface mounted items until finishes have been completed on substrates involved. Set unit level, plumb and true to line location.
- H. Locate power supplies and junction boxes as directed and verified in the low-voltage coordination meeting.
- I. Perform final connections of the system components to match the approved operational narratives. Use cable markers to label wires at each termination or end to match the final wiring diagrams. Terminate wiring in accordance with the manufacturer's recommendations. Where quick-connects are seated correctly. Provide wire ties and adhesive pads to secure and organize wires in enclosures. Outside of enclosures seal terminations in waterproof connectors. Include record drawings of the point-point and the elevations in a plastic sleeve attached to the inside cover of the power supply/junction box enclosure for the Owner's use.

3.03 FIELD QUALITY CONTROL

- A. Schedule a final walk through to inspect hardware installation ten (10) business days before final acceptance of the Owner. Visually inspect for proper fasteners and verify that doors open, close, latch properly, and that openings are installed to meet NFPA 80 and ANSI A117.1 requirements. Correct deficiencies, including missing hardware immediately. Provide a written report detailing discrepancies of each opening within five (5) business days of the walk through.
- B. Prior to receiving certificate of occupancy have doors inspected by a Certified Fire and Egress Door Assembly Inspector (CFDAI), as certified by Intertek (ITS), submit a written report to the Owner and Contractor. Doors failing inspection must be adjusted, modified, or replaced to be within appropriate code requirements without delay.

Test the functionality of electrified openings upon completion of the installation in accordance with the description of operation and the Owner's intent under the supervision of a factory authorized representative and an Owner's representative, verify that all features of the software are working correctly, including interfaces with any associated trades. Document the result of all tests and

3.04 ADJUSTMENT, CLEANING, AND DEMONSTRATING

- A. Prior to final adjustments, the HVAC system must be completed and balanced. Test that all openings meet ANSI A117.1 for closer opening pressure, closing speed, latching, and hardware operating forces. Replace items that cannot be adjusted to operate freely and smoothly or as intended for application.

- B. Prior to final walk-through inspection, clean adjacent surfaces soiled by hardware installation. Clean finish hardware per manufacturer's instructions after final adjustments have been made. Remove all protection and replace items that cannot be cleaned to manufacturer's level of finish quality.
- C. Demonstration and training will be conducted as per the following sessions. All sessions will be recorded and turned over to the Owner for future use.
 - 1. Hardware Maintenance: Conduct a training class for building maintenance personnel demonstrating the adjustment, operation, and maintenance of mechanical and electrified hardware. Special tools for finish hardware to be turned over and demonstrated usage at the meeting.
 - 2. Key control system: Train the Owner's designated representative on the key control system demonstrating the permanent file keys, duplicate loaner keys, key receipts, key envelopes, key change identification sheets, bitting lists, tags, and labels. When key management software is provided training will be provided for the setup and usage of the software.
 - 3. Access control: Demonstrate the management and programming of the access control system including the following, but not limited to:
 - a. System administration personnel to manage the LAN and databases including updating, maintaining, and backing up the system and database software.
 - b. Instruct on all software features and programming for managing the credentials, users, access points, time zones, alarms and events, door monitoring, audit trails, and time schedules.

3.05 PROTECTION

- A. Leave manufacturer's protective film intact and, protect exit devices, locks, and surface mounted hardware with kraft paper or bubble wrap. Cover fire labels at painted products that bear a label with magnetic or masking tape. Keep protection in place until time of final cleaning and adjustment.

3.06 HARDWARE SET SCHEDULE

- A. Door hardware items have been placed in sets which are intended to be a guide of design, grade, quality, function, operation, and performance.
 - 1. Review products that may require mounting accessories to meet door, frame, and swing conditions as these final details vary from manufacturer to manufacturer and provide as required.
 - 2. Where additional items of hardware are required for completion of the Work, a written statement of such omission, error, or other discrepancy is required to be submitted to the Architect, prior to bid date for clarification via an addendum.
 - 3. Abbreviations listed below do not appear in the manufacturer's literature, for any other abbreviations refer to manufacturer's literature.:
 - a. LDW = Less than Door Width
 - b. LAR = Length as Required
 - c. QTY = Quantity
 - d. CTC = Centerline to Centerline
 - e. BTB = Back-to-Back mounting

3.07 HARDWARE SCHEDULE**Manufacturer List**

Code	Name
ARRW	Arrow Lock & Door Hardware
BYOT	By Others
HA	Hager

Hardware Sets**Set #01.00**

Doors: E228C

1 Continuous Hinge(s)	780-224HD x LAR	CLR	HA
1 Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1 Thumb Turn Indicator	ABE194 V10	626	ARRW
1 Permanent Core	By Owner		BYOT
1 Construction Core(s)	3982-BLU	BLU	HA
1 Closer(s)	5100-HD	ALM	HA
1 Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1 Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3 Silencers	307D	GREY	HA

Set #01.01

Doors: E228D, E228E

1 Continuous Hinge(s)	780-224HD x LAR	CLR	HA
1 Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1 Thumb Turn Indicator	ABE194 V10	626	ARRW
1 Permanent Core	By Owner		BYOT
1 Construction Core(s)	3982-BLU	BLU	HA
1 Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1 Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3 Silencers	307D	GREY	HA

Set #01.02

Doors: E241B

1 Continuous Hinge(s)	780-224HD x LAR	CLR	HA
1 Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1 Thumb Turn Indicator	ABE194 V10	626	ARRW
1 Permanent Core	By Owner		BYOT
1 Construction Core(s)	3982-BLU	BLU	HA
1 Closer(s)	5100	ALM	HA
1 Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1 Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3 Silencers	307D	GREY	HA

Set #02.00

Doors: E228A, E228B, E241

1 Hardware

By Door Mfr./Supplier

BYOT

END OF SECTION

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

- A. Monolithic glazing.
- B. Insulating glass.
- C. Fire rated glazing.
- D. Plastic films.
- E. Glazing compounds.

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. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- E. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2018, with Editorial Revision.
- F. ASTM C1135 - Standard Test Method for Determining Tensile Adhesion Properties of Structural Sealants; 2019.
- G. ASTM C1249 - Standard Guide for Secondary Seal for Sealed Insulating Glass Units for Structural Sealant Glazing Applications; 2018.
- H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
- I. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2014.
- J. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- K. ASTM C793 - Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants; 2005 (Reapproved 2017).
- L. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- M. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- N. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- O. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- P. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- Q. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- R. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- S. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- T. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- U. GANA (GM) - GANA Glazing Manual; 2022.
- V. GANA (SM) - GANA Sealant Manual; 2008.
- W. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.
- X. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- Y. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.

- Z. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
- AA. NFPA 251 - Standard Methods of Tests of Fire Resistance of Building Construction and Materials - 2006.
- BB. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- CC. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2017.
- DD. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2014, with Errata (2017).
- EE. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

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 MOCK-UPS

- A. See Section 01 4000 - Quality Requirements for additional requirements.
- B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Install glazing in mockups specified in:
 - a. Section 08 4313 - Aluminum-Framed Storefronts.
- C. Mock-ups may remain as part of the Work.

1.07 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.

1.08 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.
 - 2. Pilkington North America Inc: www.pilkington.com.
 - 3. Viracon, Inc: www.viracon.com.
 - 4. Vitro Architectural Glass (formerly PPG Industries, Inc.): www.vitroglazings.com.
- B. Low Iron Float Glass Products:
 - 1. Guardian Glass, LLC; UltraClear: www.guardianglass.com.
 - 2. Pilkington North America Inc; Optiwhite: www.pilkington.com.
 - 3. Vitro Architectural Glass (formerly PPG Industries, Inc.); Starphire Ultra-Clear: www.vitroglazings.com.
 - 4. Substitutions: Refer to Section 01 6000 - Product Requirements.
- C. Laminated Glass Manufacturers:
 - 1. Any of the manufacturers specified for float glass.
- D. Insulating Glass Manufacturers:
 - 1. Any of the manufacturers specified for float glass.
 - 2. All lites of an Insulating Glazing Unit shall be by one manufacturer. Do not mix manufacturers within IGUs.
- E. Fire Rated Glass Manufacturers:
 - 1. McGrory Glass, Inc.: www.mcgrory.com
 - 2. SAFTIFIRST, a division of O'Keeffe's Inc.; www.safti.com.
 - 3. Schott Corporation: www.us.schott.com
 - 4. Technical Glass Products (TGP); www.fireglass.com.
 - 5. Vetrotech Saint-Gobain North America; www.vetrotech.com.
 - 6. Substitutions: Refer to Section 01 6000 - Product Requirements.
- F. Source Limitations: Obtain Float Glass and Low Iron Float Glass from one manufacturer. Obtain Fire Rated Glass from one manufacturer.

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. 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. Fire Rated Glazing:
 - 1. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL 9, UL 10B, and UL 10C.
 - a. Fire protection rated glazing with a 20 minute rating shall be exempt from the hose-stream test.
 - 2. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with ASTM E119, NFPA 80, NFPA 251, NFPA 252, NFPA 257, UL 9, UL 10B, UL 10C, and UL 263.
 - 3. Labeling: Provide permanent markings on fire rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
 - a. "W" Label: Meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
 - b. "OH" Label: Meets fire window assembly criteria including hose stream test of NFPA 257 or UL 9 fire test standards.
 - c. "D" Label: Meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
 - d. "H" Label: Meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
 - e. "T" Label: Meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.
 - f. "XXX" Label - Placeholder that represents fire protection or fire resistance rating period, in minutes.
 - 4. Accessories:
 - a. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with fire rated glazing and each other, and that are approved for use with fire rated glazing by testing agencies that listed and labeled fire rated glazing.
- G. 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.
- H. 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.
- I. 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. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
 - a. Glass Tints: Provide the following:
 - 1) Color: Gray.
 - (a) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Optigray, or a comparable product from any of the manufacturers specified for float glass.

2.04 LAMINATED GLASS

- A. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 1. Unless otherwise indicated laminate glass shall consist of two plies of clear annealed 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) Interlayer Color: Clear, unless otherwise indicated.

2.05 INSULATING GLASS

- A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
- B. 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. 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:
 - 1) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Solarban 60, 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.
 - (b) Technoform Glass Insulation; TGI-Spacer: www.glassinsulation.us.
 - (c) Viracon, Inc; VTS (Viracon Thermal Spacer): www.viracon.com.
 - (d) Vitro Architectural Glass (Formerly PPG); Intercept Spacer System: 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 SPANDREL GLASS

- A. Silicone-Coated Spandrel Glass: ASTM C1048, Type I, Condition C, Quality-Q3.
 - 1. Spandrel (Opacifying) Coating: One-component, water-based, UV resistant, silicone coating. Applied coating will cure to a tack-free silicone elastomeric film providing opacification in any color to glass. Coating shall be applied at a minimum thickness of 4-5 mils dry.
 - 2. Vision Areas: Where spandrel is used in vision glass areas the Design Intent is for the spandrel glass to be a uniform opaque field without streaking or pinhole effects when seen from the interior or exterior side with artificial lighting or daylighting on the opposite side.
 - a. Provide additional coatings as required to achieve the Design Intent.
 - b. Spandrel coating shall be on third surface.
 - 3. Product:
 - a. Opaci-Coat 300; ICD High Performance Coatings; www.icdcoatings.com .
 - 1) Color: #3-4051 Spencer; complimenting Basis-of-Design tint.
 - (a) If glass tint other than Basis-of-Design is provided, revise spandrel coating color, subject to Architect's approval, to compliment provided glass tint.
- B. Ceramic Frit Spandrel Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) type coatings on flat glass; coated spandrel glass, Kind CS.
 - 1. Color: Gray.
 - 2. Manufacturers: Any of the manufacturers specified for float glass.

2.07 FIRE RATED GLASS

- A. Fire-Protection-Rated Glazing - 20 Minute: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.
 - 1. Glass Type: Specialty tempered float glass.
 - 2. Meet safety glazing requirements indicated in performance requirements.
 - 3. Meet fire door assembly criteria for a "D" label as indicated in the performance requirements.
 - 4. Glazing Method: As required for fire rating.
 - 5. Fire-Rating: 20 minutes.
 - 6. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
 - a. McGrory Glass; FireDefend 20: www.mcgrory.com
 - b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I: www.safti.com.
 - c. Technical Glass Products; Fireglass20: www.fireglass.come.
 - d. Vetrotech Saint-Gobain North America; Pyroswiss 20: www.vetrotechusa.com.
- B. Fire-Protection-Rated Glazing For Door Lites: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.
 - 1. Glass Type: Specialty tempered float glass.
 - 2. Meet safety glazing requirements indicated in performance requirements.
 - 3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
 - 4. Glazing Method: As required for fire rating.
 - 5. Fire-Rating: As indicated.

6. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
 - a. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite X: www.safti.com.
- C. Fire-Protection-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and does not block radiant heat, as required to achieve indicated fire-rating period.
 1. Glass Type: Laminated ceramic glass.
 - a. Neutral color, free of amber tint.
 2. Meet safety glazing requirements indicated in performance requirements.
 3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
 4. Meet fire window assembly criteria for "W" and "OH" labels as indicated in the performance requirements.
 5. Glazing Method: As required for fire rating.
 6. Fire-Rating: As indicated.
 7. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
 - a. McGrory Glass; Pyran Platinum L: www.mcgrory.com
 - b. SCHOTT North America Inc; Pyran Platinum L: www.us.schott.com.
 - c. Technical Glass Products; FireLite Plus: www.fireglass.come.
 - d. Vetrotech Saint-Gobain North America; Keralite L: www.vetrotechusa.com.
- D. Fire-Resistance-Rated Glazing: Type, thickness, and configuration of glazing that contains flame, smoke, and blocks radiant heat, as required to achieve indicated fire-rating period.
 1. Glass Type: Multi-laminate annealed glass with intumescent fire retardant interlayers.
 2. Meet safety glazing requirements indicated in performance requirements.
 3. Meet fire door assembly criteria for "D", and "H" labels as indicated in the performance requirements.
 4. Meet fire window assembly criteria for "W" and "OH" labels as indicated in the performance requirements.
 5. Meet temperature rise criteria for "T" label as indicated in the performance requirements.
 6. Glazing Method: As required for fire rating.
 7. Fire-Rating: As indicated.
 8. Products: Provide one of the following products or a comparable product from one of the other manufacturers specified for fire rated glass.
 - a. McGrory Glass; AGC Pyrobel: www.mcgrory.com
 - b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite II-XL : www.safti.com/sle.
 - c. Technical Glass Products; Pilkington Pyrostop : www.fireglass.com.
 - d. Vetrotech Saint-Gobain North America; Contraflam : www.vetrotechusa.com

2.08 PLASTIC FILMS

- A. Type F-1 - Decorative Plastic Film: Polyester type.
 1. Application: Locations as indicated on drawings.
 2. Series Type: Single Gradation.
 3. Product Name: Sabrina SH2FGSB
 4. Color: Milky Crystal SH2MLCRX.
 5. Thickness Without Liner: 0.002 inch.
 6. Manufacturers:
 - a. 3M Window Film; FASARA Glass Finishes Gradation: www.solutions.3m.com
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.09 GLAZING COMPOUNDS

- A. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, butyl sealant.
 1. Product:
 - a. Pecora Corp.; BC-158: www.pecora.com.
 - b. Tremco, Inc.; Butyl Sealant: 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.
 - 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.
- C. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
 - 1. SSG adhesive in compliance with ASTM C920; Type S - Single-component, Grade NS, Class 25, Use NT, G, and A.
 - 2. Ultimate Tensile Strength: Minimum of 50 psi as determined by test method ASTM C1135 under the following conditions.
 - a. Exposure to air temperatures of 190 degrees F and minus 20 degrees F.
 - b. Water immersion for seven (7) days, minimum.
 - c. Exposure to weathering for 5,000 hours, minimum.
 - 3. Sealant Design Tensile Strength: 20 psi, maximum.
 - 4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
 - 5. Color: Black.
 - 6. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
 - 7. Products:
 - a. Dow Corning Corporation; 995 Structural Glazing Sealant: www.dowcorning.com .
 - b. GE/Momentive Performance Materials, Inc: SSG4000 UltraGlaze: www.siliconeforbuilding.com.
 - c. Pecora Corporation: 895NST: www.pecora.com.
 - d. Sika; SikaSil SG-20: www.sika.com.
 - e. Tremco, Inc.: Proglaze SSG: www.tremcosealants.com.
 - f. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.10 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.

2.11 VISION LITE KITS FOR FIRE RATED DOOR GLAZING

- A. At Contractor's option, instead of glass stops provided by door manufacturers, provide fire rated glass manufacturer's standard vision lite kits for installing fire-rated glass in doors.
 - 1. Moldings: Minimum 20 gage, 0.036 inch, thick steel.
 - 2. Profile: Manufacturer's standard profiles.
 - 3. Door Lite Sizes: As indicated on Drawings.
 - 4. Fire Ratings: As indicated on Drawings.
 - 5. Finish: Manufacturer's standard primer.
 - 6. Basis-of-Design Product: Provide SAFTIFIRST, a division of O'Keeffe's Inc.; Vision Kits: www.safti.com, or a comparable product from any of the manufacturers specified for fire-rated glass.

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, and paint.

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 INSTALLATION - DRY GLAZING METHOD (TAPE AND GASKET SPLINE GLAZING)

- A. Application - Exterior Glazed: Set glazing infills from the exterior of the building.
- B. Cut glazing tape or spline to length; install on glazing pane. Seal corners by butting tape and sealing junctions with butyl sealant.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against fixed stop with sufficient pressure to attain full contact.
- E. Install removable stops without displacing glazing spline. Exert pressure for full continuous contact.
- F. Carefully trim protruding tape with knife.

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

- A. Application - Interior Glazed: Set glazing infills from the interior of the building.
- B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch above sight line.
- C. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane or unit.
- E. Place glazing tape on free perimeter of glazing in same manner described above.
- F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- G. Carefully trim protruding tape with knife.

3.07 INSTALLATION - STRUCTURAL SILICONE GLAZING

- A. See Section 08 4413 for wall framing assembly requirements.
- B. Application - Field Glazed: Follow basic guidelines of structural silicone glazing for glazing application.
 - 1. Two-Sided Structural: Glass structurally adhered to vertical mullions with horizontal sides captured in glazing pockets.
- C. Provide design review of the glazing system and project details, adhesion testing, proper surface preparation, training and a quality service program.
- D. Provide only structural silicone sealant, tested and manufactured for structural glazing.
- E. Prevent structural silicone sealant from blocking weep systems.

3.08 INSTALLATION - FIRE-RATED GLAZING UNITS

- A. Install fire-rated glazing in compliance with written instructions of fire-rated glazing manufacturer as required to maintain specified fire rating.
 - 1. Use glazing method and materials as indicated by the fire rated glazing manufacturer as required to maintain specified fire-rating.

3.09 INSTALLATION - PLASTIC FILM

- A. Install plastic film with adhesive, applied in accordance with film manufacturer's instructions.
- B. Place without air bubbles, creases or visible distortion.
- C. Install film tight to perimeter of glass and carefully trim film with razor sharp knife. Provide 1/16 inch to 1/8 inch gap at perimeter of glazed panel unless otherwise required. Do not score the glass.

3.10 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove nonpermanent 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.

3.11 PROTECTION

- A. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

3.12 GLASS SCHEDULE

- A. GL-2: Clear monolithic safety glass.
1. Clear fully tempered safety glass.
 2. Minimum Thickness: 1/4 inch (6 mm).
 3. Safety glazing required.
- B. GL-6: Clear monolithic safety glass.
1. Clear fully tempered safety.
 2. Minimum Thickness: 3/8 inch (9 mm).
 3. Safety glazing required.
- C. GL-13: Low-E-coated, Clear tempered insulating glass.
1. Overall Unit Thickness: 1 inch.
 2. Outdoor Lite: Clear tempered float glass.
 - a. Minimum Thickness: 1/4 inch (6 mm).
 - b. Low-E Coating: On 3rd surface.
 3. Airspace:
 - a. Width: 1/2 inch.
 - b. Interspace Content: Air.
 4. Indoor Lite: Clear tempered float glass.
 - a. Minimum Thickness: 1/4 inch (6 mm).
 - b. Low-E Coating: On 3rd surface.
 5. Performance:
 - a. Winter Nighttime U-Factor: 0.29 maximum.
 - b. Visible Light Transmittance: 70 percent minimum.
 - c. Solar Heat Gain Coefficient: 0.39 maximum.
- D. GL-17: Low-E-coated, tinted, insulating safety glass
1. Overall Unit Thickness: 1 inch.
 2. Outdoor Lite: Tinted fully tempered float glass.
 - a. Minimum Thickness: 1/4 inch (6 mm).
 - b. Tint Color: Gray.
 3. Airspace:
 - a. Width: 1/2 inch.
 - b. Interspace Content: Air.
 4. Indoor Lite: Clear fully tempered float glass.
 - a. Minimum Thickness: 1/4 inch (6 mm).
 - b. Low-E Coating: On 3rd surface.
 5. Safety glazing required.
 6. Performance:
 - a. Winter Nighttime U-Factor: 0.29 maximum.
 - b. Visible Light Transmittance: 50 percent minimum.
 - c. Solar Heat Gain Coefficient: 0.30 maximum.
- E. GL-25: Tinted heat-strengthen laminated insulating glass.
1. Overall Unit Thickness: 1 inch.
 2. Outdoor Lite: Tinted heat-strengthen laminated float glass.
 - a. Minimum Thickness: 1/4 inch (6 mm).
 - b. Low-E Coating: On 3rd surface.
 - c. Tint Color: Gray.
 3. Airspace:

- a. Width: 1/2 inch.
 - b. Interspace Content: Air.
- 4. Indoor Lite: Clear heat-strengthen laminated float glass.
 - a. Minimum Thickness: 1/4 inch (6 mm).
 - b. PVB Interlayer Color: Clear.
- 5. Performance:
 - a. Winter Nighttime U-Factor: 0.29 maximum.
 - b. Visible Light Transmittance: 50 percent minimum.
 - c. Solar Heat Gain Coefficient: 0.30 maximum.
- F. SSGL-1: Clear heat-strengthened laminated security glass.
 - 1. Clear laminated safety glass.
 - 2. PVB Interlayer Thickness: .090.
 - 3. PVB Interlayer Color: Clear.
 - 4. Minimum Thickness: 9/16 inch (14 mm).
 - 5. Safety glazing required.
- G. SSGL-2 Clear heat-strengthen laminated security insulating glass.
 - 1. Overall Unit Thickness: 1-1/16 inch.
 - 2. Outdoor Lite: Clear fully tempered float glass.
 - 3. Airspace:
 - a. Width: 1/2 inch.
 - b. Interspace Content: Air.
 - 4. Indoor Lite: Clear heat-strengthen laminated float glass.
 - a. PVB Interlayer Thickness: .090.
 - b. PVB Interlayer Color: Clear.
 - c. Minimum Thickness: 7/16 inch (6 mm).
 - 5. Performance:
 - a. Winter Nighttime U-Factor: 0.29 maximum.
 - b. Visible Light Transmittance: 70 percent minimum.
 - c. Solar Heat Gain Coefficient: 0.24 maximum.

END OF SECTION

SECTION 09 0561 - COMMON WORK RESULTS FOR FLOORING PREPARATION**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Testing of concrete floor slabs for moisture and alkalinity (pH).
- B. Remedial floor coatings for concrete floor slabs.

1.02 PRICE AND PAYMENT PROCEDURES

- A. Remedial Floor Coatings.
 - 1. Contractor shall perform all required remediation of concrete floor slabs;
 - a. Contractor shall perform the work at no additional cost to Owner where moisture vapor reduction admixture (MVRA) was required as part of the concrete mix design.
 - b. Where remedial floor coating was indicated, Contractor shall perform the work at no additional cost to Owner
 - c. Where a moisture vapor reduction admixture (MVRA) was not required and at floor slabs where remedial floor coatings were not indicated, a contract modification will be issued based upon the following:
 - 1) Unit pricing as specified in Section 01 2200 - Unit Prices.
 - 2) Contingency allowance as specified in Section 01 2100 - Allowances.
 - 3) No unit pricing or allowances were provided; Contractor shall record and submit written records of costs, including material quantities used, number of labor hours used, and total area, in square feet, of remediated concrete.

1.03 REFERENCE STANDARDS

- A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2022.
- C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- D. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

- A. Testing Reports:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.
 - 5. Submit reports to Architect.
 - 6. Submit reports not more than two business days after conclusion of testing.
- B. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's statement of compatibility with types of flooring, including adhesives, applied over remedial product.
 - 2. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

1. At Contractor's option, tests may be performed by the Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
- C. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and at least 5 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Remedial Floor Coating: Single- or multi-layer coating intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Provide resistance to up to 95 percent relative humidity and 15 pounds moisture vapor transmission.
 3. Provide resistant to alkalinity (pH) level of pH 14.
 4. Products:
 - a. Maxxon Corporation; Aquafin Vaportight Coat-SG4: www.maxxon.com.
 - b. Schonox, HPS North America, Inc.; MR-18: www.hpsubfloors.com.
 - c. Specialty Products Group; Vapor Lock 0/0: www.spggogreen.com.
 - d. Spray-Lock; SCP 578: www.concreteprotection.com.
 - e. Tnemec Company, Inc; Epoxoprime MVT Series 208 : www.tnemec.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.02 MOISTURE VAPOR EMISSION TESTING

- A. Moisture vapor emission testing for concrete floor slabs.
 1. Test where adhesive applied floor finishes are to be installed, and where indicated.
 - a. Including:
 - 1) Wood gymnasium flooring.
 - 2) Wood stage flooring.
 - 3) Epoxy matrix terrazzo flooring.

- B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- C. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- D. Test in accordance with ASTM F1869 and as follows.
- E. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- F. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
 - 1. After remedial floor coating has been applied, perform the test again.
 - a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring until authorized.
- G. Report: Report the information required by the test method.

3.03 INTERNAL RELATIVE HUMIDITY TESTING

- A. Internal relative humidity testing for concrete floor slabs.
 - 1. Test where adhesive applied floor finishes are to be installed, and where indicated.
 - a. Including:
 - 1) Wood gymnasium flooring.
 - 2) Wood stage flooring.
- B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- C. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- D. Test in accordance with ASTM F2170 Procedure A and as follows.
- E. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- F. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
 - 1. After remedial floor coating has been applied, perform the test again.
 - a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring.
- G. Report: Report the information required by the test method.

3.04 ALKALINITY TESTING

- A. Alkalinity testing for concrete floor slabs.
 - 1. Test where adhesive applied floor finishes are to be installed, and where indicated.
- B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- C. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.

3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- D. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.
 1. After remedial floor coating has been applied, perform the test again.
 - a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring until authorized.
- E. Report: Report test results.

3.05 APPLICATION OF REMEDIAL FLOOR COATING

- A. Apply remedial floor coating to concrete floor slabs as indicated on Drawings.
- B. Apply remedial floor coating to concrete slabs that fail one or more of the following tests:
 1. Moisture vapor emission testing .
 2. Internal relative humidity testing.
 3. Alkalinity testing.
- C. Install in accordance with remedial floor coating manufacturer's instructions and as follows:
 1. Shot blast or mechanically abrade concrete surfaces to meet surface profile of 3 to 4 per ICRI 310.2R; acid etching is not permitted.
 2. Vacuum and clean slab to remove all dust, dirt, and debris.
 3. Apply one to two coats of remedial floor coating as recommended by remedial floor coating manufacturer.

3.06 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

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. Shaft wall framing.
- C. Suspension systems for interior ceilings and soffits.
- D. Framing accessories.

1.02 REFERENCE STANDARDS

- A. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- E. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- F. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- G. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.
- H. ASTM D3575 - Standard Test Methods for Flexible Cellular Materials Made From Olefin Polymers.
- I. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.
- J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- K. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- L. ASTM F1941/F1941M - Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric; 2016.
- M. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs; 2017.
- N. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2009 (Reapproved 2020).
- O. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
- P. GA-600 - Fire Resistance Design Manual; 2015.
- Q. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- R. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2016.
- S. 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, control joints, stud layout, framed openings, anchorage to structure, acoustic details, type and location of fasteners, and accessories.
 - 2. Describe method for securing studs to tracks, splicing, and for blocking and reinforcement of framing connections.
 - 3. Coordinate with Section 09 2900
- 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.
 - 2. Jaimes Industries Inc.: www.jaimesind.com.
 - 3. MarinoWARE: www.marinoware.com.
 - 4. MBA Building Supplies, Inc.: www.mbastuds.com.
 - 5. State Building Products; www.statebp.com.
 - 6. The Steel Network, Inc: www.SteelNetwork.com.
 - 7. Telling Industries; www.buildstrong.com.
 - 8. 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. Shaft Walls: Provide completed assemblies with the following characteristics:
 - 1. Comply with requirements of Fire-Rated Assemblies.
 - 2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
 - b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.
- E. 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.
- F. Protective Coatings: Equivalent (EQ) coatings are not acceptable; products shall be hot-dip galvanized as indicated.
- G. 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, G60, hot-dip galvanized.
 - 2. Minimum Metal Thickness: 0.030 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, G60, 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.
 - (2) MarinoWARE; FAS Track 1000: 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.
 - 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, G60, 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.
 - b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 SHAFT WALL FRAMING MATERIALS

- A. Non-Load-Bearing Steel Framing: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated and complying with requirements for fire-resistance-rated assembly indicated.
 - 1. Protective Coating: ASTM A653/A653M, G90, hot-dip galvanized.
 - 2. Minimum Metal Thickness: 0.0329 inch (20 gage).
 - 3. Profiles:
 - a. Studs: Manufacturer's standard C-H or C-T profile.
 - 1) Depth: As indicated.
 - b. Runners: Manufacturer's standard J-profile track; matching studs in depth.
 - c. Slotted Deflection Track: As specified in "Framing Materials" above.
 - 4. Fasteners and Associated Materials: As specified in "Framing Accessories" above.

2.06 SUSPENSION SYSTEMS

- A. Carrying Channels: ASTM C955; cold-rolled galvanized steel sheet U-channel.
 - 1. Protective Coating: ASTM A653/A653M, G60, 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.
 - b. CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: www.certainteed.com.
 - c. Rockfon, Part of the Rockwool Group; Chicago Metallic Drywall Grid: www.rockfon.com.
 - d. USG Corporation: Drywall Suspension System: www.usg.com
 - e. Substitutions: See Section 01 6000 - Product Requirements

2.07 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. General requirements and locations of control joints in metal-framed gypsum board construction:
 1. General: Comply with requirements of ASTM C840, and as noted below:
 - a. Control joints shall be constructed with manufactured control joint trim, or field fabricated from materials as specified.
 - b. Control joints will be installed where a partition, wall, or ceiling traverses and construction joint (expansion, or building control element) in the base building structure.
 - c. Control joints will be installed where a wall or partition extends in an uninterrupted straight plane exceeding 30 linear feet. Door and/or window frames that extend full height of partitions will be considered equivalent to control joint construction.
 - d. Control joints in interior ceilings, bulkheads, fasciae and soffits will be installed so that linear dimensions between control joints do not exceed 30 linear feet and total area between control joints does not exceed 900 square feet. Control joints will be installed to isolate wings of "L", "U": and "T" shaped ceiling and soffit areas.
 - e. A control joint will be installed where ceiling, bulkhead, fascia and soffit framing members change direction.
 - f. Provide appropriate backing material, fire-safing insulation, and sealant for control joints installed in acoustical or fire-rated construction, as required to maintain fire-rating and/or acoustical separation.
- X. 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. Shaft wall liner panels.
- C. Tile backing board.
- D. Finishing materials.
- E. Trim accessories.
- F. Acoustic insulation.

1.02 REFERENCE STANDARDS

- A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017.
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- F. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2020.
- H. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- I. 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.
- J. 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; 2020.
- K. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2019.
- L. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- M. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).
- N. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- O. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels; 2019.
- P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- S. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2020.
- T. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- U. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.

- V. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
- W. GA-600 - Fire Resistance Design Manual; 2015.
- X. 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. Shaft Walls: Provide completed assemblies with the following characteristics:
 - 1. Comply with requirements of Fire-Rated Assemblies.
 - 2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
 - b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

- E. 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.
 - b. Continental Building Products; Regular Drywall: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Gypsum Board: www.gp.com.
 - d. National Gypsum Company; Gold Bond Brand Gypsum Board: www.nationalgypsum.com.
 - e. USG Corporation; Sheetrock Brand Gypsum Panels: 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.
 - b. Continental Building Products; Firecheck Type X: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gp.com.
 - d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: www.nationalgypsum.com.
 - e. USG Corporation; Sheetrock Brand Firecode X Panels: www.usg.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.
- C. Impact 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 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 10. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
 11. Products:
 - a. CertainTeed Corp.; Extreme Impact Resistant Gypsum Board: www.certainteed.com.
 - b. Continental Building Products; Protecta HIR 300 Type X with Mold Defense: www.continental-bp.com.
 - c. National Gypsum Company; Gold Bond Brand Hi-Impact XP Gypsum Board: www.nationalgypsum.com.

- d. USG Corporation; Sheetrock Brand Mold Tough VHI Firecode X Panels: www.usg.com.
- e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SHAFT WALL LINER PANELS

- A. Gypsum Shaft Wall Liner Panels: Moisture resistant paper-faced gypsum liner panels with fire-resistant core; ASTM C1396/C1396M
 - 1. Thickness: 1 inch.
 - 2. Width: 24 inches.
 - 3. Long Edges: Double beveled with paper face wrapping edge.
 - 4. Short Edges: Square cut.
 - 5. Sized to minimize joints.
 - 6. Type: Fire resistance rated Type X, UL or WH listed.
 - 7. Products:
 - a. CertainTeed Corp.; M2Tech Shaftliner Type X: www.certainteed.com.
 - b. Continental Building Products; Shaftliner Type X: www.continental-bp.com.
 - c. Georgia-Pacific Gypsum; ToughRock Shaftliner: www.gp.com.
 - d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner: www.nationalgypsum.com.
 - e. USG Corporation; Sheetrock Brand Gypsum Liner Panels: www.usg.com.
 - f. Substitutions: See Section 01 6000 - Product Requirements.

2.04 TILE BACKING BOARDS

- A. Cementitious Backer Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - 1. Thickness: 5/8 inch.
 - 2. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
 - 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 4. Locations: Wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:
 - a. Showers.
 - b. Swimming pool areas.
 - 5. Products:
 - a. National Gypsum Company; PermaBase Brand Cement Board: www.nationalgypsum.com.
 - b. USG Corporation; Durock Brand Cement Board: www.usg.com.
 - c. Substitutions: See Section 01 6000 - Product Requirements.
- B. 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.
 - b. Georgia-Pacific Gypsum; DensShield Tile Backer: www.gp.com.
 - c. National Gypsum Company; Gold Bond Brand eXP Tile Backer: www.nationalgypsum.com.
 - d. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com.

- e. Substitutions: See Section 01 6000 - Product Requirements.

2.05 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.

2.06 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.
 - b. MarinoWARE: www.marinoware.com.
 - c. Telling Industries; www.buildstrong.com.
 - d. Phillips Manufacturing Co: www.phillipsmfg.com.
 - e. USG Corporation: 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.
 - b. Gordon, Inc.; www.gordon-inc.com.
 - c. Pittcon Industries; 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.
- C. Partition Closures: Provide one of the following types.
 - 1. Aluminum Partition Closure: Aluminum spring loaded partition closure assembly with acoustical insulation.
 - a. Extruded aluminum; ASTM B221 6063 T5 alloy
 - b. Provide all auxiliary materials and hardware for a complete installation.
 - c. Minimum STC rating of 38.
 - d. Finish: Manufacturer's standard powder coating; custom color to match Architect's sample.
 - 1) Color: To match adjacent glazing framing unless otherwise indicated.
 - e. Size closure to fit tightly in vertical juncture between end of partition and windows, glazing, and similar construction.
 - f. Products:

- 1) Gordon, Inc.; MullionMate Series: www.gordon-inc.com.
- 2) Substitutions: See Section 01 6000 - Product Requirements.
2. Foam Partition Closure: Silicone coated foam closures; compression fitted.
 - a. Foam: Manufacturer's standard open-cell, fire-resistant foam core.
 - 1) Fire-resistance: Class A per ASTM E90.
 - b. Finish Coating: Silicone; smooth finish.
 - 1) Provide finish on exposed sides, and sides compressed against glazing.
 - 2) Silicone Coating Color: Custom color to match Architect's sample.
 - (a) Color: To match adjacent glazing framing unless otherwise indicated.
 - c. Minimum STC rating of 53.
 - d. Depth of Seal: 2 inches, minimum.
 - e. Size closure to fit tightly in vertical juncture between end of partition and windows, glazing, and similar construction.
 - f. Products:
 - 1) Emseal Joint Systems, Ltd.; QuietJoint: www.emseal.com.
 - 2) Substitutions: See Section 01 6000 - Product Requirements.
3. Partition Closures: .
 - a. Sound Barrier Mullion Trip Cap
 - 1) Products: MULL-it-OVER Products Mullion Trim Cap
 - 2) Substitutions: See Section 01 6000-Product Requirements.
 - b. Profile: 55 Classic Mullion Trim Cap
 - c. Aluminum Extrusion:
 - 1) Thickness: 1/8 inch.
 - d. Sound Absorbing Foam:
 - 1) Resistant to smoke, flame, and microbial growth.
 - 2) Fire Rating: ASTM E84 Class 1.
 - 3) Fungi Resistance: Zero rating per ASTM G21.
 - e. Compressible Foam: Between edge of extrusion and interior face of curtain wall glass.
 - 1) Thickness: as required to accommodate mullion deflection.
 - 2) Color: Light gray.
 - f. Fasteners:
 - 1) Self Tapping or appropriate threaded fastener.
 - 2) Compatible with all materials fasteners will contact with and not causing galvanic corrosion.
 - g. Snap Cover: Snap-on fastener cover
 - h. Acoustical Sound Sealant: Acrylic latex based.
 - i. Accessories: Provide necessary and related parts and tools to complete installation.
 - j. Fabrication: Extrusions and generic profiles to be shipped in custom lengths as required to meet project requirements or shipped in standard incremental foot lengths and cut to exact length on jobsite.
 - k. Finishes: Exposed surfaces of exposed aluminum extrusion:
 - l. Aluminum: Architect to select from manufacturer's custom color offering to match adjacent storefront finish.

2.07 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.

- 2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts):
www.owenscorning.com.
- 3) Rockwool; Safe'n'Sound: www.rockwool.com.
- 4) Substitutions: See Section 01 6000 - Product Requirements.
2. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
 - a. Thickness: 3-1/2 inches, unless otherwise indicated.
 - b. Products:
 - 1) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts:
www.certainteed.com.
 - 2) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
 - 3) Knauf Insulation; EcoBatt Insulation with ECOSE Technology:
www.knaufinsulation.com.
 - 4) Owens Corning Corporation; EcoTouch Sound Attenuation Batts:
www.owenscorning.com.
 - 5) 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.
 - b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant:
www.liquidnails.com.
 - c. Pecora Corporation; AC-20 FTR: www.pecora.com.
 - d. Pecora Corporation; AIS-919: www.pecora.com.
 - e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant:
www.usg.com.
 - f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant:
www.usg.com.
 - g. Substitutions: See Section 01 6000 - Product Requirements.

2.08 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.
 - b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive:
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. Cementitious Backing Board: Install in accordance with ANSI A108.11 and manufacturer's instructions.
- F. 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.
- B. Hard tile trim units.
- C. Tile setting materials, grout, sealants, and accessories.
- D. Metal trim.
- E. Waterproofing, Uncoupling, 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; 2023.
- B. ANSI A108.1b - Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- C. ANSI A108.1c - Contractor's 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 Setting Bed with Dry-Set, Modified Dry-Set, or Improved Modified Dry-Set Cement Mortar; 2023.
- D. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesive or Water Cleanable Tile-Setting Epoxy Adhesive; 2023.
- E. ANSI A108.5 - Setting of Ceramic Tile with Dry-Set Cement Mortar, Modified Dry-Set Cement Mortar, EGP (Exterior Glue Plywood) Modified Dry-Set Cement Mortar, or Improved Modified Dry-Set Cement Mortar; 2023.
- F. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grout Epoxy; 2023.
- G. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2019).
- H. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 2023.
- I. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 2017 (Reaffirmed 2022).
- J. ANSI A108.12 - Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2023.
- 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 2021).
- L. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- M. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
- N. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
- O. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).
- P. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2019).

- Q. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.
- R. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- S. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2023.

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. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer:
- D. Preinstallation Conference: Conduct conference at the Project Site.
 - 1. Convene one week prior to commencing work of this section.
 - 2. Require attendance of installation material manufacturer, tile supplier, tile installer, and installers of related work. Review installation procedures and coordination required with related work.
 - 3. Meeting agenda includes, but is not limited to:
 - a. Surface preparation.
 - b. Tile and installation material compatibility.
 - c. Manufacturer and installer warranty duration and scope covered by warranty.
 - d. Edge protection, transition, and pre-fabricated movement joint profiles.
 - e. Waterproofing techniques.
 - f. Crack isolation techniques.

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 any other specific locations as requested by the Architect.
 - 3. Mockup sizes shall be sized as appropriate to demonstrate complete tile pattern layout; 16 square feet, minimum.

4. 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 - CT3: NOT USED.
- B. CT4 Floor Tile: ANSI A137.1 standard grade.
 1. Size: 12 by 24 inch, nominal.
 2. Thickness: 5/16 inch, nominal.
 3. Surface Finish: Matte.
 4. Color(s): Intensity Pebble VL72.
 5. Trim Units: Matching cove base shapes in sizes coordinated with field tile.
 6. Joint Size: 3/16 inch.
 7. Base: Cove Base P36C9.
 8. Products:
 - a. Dal-Tile Corporation; Volume 1.0 with Stepwise Technology: www.daltile.com.
 - b. Substitutions: Not permitted.
 - c. Distributor: Daltile.
 - d. Manufacturer's Representative: Taylor Sheppard, taylor.sheppard@daltile.com, (224) 374-4180.
- C. CT5 Floor Tile: ANSI A137.1 standard grade.
 1. Size: 6 by 24 inch, nominal.
 2. Thickness: 5/16 inch, nominal.
 3. Surface Finish: Matte.
 4. Color(s): Stereo Grey VL73.
 5. Joint Size: 3/16 inch.
 6. Products:
 - a. Dal-Tile Corporation; Volume 1.0 with Stepwise Technology: www.daltile.com.
 - b. Substitutions: Not permitted.
 - c. Distributor: Daltile.
 - d. Manufacturer's Representative: Taylor Sheppard, taylor.sheppard@daltile.com, (224) 374-4180.

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. Latex-Portland Cement Thin-Set Mortar Bond Coat: ANSI A118.4, ANSI A118.11 and ANSI A118.15 .
 - 1. Products:
 - a. Bostik, Inc; Bostik PM: www.bostik.com.
 - b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar: www.custombuildingproducts.com.
 - c. H.B. Fuller Construction Products, Inc; Sturdi Flex Thin Set Mortar: www.tecspecialty.com/#sle.
 - d. LATICRETE International, Inc; 253 Gold: www.laticrete.com.
 - e. MAPEI Corp.; Porcelain Tile Mortar: www.mapei.com.
 - f. Schluter Systems L.P.; All Set Thinset Mortar; www.schluter.com
 - g. Substitutions: See Section 01 6000 - Product Requirements.
- B. Large Format Tile Latex-Portland Cement Medium-Bed Mortar Bond Coat: ANSI A118.4, ANSI A118.11 and ANSI A118.15 .
 - 1. Products:
 - a. Bostik, Inc; Big Tile & Stone: www.bostik.com.
 - b. Custom Building Products; Natural Stone & Large Tile Premium Mortar: www.custombuildingproducts.com.
 - c. LATICRETE International, Inc; 4-XLT: www.laticrete.com.
 - d. MAPEI Corp.; Large Tile & Stone Mortar: www.mapei.com.
 - e. Schluter Systems L.P.; All Set thinset mortar; www.schluter.com.
 - f. TEC, H.B. Fuller Construction Products Inc; Ultimate Large Tile Mortar or Permalastic LHT: www.tecspecialty.com.
 - g. Substitutions: See Section 01 6000 - Product Requirements.

2.05 GROUTS

- A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Color(s): As selected by Architect from manufacturer's full line, unless otherwise indicated.
 - 2. Products:
 - a. Bostik, Inc; EzPoxy EzClean: www.bostik.com.
 - b. Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout: www.custombuildingproducts.com.
 - c. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Grout and Mortar: www.tecspecialty.com/#sle.
 - d. LATICRETE International, Inc; SPECTRALOCK Pro Premium: www.laticrete.com.
 - e. MAPEI Corp.; Kerapoxy or Kerapoxy CQ: www.mapei.com
 - f. Substitutions: See Section 01 6000 - Product Requirements.
 - 1) Substitutions will only be accepted for manufacturers for epoxy grout. Product substitutions for other than epoxy grouts will not be accepted.

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. Other shapes as indicated on Drawings.
 - 2. Material: Brushed stainless steel.
 - 3. Applications and Locations:
 - a. Open edges of floor tile.
 - b. Outside wall corners.
 - c. Transitions between hard tile and other floor finishes.
 - d. Tile perimeters not against a wall or other solid vertical surface.
 - e. Other areas as indicated on Drawings.

4. Manufacturers:
 - a. Schluter-Systems: 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. 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.
 - 2) LATICRETE International, Inc; Hydro Ban: www.laticrete.com.
 - 3) MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.
 - b. With Fabric Reinforcing:
 - 1) Bostik, Inc; GoldPlus: www.bostik.com.
 - 2) Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane: www.custombuildingproducts.com.
 - 3) LATICRETE International, Inc; Hydro Barrier: www.laticrete.com.
 - 4) MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
 - 5) TEC, H.B. Fuller Construction Products Inc; HydraFlex: 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. 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 epoxy 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 - FLOORS - THIN-SET METHODS

- A. Over concrete substrates, install in accordance with TCNA (HB) Method F122 or F122A, as appropriate to substrate conditions.
 1. Provide waterproofing and crack isolation membrane.

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.
 - 2. Acoustical panels.
 - 3. Acoustical insulation above ceiling.

1.02 REFERENCE STANDARDS

- A. ASTM B164 - Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire; 2014.
- B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- E. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- F. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- H. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2022.
- I. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
- J. 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.
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. USG Corporation: www.usg.com.
 - 4. 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.
 - 2. CertainTeed Corporation: www.certainteed.com.
 - 3. Rockfon North America/Chicago Metallic: www.rockfon.com.
 - 4. USG Corporation: 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. ACT1 Acoustical Panels: Paint faced glass fiber, ASTM E1264 Type XII, with the following characteristics:
 - 1. Size: 24 by 24 inches.
 - 2. Thickness: 5/8 inch.

3. Light Reflectance: 0.89 percent, determined in accordance with ASTM E1264.
4. Ceiling Attenuation Class (CAC): 33, determined in accordance with ASTM E1264.
5. Edge: Square.
6. Surface Color: White.
7. Suspension System: Exposed grid Type SG-1.
8. Products:
 - a. Armstrong World Industries, Inc; Kitchen Zone No. 673: www.armstrongceilings.com.

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. Armstrong World Industries, Inc; Prelude: www.armstrongceilings.com.
 - b. Substitutions: See Section 01 6000-Product Requirements.

2.04 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 moldings.
 3. At Bullnose Corners: Provide radius corner moldings to match bullnose radius of adjacent walls.
 4. **Teg Tabs are not acceptable.**
- D. Touch-up Paint: Type and color to match acoustical and grid units.

2.05 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.
 - 2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
 - 3) Rockwool; Safe'n'Sound: www.rockwool.com.

- 4) Substitutions: See Section 01 6000 - Product Requirements.
- 2. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
 - a. Thickness: 3-1/2 inches, unless otherwise indicated.
 - b. Products:
 - 1) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts: www.certainteed.com.
 - 2) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
 - 3) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
 - 4) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: www.owenscorning.com.
 - 5) Substitutions: See Section 01 6000 - Product Requirements.
- B. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C834; for use in conjunction with perimeter moldings of suspended ceiling systems.
 - 1. Products:
 - a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: www.titebond.com.
 - b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
 - c. Pecora Corporation; AIS-919: www.pecora.com.
 - d. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: www.usg.com.
 - e. Substitutions: See Section 01 6000 - Product Requirements.

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 9123 - INTERIOR PAINTING**PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Surface preparation.
- B. Field application of paints.
- C. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Brick, architectural concrete, cast stone, integrally colored plaster, and stucco.
 - 9. Glass.
 - 10. Acoustical materials, unless specifically indicated.
 - 11. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.03 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; 2019.
- C. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- E. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. MPI product number (e.g., MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
- D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.05 MOCK-UP

- A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
- B. Provide panel, 3 feet long by 3 feet wide, illustrating paint color, texture, and finish.
- C. Provide door and frame assembly illustrating paint color, texture, and finish.
- D. Locate where directed by Architect.
- E. Mock-up may remain as part of the work.

1.06 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.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS**2.01 MANUFACTURERS**

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of MPI-approved products by a different manufacturer is preferred over substitution of unapproved products by the same manufacturer.
 - 3. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
 - 4. Substitution of a different paint system using MPI-approved products by the same manufacturer will be considered.
- C. Paints:
 - 1. PPG Paints: www.ppgpaints.com/#sle.
 - 2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 3. Benjamin Moore; www.benjaminmoore.com/#sle
- D. Primer Sealers: Same manufacturer as top coats.
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.

2. 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.
 3. 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.
 4. 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.
 5. Supply each paint material in quantity required to complete entire project's work from a single production run.
 6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of the State in which the Project is located.
 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.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
 4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.
 5. During bidding, price accent walls as low-hide colors. Include pricing for additional prep and coats as required.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board and concrete masonry units.
1. Two top coats and one coat primer.
 2. Top Coat(s): Interior Latex; MPI #44, 53, 54.
 - a. Products:
 - 1) Benjamin Moore Super Hide Zero VOC Interior Latex Flat 355 (MPI #53).
 - 2) Benjamin Moore Super Hide Zero VOC Interior Latex Low Sheen 356 (MPI #44)
 - 3) Benjamin Moore Super Hide Zero VOC Interior Latex Semi-Gloss 358 (MPI # 53)
 - 4) Benjamin Moore Ultra Spec 500 Interior Latex, Flat T535 (MPI #53) (Dark Colors)
 - 5) Benjamin Moore Ultra Spec 500 Interior Latex, Low Sheen Eggshell T537 (MPI #44) (Dark Colors)
 - 6) Benjamin Moore Ultra Spec 500 Interior Latex, Semi-Gloss T546 (MPI # 54) (Dark Colors)
 - 7) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat B30W12651 (MPI #53).
 - 8) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
 - 9) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eggshell. (MPI #52)
 3. Top Coat Sheen:

- a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
- b. Eggshell: MPI gloss level 3; use this sheen at gypsum board, except at ceilings and wood.
- c. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
- d. Semi-Gloss: MPI gloss level 5; use this sheen at masonry and metals .
4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
 1. Medium duty applications include door frames.
 2. Two top coats and one coat primer.
 3. Top Coat(s): High Performance Architectural Interior Latex - Steel Doors and Door Frames; #141.
 - a. Products:
 - 1) Sherwin-Williams Pro Industrial DTM Acrylic Semi-Gloss, B66W01150 Series. (MPI #141).
 - 2) Substitutions: See Section 01 6000 - Product Requirements
 4. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 1. Alkali Resistant Water Based Primer - Insulated Piping , Insulated Ductwork, and Previously Painted Surfaces ; MPI #3.
 - a. Products:
 - 1) Sherwin-Williams Loxon Concrete and Masonry Primer Sealer (Existing Brick), LX02W50. (MPI #3)
 - 2) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-W60020 Series (MPI #3).
 - 3) Substitutions: Section 01 6000 - Product Requirements.
 2. Interior/Exterior Latex Block Filler; MPI #4.
 - a. Products:
 - 1) Sherwin-Williams PrepRite Interior/Exterior Latex Block Filler, B25W00025. (MPI #4)
 - 2) Substitutions: Section 01 6000 - Product Requirements.
 3. Interior Latex Primer Sealer - Gypsum Board; MPI #50.
 - a. Products:
 - 1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W02600.(MPI #50)
 - 2) Substitutions: Section 01 6000 - Product Requirements.
 4. Stain Blocking Primer, Water Based; MPI #137.
 - a. Products:
 - 1) Sherwin Williams; Multi-Purpose Latex, B51W00450 (MPI #137.
 - 2) Substitutions: Section 01 6000 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. 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 adequately prepared.

- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Masonry:
 - 1. Remove efflorescence and chalk. Do not coat surfaces if moisture content, alkalinity of surfaces, or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 - 2. Prepare surface as recommended by top coat manufacturer.
- H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- I. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
- J. 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.
 - b. Spot prime all bare areas with appropriate primer before re-priming entire surface.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Sand metal surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection.
- B. Owner will provide field inspection.
- C. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils)

- D. All coatings shall be inspected as follows:
 - 1. Coatings 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. Coatings 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.
- E. 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.
- F. Coatings rejected by the inspection shall be repaired or replaced at the expense of the Contractor.
- G. Small affected areas shall be touched up.
 - 1. Large affected areas shall be repainted.
 - 2. Small and large areas shall be as defined by the Architect.
 - 3. Areas without sufficient dry film thickness shall be repainted.
 - 4. Paint runs and sags shall be removed by scraper or sanding and repainted.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.07 SCHEDULE - PAINT SYSTEMS

- A. Concrete, Concrete Masonry Units (CMU), Concrete Block, Brick Masonry: Finish surfaces exposed to view.
 - 1. Interior: CI-OP-3L, semi-gloss.
- B. Gypsum Board: Finish surfaces exposed to view.
 - 1. Interior Ceilings and Bulkheads: GI-OP-3L, flat.
 - 2. Interior Walls: GI-OP-3A, semi-gloss.
- C. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-MD-DT, semi gloss.

END OF SECTION

SECTION 11 4000 – FOOD SERVICE EQUIPMENT

GENERAL REQUIREMENTS

RELATED DOCUMENTS

The general provisions of the Contract, including instructions to bidders, General Conditions, Supplementary Conditions, General Requirements, apply to the work specified in this section.

1. DESCRIPTION

The fabrication requirements attached are a governing part of this specification and shall be consulted for all matters pertaining to the work. When references are made to FSEC, the same shall be construed to designate the Food Service Equipment Contractor.

The FSEC is to provide all items, articles, materials, transportation, operations, and methods listed, mentioned, or scheduled on the drawings and specifications, including all labor, materials, equipment, and incidentals necessary and as required for their completion.

2. QUALITY ASSURANCE

Brands and Names

The manufacturer's catalog designations used in the following specifications are intended to illustrate and represent the standards which will be required by the Owner. Bidders are to list, by item number, manufacturer's name and quantities on itemized proposal form attached to the specifications for approval by the Owner. When not attached, the FSEC shall make up his own itemized list and submit same attached with his bid. NOTE! Base Bid must be on fixtures specified for fair comparison of all bids.

Substitutions

Substitutions by any bidder wishing to supply alternate equipment other than that specified may submit a separate itemized proposal on similar articles of other manufacturers of the same standard performance, capacity, size, durability, and appearance but must accompany their alternate proposal with complete descriptive literature of the item quoted.

Owner and Architect reserve the right to accept or reject such proposed substitutions. Bidders recommending such substitutions are cautioned to examine the mechanical plans that may have already been approved and conditions at the building site to determine if such substitutions require changes in mechanical connections already planned or installed.

If the proposed substitutions require such changes, the Bidder shall include the cost of same in his bid and call it to the attention of the Architect and Owner by including a descriptive notation in his bid.

Discrepancies

Where model numbers, quantities, sizes, or gauges of material differ on plans and specifications, it shall be understood that the FSEC shall figure the larger quantities, longest size and heavier gauge unless advised otherwise in writing.

Where an accessory or piece of equipment is shown on elevation or plan, it shall be deemed part of the Food Service Contract, even if it is not listed in the Item Specifications.

Where an item is listed in Item Specifications and not shown on plan or elevations, the item shall be deemed part of the Food Service Equipment Contract.

Measurements

All dimensions given on bidding documents are approximate and are as accurate as can be determined at the time. The Equipment Contractor shall check all measurements at the building prior to fabrication of equipment and shall bring any deviation from the dimensions shown or required by building conditions to the Architects attention. All equipment must conform to the finished building conditions. Where obstructions occur, equipment must be neatly scribed fitting to and around same resulting in a sanitary fixture.

Prior to fabrication, the Architect or the Owner reserves the right to require the Contractor to make reasonable modifications in the routing of the work and relocation of the equipment. This specifically refers to conditions where interference occurs or where materials cannot be installed because of structural or mechanical conditions encountered. The Contractor will receive no additional compensation for such work.

Ordinances

Work and materials shall be in full accord with the latest rules of U.S. Public Health Service, National Board of Fire Underwriters, O.S.H.A., local and state ordinances, State Accident Commissions Safety Ordinances, regulations of the Bureau of Fire Services and with prevailing ordinances.

Ordinances including building codes, gas codes, steam codes, and other codes applying to this contract shall be followed.

All applicable items shall conform to latest Standards Revisions established by the National Sanitation Foundations, (N.S.F.), Ann Arbor, Michigan.

Electric operated and/or heated equipment, fabricated or otherwise shall conform to the latest standards of National Electric Manufacturer's Association, Underwriters Laboratories, Inc., National Electric Code or local standards such as to be acceptable to authorities having jurisdiction.

Standard steam heated equipment shall be manufactured in accordance with A.S.M.E. code requirements and carry the A.S.M.E. stamp.

Burners for gas heated equipment shall be equipped with automatic lighters. Oven burners and other concealed burners shall have automatic safety pilots and conform to A.G.A. standards. All gas equipment is to be furnished with appliance pressure regulators.

The drawings and specifications shall govern whenever they require longer sizes or higher standards than are required by the ordinances.

The Ordinances shall govern whenever drawings and specifications require something which will violate the ordinances.

No extra change will be paid for furnishing items required by local and state ordinances not specified or shown on drawings. Rulings and interpretations of the enforcing agencies shall be considered as part of the ordinances.

Should any change in the drawings and specifications be required to conform to the above, the Architect shall be notified when bid is submitted.

After entering into contract, all necessary work shall be done to meet above laws, ordinances, Bureau of Fire Services requirements, etc., without additional expense to the Owner.

Samples

Samples of all hardware, locks, feet, brackets, and other materials that may be requested shall be submitted for approval before use.

Scheduling of Work

The work shall be scheduled so there will be no interference with work of other trades and so that it will cause no delay. A time schedule will be worked out for the entire building and this work shall keep pace with the set schedule, working nights, Sundays and holidays, if necessary, to complete the work within the time limit.

3. SUBMITTALS

All submittals to be reviewed, stamped and dated by FSEC prior to sending them to the Contractor, & Architect. Submittals not bearing the FSEC's stamp will be rejected.

FSEC shall submit required number of drawings, brochures and portfolios of all equipment, apparatus, materials, etc., which are applicable to this contract together with detailed specifications. Each piece of equipment, apparatus, and accessory to be checked by the FSEC to insure compliance with requirements of Architect's drawings and specifications and also brochures or any other item of information to be clearly marked for identification with respect to their application and installation locations. This specification page shall appear on every shop drawing.

Approval and/or review of shop drawings, details, and equipment by the Architect is for design and concept only and does not relieve the FSEC of responsibility for compliance with design drawings, details and specifications, verification of all dimensions of equipment and building conditions and reasonable adjustments due to deviations.

While the Architect's drawings and specifications propose to be complete in all respects as to layout, type of equipment and materials, they are not intended to serve as detailed sleeve or insert drawings, and preparation of such drawings, required or necessary for this purpose, or to set equipment accurately, are to be the responsibility of the FSEC.

FSEC shall submit drawings of all custom fabricated equipment within thirty (30) days after notification of contract award. Drawings to be accurately laid out and correlated with other contractors work and latest architectural final construction plans. Equipment elevation shop drawings must be on 3/4" scale (3/4" = 1'-0").

Drawings to show detailed construction for each piece of equipment. Before submitting detail drawings for review, they must be checked by the FSEC with the specifications and shall show exactly how item will be fabricated. Construction of equipment shall not deviate from approved shop drawings without written approval from the Architect.

FSEC shall submit rough-in drawings for approval at a scale of 1/4" = 1'-0", locating accurately all utility connections for each item of equipment requiring the same. Rough-in plan to be drawn up using final

architectural building drawings. **NOTE!** All rough-in connections to conform with normal acceptable standards. Rough-in requirements for present or future food service equipment shall be included on all drawings.

FSEC 1/4" scale rough-in drawings are to be dimensioned from ends of finished walls. Shop drawings with dimensions from centerline of columns will not be accepted, unless approval has been given by Architect or the General Contractor.

Drawings showing all dimensions of bases or platforms and depressions to be submitted on a scale of 1/4" = 1'-0".

Rough in connection notes are not to be listed under numbered rough in schedule, except for general purpose outlets or where drawing space is limited.

Equipment rough in plans are to be furnished complete with layout plan and item schedule similar to food service Architects FSE drawings. Plumbing, electrical, ventilation & depression plan, and base detail when required.

Plumbing and electrical plans are to be on separate sheets when drawings are prepared at 1/4" scale.

Manufacturers to strictly adhere to approved and reviewed drawings, except where field conditions require changes and in that event the Architect must be notified in writing.

Manufacturing of any equipment fitting between walls or between columns and walls to be withheld until actual field dimensions are set and approved by the General Contractor. All other items which do not require field dimensions are to be manufactured upon receipt of reviewed shop drawings.

Upon completion of contract, the contractor is to deliver to the Owner two (2) complete sets of final working drawings and two (2) portfolios of purchased equipment bound in a binder.

A time schedule will be worked out for the entire building and this work shall keep pace with set schedule, working nights, Sundays, and holidays, if necessary, to complete the work within the time limit.

4. JOB CONDITIONS

Job Meetings

It shall be the responsibility of the FSEC to have a qualified representative at all monthly or special job meetings to help the Architect and other contractors on the job to correlate work or answer questions so that the job can progress without any obstructions.

Examination of Premises

FSEC to check the Architectural Contract Plans and visit the premises at a suitable time to determine maximum size of equipment he can safely get into the building in one piece. Field joints to be held to a minimum. Should door openings not be large enough, FSEC shall provide field joints in equipment as required and re-weld inside of building.

Utilities Services

Rough-in cold water, hot water, waste and vent piping, duct work and electrical wiring to be installed by Plumbing and Electrical Trades. Such items are to be brought away from surface of floors, walls and/or ceilings by these Trades and capped prior to installation of food service equipment.

5. GUARANTEE

FSEC is to furnish one (1) year written guarantee for equipment starting from date of acceptance by the Owner or the Owner's duly authorized representative. Guarantee to be in accordance with Architect's General Conditions.

Refrigeration - Self-contained

All self-contained refrigeration compressors for milk coolers, ice cream cabinets, cold food counters, reach in refrigerators or freezers, etc., shall be furnished with a five (5) year compressor warranty and one (1) year refrigeration service starting from date of final acceptance.

6. PRODUCTS

Fabrication Requirements – See following page for details

All food service equipment is to be constructed in strict compliance with the latest standards of the National Sanitation Foundation and to meet all requirements of the local and State Health Regulations. All equipment to bear the N.S.F. seal of approval.

Welding

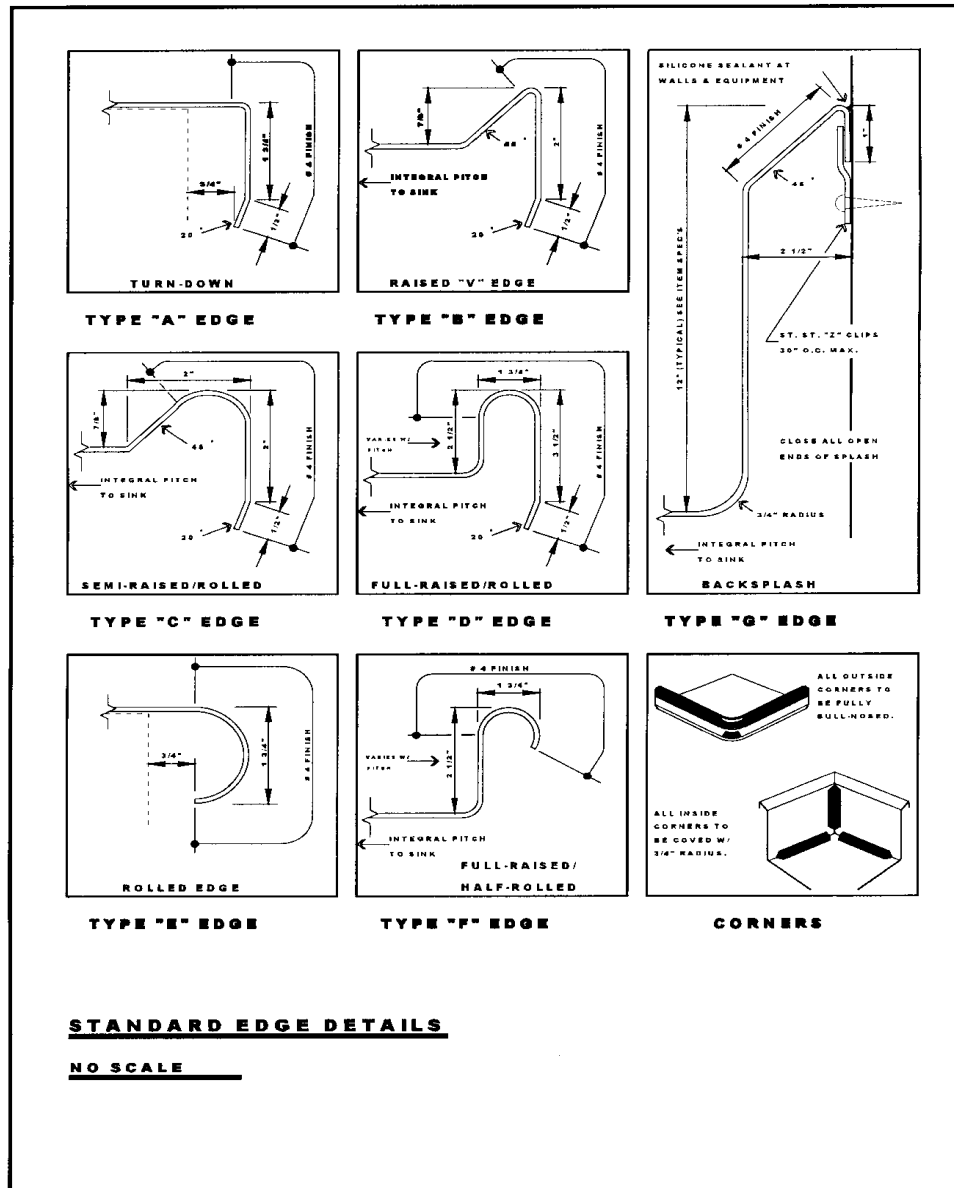
The words "weld", "welded", or "welding" as used in the item specifications, mean a metal joint continuously welded then all exposed parts ground smooth and polished to match adjoining surfaces.

All welding to be done in a thorough manner with welding rod of same composition as sheets or parts welded. Welds to be strong, ductile with excess metal and discoloration ground off and joint finished smooth to match adjoining surfaces.

Welds to be free of imperfections such as pits, runs, splatters, cracks, warping or discoloration. All welded joints to be homogeneous with parent metal itself. All fabricated equipment items where metal to metal butt joints occur to be joined and properly welded then ground and polished smooth.

Grinding, Polishing and Finishing

All exposed welded joints to be ground flush with adjoining material and neatly finished to harmonies therewith.



Whenever material has been depressed or sunken in by welding operations, such depressions shall be suitably hammered and peened flush with adjoining surfaces to then be polished and/or buffed to match adjoining surfaces to a degree consistent with good workmanship. Care shall be exercised in all grinding operations to avoid excessive heating of metal and metal discoloration. Abrasive wheels and belts used in grinding to be iron free and not having been used on carbon steel. In all cases, the grain or rough finish to be removed by successively finer polishing operations to be consistent with reasonable care and good workmanship. Final polishing operations to be uniform and smooth.

Where break band occurs, free of open texture or orange peel appearance, all such marks shall be removed by grinding, polishing and finishing. Wherever sheared edges occur, they shall be free from burrs, projections and fins to obviate all danger from cutting or laceration when hand is drawn over such sheared edges.

Where miters or bullnosed corner, they will be neatly ground to uniform condition and in no case will overlapping materials be acceptable.

Equipment quality finish consistent with high grade of manufacturing practiced in industry. All exposed surfaces to be commercial mill finishes known as #4 satin finish for corrosion resistant steel. All exposed edges to be furnished with a #7 mirror finish, unless otherwise noted in item specifications.

All cabinets, doors and shelves where exposed to be interpreted as meaning inside surface exposed to view when swinging door or sliding doors are opened. Unless otherwise specified, underside of shelves need not be satin finish.

Doors - Hinged

To be full height of door opening. Each door shall not be over 30" wide for high cabinets and 24" wide for low cabinets. Doors to be double pan construction flush type and braced and thoroughly sound deadened made of 18 ga. st. st. Inner and outer pans to be sealed with 3/4" long tack welds spaces approximately 6" apart. Balance of the space to be completely sealed between tack welds with silver solder or N.S.F. approved hard solder (Silicone not approved).

All welds ground and polished smooth. All bracings to be on proper centers to fit door size.

Doors to be mounted on heavy semi concealed nickel bronze olive knuckle hinges fastened to inside ledge of door and cabinet so that only pin will be exposed to heavy st. st. piano hinges. Provide each door with Component Hardware #M22-2420.

Doors - Sliding

Make same as specified for hinged doors, except they shall operate on Component Hardware #B58-5513 and #B58-5523 nylon tire wheels running on one (1) piece drawn aluminum overhead Component Hardware #B57 tracks. Bottom shall be guided by st. st. Component Hardware #B56-1096 guide pins at center of door openings. Provide locks where called for in item specifications. Provide flush type polished handles. (Heated cabinets with sliding doors to use Component Hardware #B58-5511 and #B58-5523 st. st. ball bearing wheels).

"High" type fixtures to be fitted with two (2) sets of doors in height, each set opening into half height of fixture.

"Low" type fixtures to be fitted with (1) set of full height doors. No door length to exceed 36".

Sinks

All sinks to be made of 14 ga. st. st. unless otherwise specified. All corners shall be coved at least 5/8" radius, with all corners and joints welded, ground and polished smooth to a #4 satin finish. Sinks, unless otherwise specified, shall not be less than 14" deep. The use of solder or separate filler pieces to obtain coved corners will not be acceptable. All sink bottoms are to be integrally pitched to insure complete drainage of sink to waste opening. Edges at table height to have exposed edges formed to match adjoining table. Edges adjacent to table to be welded to table with all welds ground and polished smooth.

Unless otherwise specified, all sinks to be provided with backsplash 12" high x 2-1/2" wide to allow for pipe space in rear. Flange over at ends, with top edge turned back 2-1/2" at 45 degree angle and down 1". Provide openings for combination swinging type water faucet for each compartment.

In sinks of two (2) or more compartments, furnish between each sink compartment a 3/4" wide full height portion integrally welded to sinks at front, back and bottom maintaining smooth 5/8" radius coved corners as described in preceding paragraph.

Front of multiple compartment sinks shall consist of st. st. apron same gauge as sinks having length same as overall length of sink bowls and same depth as bowls. This apron shall be "L" shaped and welded to or part of the top rim.

Design of apron front to be such that sinks shall have an appearance of a continuous one (1) piece front face of all overlapping joints and open spaces between sink compartments.

Each compartment to be furnished with Component Hardware rotary handle type drain, connected rear overflow, 6" tailpiece and faucet of make and model number as called for in Item Specifications. Also each sink to be furnished with 14 ga. st. st. waste handle bracket welded to underside of sink.

Tables & Tops - Height

All working tops to be 34" high from floor, unless otherwise stated under specific item.

Metal Tops

Unless otherwise specified in Item Specifications, metal tops to be 14 ga. st. st. reinforced and braced on underside by framework consisting of 1-1/2" x 1-1/2" x 3/16" angles and 1" x 3" x 3/16" channels, galvanized where concealed and st. st. where exposed.

Framework angles to run full length and width and with angle crossbrace on not over 2'-6" centers. Channel reinforcing to run full length of tops down center of top. All tops with sinks shall be integrally pitched towards same.

All joints of framework to be welded with weld re-metalized. Tops to be bolted to framework in a concealed manner with st. st. bolts similar to AN-COR-LOX cup nuts. All metal tops to appear as one piece with all field and shop joints reinforced and welded, ground smooth, and polished, also to be made of largest piece obtainable.

No short pieces of metal will be acceptable. St. st. tops to have a #4 satin finish and all tops of this metal to be full 1/2" cove at re-entrant corners, also where turned up in rear or in front, such as

dishtables. Solder filled corners will not be acceptable.

Metal edges to be made as described below and/or shown on detail drawings. Top to have all edges turned down 1-3/4" then back 1/2" at a 70 degree angle all around with all corners welded, ground, and polished smooth with no cracks or openings showing. All exterior corners to be well rounded bullnosed in 1-1/4" radius.

Dishtables & Pot Washing Tables

All free edges to be turned up 2-3/4" then rolled to 1-5/8" x 180 degrees and furnished with apron edge front, as per Edge Detail Sheet. All exposed and exterior corners to be coved at 5/8" radius with all joints welded, ground, and polished smooth.

Where tables abut a wall or other tall equipment, extend back and/or ends up 12" then back 2-1/2" at 45 degrees and down 1" parallel to wall. Provide with end filler pieces and all welded surfaces ground and polished smooth.

The underside of Dish and Pot Washing tables to be reinforced with 1-1/2" x 1-1/2" x 3/16" st. angles and 1" x 3" st. channels. Angles to run full length of tops at both front and rear of tops with crossbrace front to back on 2'-6" centers. Channel bracing to run down center, full length of tops. Tops shall be integrally pitched to dishwasher and sinks.

Fastening Tops to Washers and Other Equipment

Where tops are shown adjacent to dish or glass washer, etc., ends are to be turned down 1-1/2" into fixture and bolted tightly to it with approved gaskets between body and turned down edges. Backsplashes to have edge against fixture turned out 1-1/2" and tightly fitted to it. Free edges to be neatly fitted to fixture corners to prevent water from dripping on floor. All tops to have integral pitch to drain towards dishwasher.

Dish & Pot Table Drainage

During installation of dish tables and dishwasher, FSEC shall water test all counter tops to make sure of proper pitch before final plumbing and electrical connections are made. All water on counter tops shall drain with no standing puddles allowed. Should the FSEC fail to pitch tables properly, he shall be responsible for disconnecting plumbing and electrical connections and re-adjust tables to insure proper pitch. FSEC shall also be responsible for re-connecting all service lines after tables have been re-aligned.

Pipe Stands

All equipment requiring pipe legs or stands to be provided with sufficient supports to carry superimposed load of 100 lbs. per sq. ft. Top to be fabricated of 16 ga. st. st. Tubing to be Component Hardware #A46-5288 complete leg assembly Model Number 2236HB, 1-5/8" O.D., with st. st. hex head bullet shaped feet as previously specified. All pipe stands to be braced with crossrails, Component Hardware #A46-4288, 1-5/8" st. st. pipe welded to legs approximately 10" above floor or braced by lower shelf as specified hereinafter. Provide Component Hardware #A18-0206 st. st. gussets as previously specified, welded to framework on underside of top.

In place of gussets, st. st. legs may be welded to st. st. channels 5" long which shall fit into channel crossbracing. Flange of both channels to be machine bolted together. Holes for bolts to be slotted for adjustment. Provide legs on not over 5'-0" centers and additional if required or requested.

All pipe legs or vertical members to be set back from table top on ends and on front and back sufficient distance to offset any interference with workers, columns, walls or other items. Where tops are welded to sinks, omit pipe legs supporting top at sink location.

Shelves Under Tables

Under tops which are mounted on pipe legs or stands, shelves under table to be fabricated of 16 ga. st. st. with all edges flanged down 1-1/2" or as otherwise noted in the Item Specifications. Shelves to fit tightly around contour of legs and welded from underside. Shelves to be made up from long lengths with all joints welded, ground, and polished smooth.

Short lengths will not be permitted. Reinforced, as required, to support load of 50 lbs. per sq. ft. All sharp edges, burrs, and corners to be ground smooth and removed and then be slightly rounded. All shelves in cabinet bases are to be angle reinforced.

Cabinet Bases

Exterior cabinet bases to be constructed of 18 ga. st. st. with front face, exposed ends, rear, and corners integrally exposed with all welds ground and polished smooth to form a one piece construction appearance.

St. st. exterior to be mounted over a 1-1/2" x 1-1/2" x 1/8" all welded galvanized iron angle frame. Where st. st. exterior meets angle framework at drawer, door or shelf openings, exterior shall be turned in 1-1/2" over angle framework inside of openings. All drawers and doors to be flush with cabinet face.

All cabinet base bottoms to be enclosed with 18 ga. galvanized iron panels. Interior shelves of cabinet base to be constructed of 16 ga. st. st. and be reinforced with 1-1/2" x 1-1/2" x 1/8" angles. Rear and ends of shelves to be turned up 2" with all interior corners coved to 5/8" radius.

Drawers

Drawer front to be 3/4" thick double pan construction with 16 ga. st. st. telescoping rear panels. Joints to be sealed same as specified for double pan hinged doors. Drawer front fitted with recessed st. st. grip handle, Component Hardware #CAGP63-1012. Drawer to be furnished with 18 ga. galvanized iron bottom with openings in front to accommodate drawer. Provide with cylinder type lock when specified under Item Specifications or shown on elevation details.

Opening in front to have edges turned in to fit drawer front which will be flush when drawer is closed. Bottom of enclosure to be open with edges turned in 1" on all sides.

All corners on enclosure to be continuously welded, then polished and ground smooth. Exposed rivets or screws will not be acceptable. Component Hardware #S81-2020 Drawer insert to consist of removable die-stamped 18 ga. st. st. pan approximately 20" square x 5" deep. Top edges of drawer insert to be flanged out on all sides, not less than 1/2" for resting on drawer extension glides. All sharp edges and burrs to be removed from drawer flange.

Housing supports to be made of 12 ga. st. st. formed into angles welded to underside of metal tops or screwed to underside of wood tops and to extend full width of top with rear enclosure, where exposed. All welded items to be ground and polished smooth. Screws for wood tops to be st. st. countersunk. Drawer housings to slide on 14 ga. st. st. telescoping channels with st. st. rollers, Component Hardware #S52 series extension roller slides.

Drawers

This mechanism must be designed so that drawer will not tilt when fully opened. Provide with stop mechanism to prevent pulling the housing from slides but with suitable extension so it may be removed for cleaning.

Tier of Drawers

To be two (2) or three (3) in number of same size as specified for above and entirely enclosed with 18 ga. st. st. same as specified under cabinet bases with openings for drawers with all joints flush welded, grounded, and polished smooth.

Single drawers under table tops to be one inch (1") back of edge of fixture. All draws shall have front flush with cabinet body.

Fasteners

Exposed screw or bolt heads will not be permitted on fixtures. Rivets, if specified, shall be countersunk flush. Rivets to be same material as they join. Butt joints made by riveting straps under seams and then filling with solder or caulking will not be permitted or accepted.

Name Plates

All buy-out equipment shall be furnished with a permanently affixed metal name plate listing manufacturer's name, model number, voltage, cycle, phase, horsepower, etc., in an easily readable location. Dealers, installers, fabricators or service agencies name plate stickers shall not be fastened to any item without the approval of the Architect

7. MATERIALS AND WORKMANSHIP

Unless otherwise specified, all material shall be new and of best quality, perfect, and without flaws and shall be delivered upon completion in an undamaged condition.

Stainless Steel

Shall be type 304 having a standard analysis of 18% chrome and 8% nickel. St. st. to be as manufactured by Republic Steel Company, "Endure", Allegheny Metal Company, Crucible Steel Company, "Rezistal" or approved equal. Gauge to be specified under Item Specifications and furnished with #4 satin finish, unless otherwise specified.

Galvanized Iron

Shall be American Rolling Mills "Armco", Republic Steel, Inland Steel, "Tocan" or approved equal.

Pipe legs shall be Standard-Keil #2235HB, 16 ga. st. st. (0.65" thick), tubing furnished with st. st. adjustable foot and Standard-Keil #481-58 with enclosed gusset welded to underside of table top reinforcing channel.

Tubing to be seamless drawn, ground, and polished smooth to a #4 satin finish. Bottom of legs to be swedged for close fit to adjustable foot. Where space permits furnish 1-1/4" dia. st. st. crossrails welded to leg uprights. All welds shall have radius corners and be ground and polished smooth to a #4 satin finish.

Handles, Hinges & Door Fasteners

All hardware and other fittings used in connection with the equipment to be cast nickel bronze or st. st. Handles to be welded or bolted to the equipment in a concealed manner. Bolts to be st. st. and hinges to be recessed in door with st. st. Component Hardware #M75-I002 lift-off, N.S.F. approved hinge. Hinges to be fastened in place with st. st. recessed rivets or welded in place with weld ground and polished smooth.

Sliding doors to be depressed type and furnished with Component Hardware Model #P62-1010 handles. Hinges to be olive knuckle, semi concealed type of nickel bronze or st. st. piano type as described under the specific item.

Painting and Coating

All metal that is not st. st. is to be painted with two (2) coats of an approved rust-proof paint such as Rustoleum or other approved equal of highest quality gray enamel.

Electric Receptacles

All 120V-1 phase duplex receptacles in cabinet bases to be Pass & Seymour Model #6307 and receptacles over 120 volt shall be Hubbel receptacles sized as per the rough-in drawings.

All receptacles are to be grounded type being both dust and moisture proof. Furnish outlets with st. st. face plates and neoprene mats. In cabinet bases, all receptacles are to be mounted in Chase #R-1 all coved corners st. st. recessed type enclosure mounted to cabinet base. Component Hardware #R73 - 1210 receptacles shall be pre-wired by FSEC to junction box in bottom of base cabinet left ready for final connection by Electrical Trades. All wiring between receptacles and junction box to be run in rigid conduit.

All counter top receptacles to be Component Hardware #R58 chrome plated type as specified in Item Specifications. Counter top receptacles to be pre-wired to junction box in rigid conduit same as previously specified. All wiring to be in strict compliance with latest standards of the National Sanitation Foundation and Board of Health Requirements.

Quietness of operation of all food service equipment is a requirement and the FSEC shall be required to remove or repair any equipment producing objectionable noises.

Shop Drawing Review

All submittals to be reviewed, stamped and dated by FSEC prior to sending them to the Contractor, Architect

By reviewing and submitting shop drawings and samples, the FSEC thereby represents that he has verified all construction criteria, materials, catalog numbers and similar data and that he has checked and coordinated each shop drawing and sample with the requirements of the work and of the contract documents.

If shop drawings and/or samples are submitted without proper identification and in the Architects opinion it is evident that they have not been properly reviewed by the FSEC or if shop drawings are submitted in an unprofessional manner, they will be returned to the FSEC for identification and/or review and re-submission. In such an event, it will be held that the FSEC has not complied with the above requirements for reviewing and identifying shop drawings and samples. The FSEC shall bear the risk of

all delays in work or in work of any other trade, the same as if no shop drawing or samples had been submitted. The above requirements will be strictly enforced.

The Architect will review and process only two (2) submissions of each shop drawing and/or sample. Shop drawings and samples returned because the FSEC has not complied with the above requirements shall be counted as the first submission. If more than two (2) submissions are required, the FSEC shall pay the Architects cost for reviewing and processing the third and subsequent submissions.

The Architects cost shall be computed at two and one half (2-1/2) times payroll plus reproduction and mailing expense.

Buy-out Booklets

By submitting prepared Buy-out Booklets, the FSEC thereby represents that he has determined and verified voltage and phase requirements and that he has checked and coordinated each item with shop drawings and contract documents.

Each item in the Buy-out booklet shall have a typed title page, complete with descriptive details and included accessories.

TITLE PAGE TO BE AS PER THE FOLLOWING PAGE.

SAMPLE TITLE PAGE

Food Service Equipment Contractor _____

ITEM # _____ QUANTITY _____

Description: _____

Electrical

Motor H.P. _____ Volts _____ Phase _____ Cycle _____

Heating Element: KW _____ Volts _____ Phase _____

Lighting and/or Fan Circuit: _____ Volts _____ Phase _____

Refrigeration specs.Plumbing

Cold Water _____ 140 degree water _____ 180 degree water _____

Steam in _____ Steam Pressure _____ Pounds _____

Steam Return _____ Connected Waste _____ Floor Waste _____

Gas

Kind _____ Size _____ B.T.U. _____

Spec. Gravity _____ Pressure _____

Direction of Feed for Dishwasher

Right to Left, Left to Right, Straight Thru, Corner type, Clockwise, and Counter Clockwise (circle unit required).

Door Hinged

Right Side, Left side (Circle unit required).

8. EXECUTION

Inspections

The Owner, Architect, and/or their duly authorized representative shall have free access to the contractor's shop or shops during the construction of this equipment for the purpose of making inspections to see that the plans and specifications and detailed drawings are being adhered to carefully.

Contractor shall correct any errors found during the inspections, to the extent within the scope of the plans, specifications and detailed drawings.

Upon being notified of job completion, it shall be the responsibility of the Architect to inspect the job site and prepare an itemized Punch List.

If items are found not to be complete per approved drawings, General Requirements and the Architects Item Specifications, upon receiving the Punch List, the FSEC shall correct all items on the list within thirty (30) days.

It shall be the responsibility of the Plumbing and Electrical Trades to check all rough-in connections installed by their personnel to make sure that they agree with the dimensioned

FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.

When deemed necessary by the Architect and FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.

The FSEC shall check all base sizes, after installation by the Architectural Trades, to make sure that they will fit his equipment. Should base be installed incorrectly, the FSEC shall advise the Architectural Trades in writing at once to have base corrected as required.

The FSEC shall check all walls where equipment abuts or fits between, after installation by the Architectural Trades, to make sure that the equipment will fit correctly.

9. PREPARATION

All gas equipment is to be furnished with appliance pressure regulators. Electrical requirements shall be in accordance with rough-in plan and verified on the job site.

Should the electrical requirements and the item specifications not agree with the rough-in plan or electrical requirements on the job site, it shall be the responsibility of the FSEC to send a written report to the Architect advising them of the discrepancy. Should the FSEC fail to verify voltages on the job site, it shall be his full responsibility to make all necessary changes on his equipment at no cost to the Owner.

All measurements shall be verified at the building site and full responsibility for their correctness must be assumed by the Contractor.

No extra charge or compensation will be allowed on account of difference between actual dimensions and the measurements indicated on the drawings. All or any differences which may be found shall be

submitted to the Architect for consideration before proceeding with the work.

10. INSTALLATION

Food Service Equipment

FSEC shall be responsible for assembly and erection of all equipment included herein and in required location as shown on drawings, leaving same with outlets for other contractors to make final steam, plumbing, electrical and ventilation connections.

FSEC is to provide a competent foreman to supervise the erection and placing of equipment and to advise other Trades in regards to connections at time of installation. Where applicable, he shall deliver to other Trades all plumbing, steam fittings, and electrical parts included with his equipment for their proper installation.

FSEC to have qualified personnel on job site while the Plumbing, Electrical, and H.V.A.C. Trades are making final connections between rough-in and equipment. Where necessary, FSEC is to move equipment to allow these Trades to make final connections.

Should the FSEC fail to assist the other Trades and final location of equipment is incorrect, it shall be the responsibility of the FSEC to move the equipment to correct location and assume the cost of disconnecting and reconnecting the service connections.

FSEC is responsible for cutting all holes thru tops, backsplashes, shelves and cabinets so the other Trades can make final connections to outlets in fixtures from his rough-in.

Should these Trades fail to check rough-in before slab is poured, they shall assume all responsibility for making necessary changes and paying all the costs involved. Should the dimensioned rough-in drawings be incorrect, it shall be the responsibility of the FSEC to assume costs involved for revising all connections involved in the dimensioned error.

FSEC shall verify with the Electrical Trades the voltage and phase required for each piece of equipment that is to be supplied. Should the FSEC fail to verify the voltage characteristics it shall be his responsibility for changing the equipment on the job site to fit the voltage on the site.

When deemed necessary by the Architect FSEC shall meet on the job site with the Electrical and Plumbing Trades to determine the best way of offsetting rough-in connections that interfere with beams, foundations or other possible field obstructions.

Rough-in Inspections

It shall be the responsibility of the Plumbing and Electrical Trades to check all rough-in connections installed by their personnel to make sure that they agree with the dimensioned rough-in drawings as prepared by the FSEC.

Should these Trades fail to check rough-in before slab is poured, they shall assume all responsibility for making necessary changes and paying all the costs involved. Should the dimensioned rough-in drawings be incorrect, it shall be the responsibility of the FSEC to assume costs involved for revising all connections involved in the dimensioned error.

FSEC to have qualified personnel on job site while the Plumbing, Electrical, and H.V.A.C. Trades are making final connections between rough-in and equipment. Where necessary, FSEC is to move equipment to allow these Trades to make final connections. Should the FSEC fail to assist the other Trades and final location of equipment is incorrect, it shall be the responsibility of the FSEC to move the equipment to correct location and assume the cost of disconnecting and reconnecting the service connections.

FSEC is responsible for cutting all holes thru tops, backsplashes, shelves and cabinets so the other Trades can make final connections to outlets in fixtures from his rough-in.

Should specified equipment arrive at the job site with incorrect finish, model number, damaged, etc. A replacement item must be ordered immediately. Should the project schedule require the incorrect unit for opening operation, existing unit is to be left in operation until replacement is available, at no cost to the owner. It shall be the responsibility of the FSEC to assume all costs for re-stocking, re-selling, etc., of the incorrect items that have been used by the Owner.

All holes or openings must be cut in a workmanlike manner, with all edges ground and polished smooth and free of sharp edges. Opening in rear of base cabinet must not be larger than 1" bigger than pipe extending thru cabinet. Oversize cutouts with rough edges will not be approved.

All faucets and waste assemblies to be furnished by the FSEC and to be turned over to the Plumbing Trades for their installation. NOTE! Faucets and waste assemblies to be tagged properly to insure proper installation of these items on the correct fixtures.

Ventilating Trades

This Trade will furnish all ductwork to openings on top hoods, furnished by the FSEC.

Electrical and Plumbing Trades

These Trades shall furnish all final electrical and plumbing connections between fixtures and rough-in outlets in walls or floors.

Internal connections on booster heater and disposer to be furnished by the Plumbing and Electrical Trades and proper installation of these above named items. FSEC shall also include detailed drawings showing proper location of all accessories. General Building Contractor shall furnish all masonry platforms, tile bases and floor depressions.

Trimming & Sealing Equipment

Space between units to walls, ceilings, and floors and adjoining units not portable and with enclosed bodies, shall be completely sealed against entrance of food particles or vermin by means of st. st. trim strips, welding or commercial joint material suitable to the nature of the equipment. Sealer when not exposed to extreme heat shall be silicone construction sealant in the appropriate color. Ends of hollow sections to be closed. Enclosed fixtures without legs mounted on masonry bases or floor shall be sealed watertight to base of floor.

All equipment setting on masonry bases will be constructed to overhang to provide toe spaces, however, metal framework and/or housings are to be turned under a sufficient distance to overlap masonry base and eliminate openings at these points. Bases to be sealed with Dow Corning sealant #786 or approved G.E. sealant.

Caulking at all backsplash areas in pot washing, dishwashing and preparation sinks and counters shall not have any recessed or convex areas which will allow for debris and water to sit on caulk.

Upright penetrations in backsplash and counter tops to have gap sealed with silicone.

11. ADJUST & CLEAN

FSEC shall adjust and lubricate all moving parts for smooth quiet operation. The FSEC shall touch up scratches, marred or abraded surfaces to restore equipment to the original condition.

The FSEC shall also remove all crating and packing material from the job site and shall also remove fingerprints and leave equipment and adjacent equipment or surfaces clean.

The FSEC shall be responsible for missing items unless he can produce signed receipts from the Owner's personnel that the items were received and accounted for. Owner cannot be responsible for items that were dropped off at the job site and were not signed for by the Owner's personnel or representatives.

12. DEMONSTRATION

The FSEC shall arrange a demonstration date with the Owner and at the same time check out all loose items with the Food Service Manager.

13. GUARANTEE

All items furnished by the Food Service Equipment Contractor as part of this Contract, shall be guaranteed against defects in workmanship and material for a period of one (1) year.

Manufacturers of standard items of equipment as supplied under this Contract are to provide a one (1) year warranty on parts and labor.

In addition, connected pieces of equipment requiring calibration are to be so calibrated by a qualified person as part of this Contract.

Commencement date for warranty purposes is as follows:

- a. Connected equipment: - When equipment is started up for intended use."
- b. non-connected equipment: - At date of Owner acceptance."

14. PROTECTION OF EQUIPMENT

Fabricated fixtures such as custom st. st. & plastic laminate items are to have fiberboard or plywood taped to tops and exposed body panels. Protective covering is to be left in place until all trades are completed.

Manufactured equipment is to have fiberboard or plywood tape as required per equipment shape and installation access requirements.

Prohibited use of equipment; tool and material storage area, workbench, scaffold, stacking area, etc.

15. APPROVED CUSTOM ST. ST. FABRICATORS

The following is a list of fabricators who have demonstrated the ability to provide quality equipment.

Florida Stainless

Oviedo, FL

American Stainless Steel Corp

Englewood, CO.

PRS

Warren, MI

R&D Fabricating

Clinton Twp, MI

Great Lakes Stainless

Traverse City, MI

MCM Fixture Co.

Hazel Park, MI

Midwest Stainless Fabricating Co.

Livonia, MI

Nationwide Fabrication, Inc.

Northglenn, CO

Stainless Fixtures Inc.

Pomona, CA

Use of a food service equipment fabricator other than those listed must be specifically approved in writing by the architect prior to submission of food service equipment bids on this project.

ITEM # 1 EXISTING WARMER

One (1) Unit relocated and reused as is by owner. "NIC"

ITEM # 2 EXISTING WARMER

One (1) Unit relocated and reused as is by owner. "NIC"

ITEM # 3 ST. ST. WORK TABLE

One (1) ADVANCE TABCO model # KSS-365 st. st. work table furnished per manufacturers standards. Unit to include the following:

One (1) Lot st st legs with lower shelf
One (1) SS-2020 Deluxe enclosed drawer
One (1) Lot casters, two with locks

ITEM # 4 EXISTING COMBI OVEN

One (1) Existing unit to remain as is. "NIC"

ITEM # 5 EXISTING COMBI OVEN

One (1) Existing unit to remain as is. "NIC"

ITEM # 6 ST. ST. COOKS TABLE W/ SHELF OVER

One (1) Custom fabricated unit sized 15' - 0" long x 36" wide x 34" high.

TOP: Fabricated of 14 gauge stainless steel with type "A" edges on all open sides. Top to have bullnosed corners with No. 4 finish and reinforcing angles/channels under, per General Requirements.

DRAWERS & ENCLOSURE: Under top, furnish tier of three (3) 18 ga. st. st. drawers each 20" x 20" x 5" deep. Drawer inserts to be removable type with roller bearing extension slides, double pan construction drawer fronts and 18 ga. st. st. cabinet enclosure constructed per General Requirements. Counter base to be enclosed on three sides

CYLINDER LOCKS: Each drawer to be furnished with Standard-Keil #1210 Cylinder Locks installed per Manufacturer's recommendations. All drawer locks to be keyed alike on entire job.

SHELF UNDER: Under top, where shown on plan furnish 16 gauge stainless steel removable shelf with all free edges rolled over 90 degrees to match contour of crossrails. Edge against drawer enclosure to be turned up 2" with coved interior corners. Shelf to be made in two (2) removable sections with edges turned down 1" at 90 degree bend at all joints

SHELF OVER: Over top as shown on plan furnish single deck 16 ga. st. st. shelf with 1" rolled rim on all sides. Shelf to be mounted on 1 1/4" dia., st. st. cantilever uprights extending up thru top Holes in top to be cut out to fit upright with not more than 1/16" clearance, then caulked with clear silicone sealant. Shelf to be sized to accommodate microwave on end as shown on plan.

LEGS: Cabinet base to be mounted on 6 high st. st. adjustable legs with flange feet. Feet to be secured to floor with anchors and st. screws.

Submit shop drawing for review and approval.

ITEM # 7 SPARE - NOT USED

ITEM # 8 HOLDING CABINET, HUMIDIFIED HEATED

One (1) FWE model #MTU-12 portable hot food cart. Units to be sized to accommodate both 12 x 20 & 18 x 26 pans and trays. Provide units with the following standard and optional accessories:

One (1) Lot of locking casters
One (1) UL Approved cord and plug

ITEM # 9 DISPLAY CASE, HEATED

One (1) HATCO model # GRSDS-30D heated gravity chutes furnished per manufacturers standards. Unit to be provided with the following standard and optional accessories:

One (1) Designer Color
One (1) LED temp control
One (1) UL Cord and plug

ITEM # 10 SPARE - NOT USED

ITEM # 11 SPARE - NOT USED

ITEM # 12 REFRIGERATOR, REACH-IN

QTY: One (1)

MFG/MODEL: Traulsen G20010

CONST: Per manufacturers standards.

ACCESSORIES:

Two (2) Full height stainless steel doors Door swings hinged per plan.
One (1) Set of Heavy Duty 6" High Casters with wheel locks
One (1) UL. approved grounded cord & plug
One (1) Automatic condensate evaporator
Six (6) Epoxy coated wire shelves per section
Three (3) Year service/labor policy
One (1) Lot Lifetime warranty on door handles and hinges
Five (5) Year non-prorated compressor Warranty.

Details: Refrigerator to have 48 cu. Ft. Capacity, size 52 1/8" w x 32" d x 83 1/4" high. Compressor to be top mounted, air cooled unit. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. .

Elect: Per rough-in plan.

ITEM # 13 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-46SS Thurmaduke™ Solid Top Unit, mobile utility counter, 46"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves.

- 1 ea P-LAM Veneer plastic laminate on body
- 1 ea MOD-3P Veneer on customer's side
- 1 ea CORD 6 ft. cord & plug
- 1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source
- 1 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location) for cord pass on top for item#9 Hatco GR2SDS-30D
- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
- 1 ea MOD-HT Special Height Body, per unit
- 1 ea MOD-HT-34 34" Height Body
- 1 ea MOD-32 For special width body...per unit **34"***
- 1 ea TDST-X-1 For special length not listed (maximum one-piece length of 88"): To next longer standard unit price...ADD (for TST models) **40"***
- 1 ea MOD-2S-3CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets** 48"D, 8" extended on customer side**
- 1 ea LED-46 Lights under extended top with 3" turn down edge
- 1 ea Body pilasters

NOTE ! For bidding purposes, the following material are to be used.

Quartz Countertop: Corian Quartz Concrete Carrara

<https://coriandesignsamples.colors2u.net/product/corian-quartz-concrete-carrara/>

Plastic Laminate: Wilsonart Phantom Cocoa 8213K-28

<https://www.wilsonart.com/phantom-cocoa-8213>

FSEC/DUKE to verify prior to fabrication.

Submit shop drawing for review and approval.

ITEM # 14 SPARE - NOT USED**ITEM # 15 FOOD SHIELD, ADJUSTABLE HEAT & LIGHT**

One (1) Lot PREMIER METAL & GLASS model FM2R-A 1" OD Gearless Adjustable Self Service Food Shield With Top Shelf; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; Hatco GRNM (120v) Narrow Heat Lamp And Ultra slim Led Light In Complementary Colored Housing; Brushed Stainless Finish. Submit shop drawing for review and approval. FSEC to coordinate DUKE and PMG installation requirements.

ITEM # 16 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST unit common with item #23 for total of 99"

ITEM # 17 INDUCTION RANGE, COUNTERTOP

Four (4) HATCO model # IRNG-HC1-18 counter top induction units furnished per manufacturers standard.

ITEM # 18 DROP-IN, HOT WELLS

Two (2) Duke Manufacturing WWG2 Waterless Hot Food Well Drop-In Unit, ganged, electric, dry operation, with (2) 12" x 20" hot food well, 32-1/4"W x 24-1/4"D x 12-3/4"H, stainless steel well, removable FDA approved silicone rubber liner, fully insulated galvanized exterior housing, touch screen control panel, without drain, 6' cord & plug, UL, cULus

2 ea WWG-2-120 120v/60/1-ph, 11.1 amps, NEMA 5-15

ITEM # 19 EXISTING UTILITY CART

One (1) Existing cart relocated and reused as is by owner. "NIC"

ITEM # 20 SPARE - NOT USED**ITEM # 21 SPARE - NOT USED****ITEM # 22 BUFFET/CAFETERIA, FLAT TOP**

One (1) Duke Manufacturing TST-60SS Thurmaduke™ Solid Top Unit, mobile utility counter, 60"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves.

1 ea P-LAM Veneer plastic laminate on body

1 ea MOD-4P Veneer on customer's side

1 ea CORD 6 ft. cord & plug – Verify cord length to reach side wall.

2 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)

For cord pass on top for item#17, Hatco IRNG-HC1-1 (By others)

1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location) **In rail**

1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot

1 ea MOD-HT Special Height Body, per unit

1 ea MOD-HT-34 34" Height Body

1 ea MOD-32 For special width body...per unit **34"***

1 ea MOD-2S-4CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea TOP CUTOUT Cut out in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **for item# 24, installed on customer side**

1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets** 48"D, 8" extended on customer side**

1 ea LED-46 Lights under extended top with 3" turn down edge

1 ea ICB CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base

for 2- item#17, drop in #24, guard LED lights

1 ea Body pilasters

1 ea TDST-MOD For special height rail

1 ea ON & OFF switch for outlet **Guard LED**

1 ea Cut out side panel to accommodate electrical receptacle access (verify size/location)

Submit shop drawing for review.

ITEM # 23 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-60SS Thurmaduke™ Solid Top Unit, mobile utility counter, 60"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

1 ea P-LAM Veneer plastic laminate on body

1 ea MOD-4P Veneer on customer's side

1 ea CORD 6 ft. cord & plug - verify cord length to reach side wall.

2 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)

For cord pass on top for item#17, Hatco IRNG-HC1-1 (By others)

1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location) **In rail**

1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot

1 ea MOD-HT Special Height Body, per unit

1 ea MOD-HT-34 34" Height Body

1 ea MOD-32 For special width body...per unit **34***

1 ea MOD-2S-4CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea TOP CUTOOUT Cut out in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **for item# 24, installed on customer side**

1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets** 48"D, 8" extended on customer side**

1 ea LED-46 Lights under extended top with 3" turn down edge

1 ea ON & OFF switch for outlet ** LED under extended tops**

1 ea ICB CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base

for 2- item#17, drop in #24, guard LED lights, LED under extended tops

1 ea Body pilasters

1 ea TDST-MOD For special height rail

1 ea ON & OFF switch for outlet **Guard LED**

1 ea Cut out side panel to accommodate electrical receptacle access (verify size/location)

Submit shop drawing for review

ITEM # 24 DROP-IN, COLD FOOD STATION

Two (2) Duke Manufacturing FCP2-SL Flush Mount Cold Pan Unit, drop-in unit, 49-3/8"W x 18"D x 24"H, slimline, (2) pan size, touchscreen control, 12" x 20" food pan, drain for each well manifolded to one location, 6' cord & plug, 120v/60/1-ph, R448a, NEMA 5-15, 3.7 amps, NSF, CULus, UL EPH Classified

ITEM # 25 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-46SS Thurmaduke™ Solid Top Unit, mobile utility counter, 46"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

1 ea P-LAM Veneer plastic laminate on body

- 1 ea MOD-3P Veneer on customer's side
- 1 ea CORD 6 ft. cord & plug
- 1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source **Drop in and guard LED**
- 1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location) **In rail**
- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
- 1 ea MOD-HT Special Height Body, per unit
- 1 ea MOD-HT-34 34" Height Body
- 1 ea MOD-32 For special width body...per unit **34***
- 1 ea TDST-X-1 For special length not listed (maximum one-piece length of 88"): To next longer standard unit price...ADD (for TST models) **39***
- 1 ea MOD-2S-3CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea TOP CUTOUT Cut out in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **for item# 18, installed on operator side**
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets** 48"D, 8" extended on customer side**
- 1 ea LED-46 Lights under extended top with 3" turn down edge
- 1 ea Body pilasters
- 1 ea TDST-MOD For special height rail
- 1 ea ON & OFF switch for outlet **Guard LED**

Submit shop drawing for review and approval

ITEM # 26 HAND SINK, WALL MOUNT

QTY: One (1) Lot

MFG. & MODEL: ADVANCE #7-PS-40

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 3101 TMV electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner. Unit to include right and left hand splash shields.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

ITEM # 27 ST. ST. WORK TABLE

One (1) ADVANCE TABCO model # KSS-305 st. st. work table furnished per manufacturers standards. Unit to include the following:

- One (1) Lot st st legs with lower shelf
- One (1) SS-2020 Deluxe enclosed drawer
- One (1) Lot casters, two with locks

ITEM # 28 HOLDING CABINET, HUMIDIFIED HEATED

One (1) FWE model #MTU-12 portable hot food cart. Units to be sized to accommodate both 12 x 20 & 18 x 26 pans and trays. Provide units with the following standard and optional accessories:

One (1) Lot of locking casters

One (1) UL Approved cord and plug

ITEM # 29 HOLDING CABINET, HUMIDIFIED HEATED

One (1) FWE model #MTU-12 portable hot food cart. Units to be sized to accommodate both 12 x 20 & 18 x 26 pans and trays. Provide units with the following standard and optional accessories:

One (1) Lot of locking casters

One (1) UL Approved cord and plug

ITEM # 30 SPARE - NOT USED**ITEM # 31 SPARE - NOT USED****ITEM # 32 BUFFET/CAFETERIA, FLAT TOP**

One (1) Duke Manufacturing TST-88SS Thurmaduke™ Solid Top Unit, mobile utility counter, 88"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

1 ea P-LAM Veneer plastic laminate on body

1 ea MOD-6P Veneer on customer's side

1 ea MOD-P-END Veneer on end, each

1 ea CORD 6 ft. cord & plug

1 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)

1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot

1 ea MOD-HT Special Height Body, per unit

1 ea MOD-HT-34 34" Height Body **ADA height**

1 ea TDST-X-1 For special length not listed (maximum one-piece length of 88"): To next longer standard unit price...ADD (for TST models)

1 ea MOD-2S-6CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**

1 ea LED LED lights under extended tops with 3-1/2" turn down edge.

1 ea ON & OFF switch for LED downlights

1 ea ICB CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base

Submit shop drawing for review.

ITEM # 33 DISPLAY CASE, HEATED

One (1) HATCO model # GRSDS-60D heated gravity chutes furnished per manufacturers standards. Unit to be provided with the following standard and optional accessories:

One (1) Designer Color
One (1) LED temp control
One (1) UL Cord and plug
Eight (8) stainless divider rods

ITEM # 34 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

1 ea P-LAM Veneer plastic laminate on body
1 ea MOD-5P Veneer on customer's side
1 ea MOD-P-END Veneer on end, each
1 ea CORD 6 ft. cord & plug
1 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)
1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
1 ea MOD-HT Special Height Body, per unit
1 ea MOD-HT-34 34" Height Body **ADA height**
1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
1 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
1 ea LED LED lights under extended tops with 3-1/2" turn down edge.
1 ea ICB CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base

1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 35 DISPLAY CASE, HEATED

One (1) HATCO model # GRSDS-60D heated gravity chutes furnished per manufacturers standards. Unit to be provided with the following standard and optional accessories:

One (1) Designer Color
One (1) LED temp control
One (1) UL Cord and plug

ITEM # 36 HAND SINK, WALL MOUNT

QTY: One (1) Lot

MFG. & MODEL: ADVANCE #7-PS-40

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 3101 TMV electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner. Unit to include right and left hand splash shields.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

ITEM # 37 HOLDING CABINET, HUMIDIFIED HEATED

One (1) FWE model #MTU-12 portable hot food cart. Units to be sized to accommodate both 12 x 20 & 18 x 26 pans and trays. Provide units with the following standard and optional accessories:

One (1) Lot of locking casters
One (1) UL Approved cord and plug

ITEM # 38 TABLE, WORK, 14 GAUGE, BACK SPLASH W/ UNDERSHELF

One (1) ADVANCE TABCO model # KSS-363 st. st. work table furnished per manufacturers standards. Unit to include the following:

One (1) Lot st st legs with lower shelf
One (1) SS-2020 Deluxe enclosed drawer
One (1) Lot casters, two with locks

ITEM # 39 TABLE, WORK, 14 GAUGE, BACK SPLASH W/ UNDERSHELF

One (1) ADVANCE TABCO model # KSS-366 st. st. work table furnished per manufacturers standards. Unit to include the following:

One (1) Modified height – 24" top work surface for conveyor ovens
One (1) Lot st st legs with lower shelf
One (1) Lot casters, two with locks

ITEM # 40 SPARE - NOT USED

ITEM # 41 SPARE - NOT USED

ITEM # 42 OVEN, CONVEYOR, COUNTERTOP, ELECTRIC, VENTLESS

Two (2) Ovention Conveyor C2000 Ventless Precision Impingement® Oven, Rapid Cook, countertop, one 48" long x 20.5" wide belt, 21" cook chamber, triple-layer impingement jet plates, touchscreen display, built-in self-diagnostics, USB menu upload, smart voltage sensor technology, cool to touch 430 ss exterior, 304 ss interior, two 2/3 HP variable speed motors, internal catalytic filtration, 4" adjustable legs, Made in USA, cULus, UL EPH Classified, ANSI/NSF 4. Include the following: OV-ACCS-C2000 Premium Accessory Package for CONVEYOR C2000, includes: (4) 18" round heavy duty pizza screens (OV-HDSCREEN-18), (1) 18" square fry basket (OV-FRYBSKT-18), (1) 13" x 18" grill plate (OV-GRLPLT-13x18), (1) spatula paddle (OVNTN-PDL) One (1) Stacking kit

ITEM # 43 REFRIGERATOR, REACH-IN

QTY: One (1)

MFG/MODEL: Traulsen G20012

CONST: Per manufacturers standards.

ACCESSORIES:

Two (2) Full height stainless steel doors Door swings hinged per plan.

One (1) Set of Heavy Duty 6" High Casters with wheel locks

One (1) UL. approved grounded cord & plug

One (1) Automatic condensate evaporator

Six (6) Epoxy coated wire shelves per section

Three (3) Year service/labor policy

One (1) Lot Lifetime warranty on door handles and hinges

Five (5) Year non-prorated compressor Warranty.

Details: Refrigerator to have 48 cu. Ft. Capacity, size 52 1/8" w x 32" d x 83 1/4" high. Compressor to be top mounted, air cooled unit. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. .

Elect: Per rough-in plan.

ITEM # 44 DISPLAY CASE, REFRIGERATED

One (1) TRUE model # GDM-23-HC-TSL01 glass door display refrigerator. Unit to be provided with the following:

One (1) Lot 4" castors, two with locks

One (1) Stainless Steel Finish

Three (3) Additional shelves

One (1) Hinged right door

ITEM # 45 BUFFET/CAFETERIA, CASHIER STATION

One (1) Duke Manufacturing TCS-30SS Thurmaduke™ Cashier Stand, mobile, 30"W, 32"D, 36"H, 16ga stainless top, 20ga stainless steel body & partial undershelf, stainless steel tube foot rest

1 ea CS-DR-LK Stainless steel drawer, with lock and keys, for cashier stand

1 ea CORD 6 ft. cord & plug

2 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source

1 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)

1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot

1 ea MOD-HT Special Height Body, per unit

1 ea MOD-HT-34 34" Height Body **ADA height**

1 ea MOD-2S-2CL Kick Plate, cashier's left, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

- 1 ea MOD-2S-2OC Kick Plate, opposite cashier, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- 1 ea LED LED Lights under extended tops with 3-1/2" turn down edge.
- 1 ea ON & OFF switch for LED downlights

ITEM # 46 POS / REGISTER

One (1) Lot of cash register/POS system furnished and installed by owner. "NIC"

ITEM # 47 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

- 1 ea P-LAM Veneer plastic laminate on body
- 1 ea MOD-5P Veneer on customer's side
- 1 ea CORD 6 ft. cord & plug
- 1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location) **In rail**
- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
- 1 ea MOD-HT Special Height Body, per unit
- 1 ea MOD-HT-34 34" Height Body **ADA height**
- 1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- 1 ea TDST-MOD For special height rail
- 1 ea TOP CUTOUT Cutout in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **For drop-in#48**
- 1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
- 1 ea LOUVER Stainless louvered panel at customer side for drop-in ventilation
- 1 ea CUSTOM CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base
- 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring **Item#49, PMR FM2R-A w/LED lights and heater)**
- 1 ea LED LED Lights under extended tops with 3-1/2" turn down edge.
- 1 ea ON & OFF switch for guard LED
- 1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 48 DROP-IN, HOT/COLD WELLS

One (1) Duke Manufacturing HCF-3 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 49" long, (3) 12" x 20" individual pans, 300 series stainless steel top rim, 5" deep 300 series stainless steel interior liners, steel exterior housing, individual wired remote digital controls for hot or cold operation, air-

cooled condensing unit, individual drains manifolded to a valve, 6' cord & plug, UL, cULus, NSF #4 & 7

- 1 ea PH_VOLTAGE Voltage to be determined
- 1 ea MOD-DRY No Drains, in lieu of standard drains

ITEM # 49 FOOD SHIELD, ADJUSTABLE

One (1) Premier Metal & Glass Model No. FM2R-A - 1" OD Gearless Adjustable Self Service Food Shield With Top Shelf; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; Hatco GRNM (120v) Narrow Heat Lamp And Ultra slim Led Light In Complementary Colored Housing; Brushed Stainless Finish.

Submit shop drawing for review.

ITEM # 50 SPARE - NOT USED

ITEM # 51 SPARE - NOT USED

ITEM # 52 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

- 1 ea P-LAM Veneer plastic laminate on body
- 1 ea MOD-5P Veneer on customer's side
- 1 ea CORD 6 ft. cord & plug
- 1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source
- 1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location)

****In rail****

- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
 - 1 ea MOD-HT Special Height Body, per unit
 - 1 ea MOD-HT-34 34" Height Body ****ADA height****
 - 1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
 - 1 ea TDST-MOD For special height rail
 - 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, ****3cm with 3/4 inch backer board**** Extended and mounted on fixed brackets******
 - 1 ea CUSTOM Installation of drop in supplied by dealer Installed by Duke including wiring
 - 1 ea TOP CUTOUT Cut out in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring ****For drop-in#53, Hatco GRSBF-60-I ****
 - 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring
- **Item#55, PMR FM1R-A ****
- 1 ea LED lights under extended tops with 3-1/2" turn down edge.
- NOTE: sneeze guard is NOT included, FSEC supplies the food shields
 NOTE: glass guards NOT assembled for shipment
 NOTE: glass guards packed separately for jobsite installation
- 1 ea ON & OFF switch for LED downlights

ITEM # 53 DROP-IN, HEATED SHELF

One (1) HATCO model #GRSBF-60-I drop in heated shelf sized 61.5" long x 21" wide overall. Unit to be furnished per manufacturers standards.

Include the following standard and optional accessories:

One (1) Electronic Control – Flush Mounted in Duke Counter Apron
One (1) UL Cord and plug

Unit to be turned over to counter fabricator for installation.

ITEM # 54 HEAT LAMP, DECORATIVE

One (1) Lot HATCO decorative heat lamp and track as shown on plan. Provide the following:

One (1) DL-TRACK-4B 4'- 0" tracks (black)
Three (3) DL 400 RTL furnished with type "RT" mounts. (black)
Three (3) WHITE 250 watt clear coated bulbs

FSEC to turn units over to Electrical Trades for installation and wiring.

NOTE! Verify color and style of shades & track with interior designer before ordering.

ITEM # 55 FOOD SHIELD, ADJUSTABLE

One (1) FM1R-A -EXT- 1" OD Gearless Adjustable Self Service Food Shield ; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; No Heat/Light Included; Brushed Stainless Finish; 65-1/8" CI Length;

Submit shop drawing for review

ITEM # 56 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

1 ea P-LAM Veneer plastic laminate on body
1 ea MOD-5P Veneer on customer's side
1 ea MOD-P-END Veneer on end, each
1 ea CORD 6 ft. cord & plug
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source
1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location)
In rail
1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
1 ea MOD-HT Special Height Body, per unit
1 ea MOD-HT-34 34" Height Body **ADA height**

- 1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea TDST-MOD For special height rail
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- 1 ea CUSTOM Installation of drop in supplied by dealer Installed by Duke including wiring
- 1 ea TOP CUTOUT Cutout in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **For drop-in#57, Hatco GRSBF-60-I **
- 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring
- **Item#59, PMR FM1R-A **
- 1 ea LED lights under extended tops with 3-1/2" turn down edge.
- 1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 57 DROP-IN, HEATED SHELF

One (1) HATCO model #GRSBF-60-I drop in heated shelf sized 61.5" long x 21" wide overall. Unit to be furnished per manufacturers standards.

Include the following standard and optional accessories:

- One (1) Electronic Control – Flush Mounted in Duke Counter Apron
- One (1) UL Cord and plug

Unit to be turned over to counter fabricator for installation.

ITEM # 58 HEAT LAMP, DECORATIVE

One (1) Lot HATCO decorative heat lamp and track as shown on plan. Provide the following:

- One (1) DL-TRACK-4B 4'- 0" tracks (black)
- Three (3) DL 400 RTL furnished with type "RT" mounts. (black)
- Three (3) WHITE 250 watt clear coated bulbs

FSEC to turn units over to Electrical Trades for installation and wiring.

NOTE! Verify color and style of shades & track with interior designer before ordering.

ITEM # 59 FOOD SHIELD, ADJUSTABLE

One (1) FM1R-A -EXT- 1" OD Gearless Adjustable Self Service Food Shield ; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; No Heat/Light Included; Brushed Stainless Finish; 65-1/8" CI Length;

Submit shop drawing for review

ITEM # 60 SPARE - NOT USED

ITEM # 61 SPARE - NOT USED**ITEM # 62 REFRIGERATOR, PASS-THRU, GLASS DOOR**

One (1) TRUE model # STA1RPT-1G-1G-HC pass through glass door refrigerator furnished per manufacturers standards. Unit to be furnished with the following:

Two (2) Hinged doors per plan

One (1) Lot door locks – Student side to be locked for no self service

One (1) Lot casters, two with locks

One (1) UL cord and plug

Three (3) Additional wire shelves.

ITEM # 63 BUFFET/CAFETERIA, CASHIER STATION

One (1) Duke Manufacturing TCS-30SS Thurmaduke™ Cashier Stand, mobile, 30"W, 32"D, 36"H, 16ga stainless top, 20ga stainless steel body & partial undershelf, stainless steel tube foot rest

1 ea CS-DR-LK Stainless steel drawer, with lock and keys, for cashier stand

1 ea P-LAM Veneer plastic laminate on body

1 ea MOD-2P-CR Veneer on cashier's right

1 ea MOD-2P-OC Veneer opposite the cashier

1 ea CORD 6 ft. cord & plug

2 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source

1 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)

1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot

1 ea MOD-HT Special Height Body, per unit

1 ea MOD-HT-34 34" Height Body **ADA height**

1 ea MOD-2S-2CR Kick Plate, cashier's right, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea MOD-2S-2OC Kick Plate, opposite cashier, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**

1 ea Hinged louvered door on operator side with locks

1 ea MOD Full undershelf in lieu stainless steel tube foot rest

1 ea LED LED Lights under extended tops with 3-1/2" turn down edge.

1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 64 POS / REGISTER

One (1) Lot of cash register/POS system furnished and installed by owner. "NIC"

ITEM # 65 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

- 1 ea P-LAM Veneer plastic laminate on body
- 1 ea MOD-5P Veneer on customer's side
- 1 ea MOD-P-END Veneer on end, each
- 1 ea CORD 6 ft. cord & plug
- 2 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location)
- **In rail and bottom shelf**
- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
- 1 ea MOD-HT Special Height Body, per unit
- 1 ea MOD-HT-34 34" Height Body **ADA height**
- 1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea TDST-MOD For special height rail
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- 1 ea TOP CUTOUT Cutout in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring
- **For drop-in#66**
- 1 ea CUSTOM CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base
- 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring
- **Item#67, PMR FM2R-A w/LED LIGHTS and HEAT**
- 1 ea LED LED Lights under extended tops with 3-1/2" turn down edge.
- NOTE: sneeze guard is NOT included, FSEC supplies the food shields
- NOTE: glass guards NOT assembled for shipment
- NOTE: glass guards packed separately for jobsite installation
- 1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
- 1 ea ON & OFF switch for guard LED
- 1 ea ON & OFF switch for LED downlights

ITEM # 66 DROP-IN, HOT/COLD WELLS

One (1) Duke Manufacturing HCF-3 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 49" long, (3) 12" x 20" individual pans, 300 series stainless steel top rim, 5" deep 300 series stainless steel interior liners, steel exterior housing, individual wired remote digital controls for hot or cold operation, air-cooled condensing unit, individual drains manifolded to a valve, 10" cord & plug, UL, cULus, NSF #4 & 7

- 1 ea HCF-3-120 120v/60/1-ph, 16.0 amps, NEMA 5-20P
- 1 ea MOD-DRY No Drains, in lieu of standard drains

ITEM # 67 FOOD SHIELD, ADJUSTABLE

One (1) Premier Metal & Glass Model No. FM2R-A - 1" OD Gearless Adjustable Self Service Food Shield With Top Shelf; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; Hatco GRNM (120v) Narrow Heat Lamp And Ultra slim Led Light In Complementary Colored Housing; Brushed Stainless Finish.

Submit shop drawing for review.

ITEM # 68 REFRIGERATOR, PASS-THRU, GLASS DOOR

One (1) TRUE model # STA1RPT-1G-1G-HC pass through glass door refrigerator furnished per manufacturers standards. Unit to be furnished with the following:

Two (2) Hinged doors per plan

One (1) Lot door locks – Student side to be locked for no self service

One (1) Lot casters, two with locks

One (1) UL cord and plug

Three (3) Additional wire shelves.

ITEM # 69 BUFFET/CAFETERIA, CASHIER STATION

One (1) Duke Manufacturing TCS-30SS Thurmaduke™ Cashier Stand, mobile, 30"W, 32"D, 36"H, 16ga stainless top, 20ga stainless steel body & partial undershelf, stainless steel tube foot rest

1 ea CS-DR-LK Stainless steel drawer, with lock and keys, for cashier stand

1 ea P-LAM Veneer plastic laminate on body (NOTE: Manufacturer's standard colors ONLY, metallics, color-core & raised textures may incur additional cost)

1 ea MOD-2P-CR Veneer on cashier's right

1 ea MOD-2P-OC Veneer opposite the cashier

1 ea CORD 6 ft. cord & plug

2 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source

1 ea CUT-OP1-G Round cutout with grommet, in counter top, body panel or a shelf (specify cutout diameter & location)

1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot

1 ea MOD-HT Special Height Body, per unit

1 ea MOD-HT-34 34" Height Body **ADA height**

1 ea MOD-2S-2CR Kick Plate, cashier's right, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea MOD-2S-2OC Kick Plate, opposite cashier, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**

1 ea Hinged louvered door on operator side with locks

1 ea MOD Full undershelf in lieu stainless steel tube foot rest

1 ea LED Lights under extended tops with 3-1/2" turn down edge.

1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 70 SPARE - NOT USED**ITEM # 71 SPARE - NOT USED****ITEM # 72 POS / REGISTER**

One (1) Lot of cash register/POS system furnished and installed by owner. "NIC"

ITEM # 73 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

- 1 ea P-LAM Veneer plastic laminate on body
- 1 ea MOD-5P Veneer on customer's side
- 1 ea MOD-P-END Veneer on end, each
- 1 ea CORD 6 ft. cord & plug
- 2 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location)
- **In rail and bottom shelf**
- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
- 1 ea MOD-HT Special Height Body, per unit
- 1 ea MOD-HT-34 34" Height Body **ADA height**
- 1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea TDST-MOD For special height rail
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- 1 ea TOP CUTOUT Cutout in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **For drop-in#74**
- 1 ea CUSTOM CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base
- 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring
- **Item#75, PMR FM2R-A w/LED LIGHTS HEAT**
- 1 ea LED LED Lights under extended tops with 3-1/2" turn down edge.
- NOTE: sneeze guard is NOT included, FSEC supplies the food shields
- NOTE: glass guards NOT assembled for shipment
- NOTE: glass guards packed separately for jobsite installation
- 1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
- 1 ea ON & OFF switch for guard LED
- 1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 74 DROP-IN, HOT/COLD WELLS

One (1) Duke Manufacturing HCF-3 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 49" long, (3) 12" x 20" individual pans, 300 series stainless steel top rim, 5" deep 300 series stainless steel interior liners, steel exterior housing, individual wired remote digital controls for hot or cold operation, air-cooled condensing unit, individual drains manifolded to a valve, 10" cord & plug, UL, cULus, NSF #4 & 7

1 ea HCF-3-120 120v/60/1-ph, 16.0 amps, NEMA 5-20P
1 ea MOD-DRY No Drains, in lieu of standard drains

ITEM # 75 FOOD SHIELD, ADJUSTABLE

One (1) Premier Metal & Glass Model No. FM2R-A - 1" OD Gearless Adjustable Self Service Food Shield With Top Shelf; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; Hatco GRNM (120v) Narrow Heat Lamp And Ultra slim Led Light In Complementary Colored Housing; Brushed Stainless Finish.

Submit shop drawing for review.

ITEM # 76 DISPLAY CASE, REFRIGERATED

One (1) TRUE model # GDM-23-HC-TSL01 glass door display refrigerator. Unit to be provided with the following:

One (1) Lot 4" castors, two with locks
One (1) Stainless Steel Finish
Three (3) Additional shelves
One (1) Hinged left door

ITEM # 77 TABLE, WORK, 14 GAUGE, BACK SPLASH W/ UNDERSHELF

One (1) ADVANCE TABCO model # KSS-305 st. st. work table furnished per manufacturers standards. Unit to include the following:

One (1) Lot st st legs with lower shelf
One (1) SS-2020 Deluxe enclosed drawer
One (1) Lot casters, two with locks

ITEM # 78 EXISTING WARMER

One (1) Existing warmer relocated and reused as is by owner. "NIC"

ITEM # 79 HAND SINK, WALL MOUNT

QTY: One (1) Lot

MFG. & MODEL: ADVANCE #7-PS-40

CONST: Sink to be constructed of Stainless Steel Sink to be furnished with 8" backsplash with 2" return to wall and flange down.

ACCESSORIES: Furnish with strainer type 6" tailpiece and "P" trap all to be chrome plated brass. Faucet shall be T & S EC 3101 TMV electronic gooseneck faucet, aerator, mixing valve, 120 Volt A.C. transformer. Soap and towel dispenser to be provided by owner. Unit to include right and left hand splash shields.

DETAILS: Sink to be mounted with rim 34" above finished floor with rough-in for water and waste located 4-7/8" below the 6-1/2" deep sink.

ITEM # 80 SPARE - NOT USED

ITEM # 81 SPARE - NOT USED

ITEM # 82 BUFFET/CAFETERIA, CASHIER STATION

One (1) Duke Manufacturing 306-25SS AeroServ™ Cashier Stand Unit, 24-1/2"W x 24-1/2"D x 36"H, 20ga stainless steel top, stainless steel body & undershelf, 6"H stainless steel legs & adjustable feet

- 1 ea CS-DR-LK Stainless steel drawer, with lock and keys, for cashier stand
 - 1 ea P-LAM Veneer plastic laminate on body (NOTE: Manufacturer's standard colors ONLY, metallics, color-core & raised textures may incur additional cost)
 - 1 ea MOD-2P-CR Veneer on cashier's right
 - 1 ea MOD-2P-OC Veneer opposite the cashier
 - 1 ea CORD 6 ft. cord & plug
 - 2 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, duplex or single receptacle & stainless steel cover, wired to existing power source
 - 1 ea CUT-OP1 Round cutout with raw edge, in counter top, body panel or a shelf (specify cutout diameter & location)
 - 1 ea MOD-HT Special Height Body, per unit
 - 1 ea MOD-HT-34 34" Height Body **ADA height**
 - 1 ea MOD-2S-2OC Kick Plate, opposite cashier, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
 - 1 ea MOD-2S-2CR Kick Plate, cashier's right, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
 - 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- **Shaper per plan view**
- 1 ea LED LED Lights under extended tops with 3-1/2" turn down edge.
 - 1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 83 POS / REGISTER

One (1) Lot of cash register/POS system furnished and installed by owner. "NIC"

ITEM # 84 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-60SS Thurmaduke™ Solid Top Unit, mobile utility counter, 60"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

- 1 ea P-LAM Veneer plastic laminate on body
 - 1 ea MOD-4P Veneer on customer's side
 - 1 ea 442-4S-FX-OP Cutting Board/Shelf, operator's side, 7"D, 18ga stainless steel shelf, (3) fixed brackets, shelf mounted flush to counter top (specify any special height)
 - 1 ea CORD 6 ft. cord & plug
 - 1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location) **In rail**
 - 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
 - 1 ea MOD-HT Special Height Body, per unit
 - 1 ea MOD-HT-34 34" Height Body **ADA height**
 - 1 ea TDST-X-1 For special length not listed (maximum one-piece length of 88"): To next longer standard unit price...ADD (for TST models)
 - 1 ea MOD-2S-4CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
 - 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
 - 1 ea LED LED ILights under extended tops with 3-1/2" turn down edge.
 - 1 ea TDST-MOD For special height rail
 - 1 ea TOP CUTOUT Cutout in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring
- **For drop-in#85**
- 1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
 - 1 ea LOUVER Stainless louvered panel at customer side for drop-in ventilation
 - 1 ea CUSTOM CUSTOM Electric inter connect box with outlets breakers and cord, mounted in the base
 - 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring
- **Item#86, PMR FM2R-A w/LED heaty & lights**
- NOTE: sneeze guard is NOT included, FSEC supplies the food shields
- NOTE: glass guards NOT assembled for shipment
- NOTE: glass guards packed separately for jobsite installation
- 1 ea ON & OFF switch for guard LED
 - 1 ea ON & OFF switch for LED downlights

Submit shop drawing

ITEM # 85 DROP-IN, HOT/COLD WELLS

One (1) Duke Manufacturing HCF-2 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 34" long, (2) 12" x 20" individual pans, 300 series stainless steel top rim, 5" deep 300 series stainless steel interior liners, steel exterior housing, individual wired remote digital controls for hot or cold operation, air-cooled condensing unit, individual drains manifolded to a valve, 10" cord & plug, UL, cULus, NSF #4 & 7

- 1 ea HCF-2-120 120v/60/1-ph, 10.5 amps, NEMA 5-15P
- 1 ea MOD-DRY No Drains, in lieu of standard drains

ITEM # 86 FOOD SHIELD, ADJUSTABLE

One (1) Premier Metal & Glass Model No. FM2R-A - 1" OD Gearless Adjustable Self Service Food Shield With Top Shelf; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels

Included (Fixed); 644b Surface Mounting Option; Hatco GRNM (120v) Narrow Heat Lamp And Ultra slim Led Light In Complementary Colored Housing; Brushed Stainless Finish.

Submit shop drawing for review.

ITEM # 87 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 74"W x 32"D x 36"H, 16ga stainless steel top, 20ga stainless steel body & undershelves

- 1 ea P-LAM Veneer plastic laminate on body
- 1 ea MOD-5P Veneer on customer's side
- 1 ea MOD-P-END Veneer on end, each
- 1 ea 442-5S-FX-OP Cutting Board/Shelf, operator's side, 7"D, 18ga stainless steel shelf, (3) fixed brackets, shelf mounted flush to counter top (specify any special height)
- 1 ea CORD 6 ft. cord & plug
- 1 ea CUT-OP2 Rectangular cutout with raw edge, must be 12" or less, in counter top, body panel or a shelf (specify cutout size & location) **In rail**
- 1 ea MOD-LEG 6" high stainless steel legs in lieu of standard casters, with stainless steel adjustable foot
- 1 ea MOD-HT Special Height Body, per unit
- 1 ea MOD-HT-34 34" Height Body **ADA height**
- 1 ea MOD-2S-5CU Kick Plate, Exposed sides, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
- 1 ea TDST-MOD For special height rail
- 1 ea QUARTZ STYLE TOP Solid surface quartz composite type counter top, continuous, **3cm with 3/4 inch backer board** Extended and mounted on fixed brackets**
- 1 ea LED Lights under extended tops with 3" turn down edge.
- 1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
- 1 ea LOUVER Stainless louvered panel at customer side for drop-in ventilation
- 1 ea TOP CUTOUT Cut out in solid surface countertop for drop-in equipment, & stainless steel isolation trim ring **For drop-in#88**
- 1 ea CUSTOM electric inter connect box with outlets breakers and cord, mounted in the base
- 1 ea CUSTOM Installation of food guards supplied by dealer Installed by Duke including wiring
- **Item#89, PMR FM2R-A w/LED HEAT & LIGHTS **
- 1 ea LED Lights under extended tops with 3-1/2" turn down edge.
- 1 ea ON & OFF switch for guard LED
- 1 ea ON & OFF switch for LED downlights

Submit shop drawing for review.

ITEM # 88 DROP-IN, HOT/COLD WELLS

One (1) Duke Manufacturing HCF-4 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 65" long, (4) 12" x 20" individual pans, 300 series stainless steel top rim, 5" deep 300 series stainless steel interior liners, steel exterior housing, individual wired remote digital controls for hot or cold operation, air-cooled condensing unit, individual drains manifolded to a valve, 10" cord & plug, UL, cULus, NSF #4 & 7

- 1 ea PH_VOLTAGE Voltage to be determined
- 1 ea MOD-DRY No Drains, in lieu of standard drains

ITEM # 89 FOOD SHIELD, ADJUSTABLE

One (1) Premier Metal & Glass Model No. FM2R-A - 1" OD Gearless Adjustable Self Service Food Shield With Top Shelf; 3/8" Clear Tempered Glass With Polished Edges And Radius Corners; Both End Panels Included (Fixed); 644b Surface Mounting Option; Hatco GRNM (120v) Narrow Heat Lamp And Ultra slim Led Light In Complementary Colored Housing; Brushed Stainless Finish.

Submit shop drawing for review.

ITEM # 90 EXISTING REFRIGERATION RACK (ALTERNATE NO. 1)

One (1) Existing FLOCOLD water cooled refrigeration rack to be removed and disposed of after utilities have been disconnected.

ITEM # 91 POS / REGISTER

One (1) Lot of cash register/POS system furnished and installed by owner. "NIC"

ITEM # 92 SERVICE COUNTER & BASE

One (1) Custom Fabricated counter and base cabinet in size and shape as shown on plan. Counters to be 34" to working surface. Cabinet base to sit on 6" high st. st. legs with adjustable bullet feet. Provide st. st. snap on/off st. st. kickplates secured with Component Hardware Kick Plate Clamps. Kickplates to be turned back on top and bottom edge for increased rigidity. Soda system cabinet to have bottom shelf and legs omitted. Doors to extend down to 1" above the floor. Rear and side walls to be stainless with cut outs for utilities. FSEC to provide vinyl base on rear and side walls to provide coved base.

See elevation and general requirements for additional fabrication details.

TOP: Top & splash to Be Fabricated of quartz material per manufacturers standards. FSEC to refer to architectural material legend for manufacturer and color. NOTE! Top and base cabinets must be fabricated by the same manufacturer. Top to extend through pass opening and be turned down 2" on customer side to conceal blocking, etc. Rear to be 3cm thickness.

BASE CABINET & SHELVES: Basic configuration to be 3/16" powder coated, or stainless steel end panels connected by galvanized horizontal supports using mechanical fasteners.

Interior to be made up of 16 ga. stainless steel, removable bottom shelf and 18 ga. stainless steel. Bottom shelves to be secure and not tip or move when in place.

Submit shop drawing for approval.

ITEM # 93 SODA DISPENSER

One (1) Soda dispenser by Coke. Boosters to coordinate work. "NIC"

ITEM # 94 UNDERCOUNTER BIB RACK

One (1) Undercounter BIB rack, pumps, carbonator & CO2 equipment provided by Coke. Boosters to coordinate work. "NIC"

ITEM # 95 EXISTING AIRPOT COFFEE BREWER

One (1) Existing unit relocated and reused as is by owner. "NIC"

ITEM # 96 TABLE, ENCLOSED BASE, SLIDING DOORS

One (1) ADVANCE TABCO model # CK-SS-246M st. st. work counter furnished per manufacturers standards. Unit to be furnished with the following:

- One (1) Lot st. st. legs
- One (1) Lot st. st. clip on kickplates
- One (1) Adjustable mid shelf
- One (1) Lot sliding doors w/ locks
- One (1) 5" integral backsplash

FSEC to seal splash to wall with silicone.

ITEM # 97 ST. ST. WALL CABINET

Two (2) ADVANCE TABCO model # WCH-15-36 & 72 st. st. wall cabinet furnished per manufacturers standards. Units to be furnished with the following:

- One (1) Adjustable mid shelf
- One (1) Lot hinged doors with locks

FSEC to seal bottom and sides to wall with silicone. FSEC to coordinate mounting height over owners existing equipment.

ITEM # 98 DISPLAY CASE, REFRIGERATED

One (1) TRUE model # GDM-23-HC-TSL01 glass door display refrigerator. Unit to be provided with the following:

- One (1) Lot 4" castors, two with locks
- One (1) Stainless Steel Finish
- Three (3) Additional shelves
- One (1) Hinged right door

ITEM # 99 TABLE, ENCLOSED BASE, SLIDING DOORS

One (1) ADVANCE TABCO model # CK-SS-244M st. st. work counter furnished per manufacturers standards. Unit to be furnished with the following:

- One (1) Lot st. st. legs
- One (1) Lot st. st. clip on kickplates
- One (1) Adjustable mid shelf
- One (1) Lot sliding doors w/ locks

One (1) 5" integral backsplash

FSEC to seal splash to wall with silicone.

ITEM # 100 EXISTING COUNTER TOP WARMER

One (1) Existing counter top warmer relocated and reused as is by owner. "NIC"

ITEM # 101 REFRIGERATOR, REACH-IN

QTY: One (1)

MFG/MODEL: Traulsen G10010

CONST: Per manufacturers standards.

ACCESSORIES:

One (1) Full height stainless steel door. Door hinged per plan.

One (1) Set of Heavy Duty 6" High Casters with wheel locks

One (1) UL approved grounded cord & plug

One (1) Automatic condensate evaporator

Six (6) Epoxy coated wire shelves

Three (3) Year service/labor policy

One (1) Lot Lifetime warranty on door handles and hinges

Five (5) Year non-prorated compressor Warranty.

Details: Compressor to be top mounted, air cooled unit. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. .

Elect: Per rough-in plan.

ITEM # 102 PORTABLE ICE CART

One (1) CAMBRO model # ICS100L portable 100# ice caddy. Unit to be furnished per manufacturers standards.

ITEM # 103 EXISTING WALK IN REF/FZR

One (1) Existing refrigerator / freezer complex to remain as is. "NIC"

ITEM # 104 REMOTE REFRIGERATION SYSTEM (ALTERNATE NO. 1)

One (1) COOLTEC model #CRS-6 remote refrigeration system sized to accommodate walk in refrigerator/freezers as shown plan.

See sheets FSE-6 & FSE-7 for system specification and details.

FSEC to be responsible for 100% operation system after utilities have been connected. System to be provided with optional 4 year extended warranty.

Submit shop drawing of final unit after line runs and mounting location have been determined to ensure proper sizing.

ITEM # 105 FREEZER BLOWER COILS (ALTERNATE NO. 1)

Two (2) Units included with item # 104

ITEM # 105.1 HEAT TAPE (ALTERNATE NO. 1)

One (1) Lot furnished and installed by FSEC refrigeration trade.

ITEM # 106 REFRIGERATOR BLOWER COIL (ALTERNATE NO. 1)

One (1) Unit included with item # 104

ITEM # 107 REFRIGERATOR BLOWER COIL (ALTERNATE NO. 1)

One (1) Unit included with item # 104

ITEM # 108 FIELD ERECTION LABOR

FSEC shall deliver, unload, uncrate, and install all items herein specified ready for final plumbing, electrical and ventilation connections furnished by respective trades as outlined in the General Requirements.

All equipment shall be cleaned and polished before demonstrating equipment to the Owner. All crating and packing material to be removed from job site.

FSEC shall arrange demonstration date with Owner and at the same time check out all loose items with the Food Service Manager.

FSEC shall be responsible for missing items unless he can produce signed receipts from Owner's personnel that the items were received and accounted for. Owner cannot be responsible for items delivered to the job site that were dropped off without being signed for by Owner's personnel or representatives.

Rough-in plans to be submitted at a scale of 1/4" = 1'-0". When present equipment is re-used at new locations, it shall be the FSEC'S responsibility to show necessary rough-in requirements for these items. (See General Requirements for complete details relating to submission of shop drawings).

Two (2) complete sets of all final shop drawings, instructions, and parts lists are to be turned over to the Owner secured in a binder. This booklet shall include the telephone number and address of the service company for each piece of equipment.

NOTE! FSEC shall pay all sales, consumer, use and other similar taxes for the work or portions thereof provided by the Contractor which are legally enacted at the time bids are received, whether or not yet effective.

Final payment cannot be recommended until all of the above items have been completed to our satisfaction.

NAME OF BIDDER: _____

ADDRESS: _____

DATE: _____ TELEPHONE NO _____

BASE BID

If this Proposal is accepted in writing within thirty (30) days from the date of the bid opening, undersigned having familiarized themselves with the drawings and specifications as prepared by TMP ASSOCIATES, INC. agrees to enter into a Contract for furnishing all labor, materials, and facilities for Food Service Equipment in connection with the above named project for the total base bid sum amount of \$_____ including sales tax.

(\$ _____ DOLLARS)

The amount shown shall be shown in both words and figures. In case of a discrepancy, the amount shown in words shall govern. Sales tax amount must be shown.

TIME OF COMPLETION

The Bidder agrees to complete the above named project in _____ consecutive calendar days.

BID GUARANTEE TYPE: _____

AMOUNT \$ _____

CONTRACT ASSUMPTIONS

The Bidder agrees to enter into a sub contract with the General Construction Work Contractor, (Architectural Trades) as designated by the Owner. The sub contract shall be based upon the prices, terms, and conditions set forth in the Proposal.

ADDENDA

Proposal is based on the following Addenda:

Addendum # _____ Dated: _____

Addendum # _____ Dated: _____

Addendum # _____ Dated: _____

SIGNATURE

Signed By: _____

Dated and signed at: _____

State of _____ this _____ day of _____, 2024

LEGAL STATUS OF BIDDER

A Corporation duly organized and doing business under the laws of the State of _____ for whom _____ whose signature is affixed to this Proposal is duly authorized to execute contracts.

A Partnership, all members:

An individual whose signature is affixed to this Proposal: _____

INSTRUCTIONS

The Base Bid must be on fixtures specified for a fair comparison of all the bids. Prices on alternate equipment will be accepted on a separate sheet made up by the Bidder with illustrations and alternate specifications.

The following pages contain a schedule of the various items of equipment. All manufacturers' names and other data requested must be filled in by the Bidder.

ON FABRICATED ITEMS, PLEASE GIVE THE NAME OF YOUR FABRICATOR

ITEM NUMBER	DESCRIPTION	QUANTITY	MANUFACTURER'S OR FABRICATOR'S NAME AND MODEL NUMBER		PRICE
1	Existing Warmer	_____	_____	_____	_____
2	Existing Warmer	_____	_____	_____	_____
3	St. St. Work Table	_____	_____	_____	_____
4	Existing Combi Oven	_____	_____	_____	_____

5 Existing Combi Oven	_____	_____	_____
6 St. St. Cooks Table W/ Shelf Over	_____	_____	_____
7 Spare - Not Used			
8 Holding Cabinet, Humidified Heated	_____	_____	_____
9 Display Case, Heated	_____	_____	_____
10 Spare - Not Used			
11 Spare - Not Used			
12 Refrigerator, Reach-In	_____	_____	_____
13 Buffet/Cafeteria, Flat Top	_____	_____	_____
14 Spare - Not Used			
15 Food Shield, Adjustable	_____	_____	_____
16 Buffet/Cafeteria, Flat Top	_____	_____	_____
17 Induction Range, Countertop	_____	_____	_____
18 Drop-In, Hot Wells	_____	_____	_____
19 Existing Utility Cart	_____	_____	_____
20 Spare - Not Used			
21 Spare - Not Used			
22 Buffet/Cafeteria, Flat Top	_____	_____	_____
23 Buffet/Cafeteria, Flat Top	_____	_____	_____
24 Drop-In, Cold Food Station	_____	_____	_____
25 Buffet/Cafeteria, Flat Top	_____	_____	_____
26 Hand Sink, Wall Mount	_____	_____	_____
27 St. St. Work Table	_____	_____	_____
28 Holding Cabinet, Humidified Heated	_____	_____	_____
29 Holding Cabinet, Humidified Heated	_____	_____	_____
30 Spare - Not Used			

31 Spare - Not Used			
32 Buffet/Cafeteria, Flat Top	_____	_____	_____
33 Display Case, Heated	_____	_____	_____
34 Buffet/Cafeteria, Flat Top	_____	_____	_____
35 Display Case, Heated	_____	_____	_____
36 Hand Sink, Wall Mount	_____	_____	_____
37 Holding Cabinet, Humidified Heated	_____	_____	_____
38 Table, Work	_____	_____	_____
39 Table, Work	_____	_____	_____
40 Spare - Not Used			
41 Spare - Not Used			
42 Ventless Conveyor Oven	_____	_____	_____
43 Refrigerator, Reach-In	_____	_____	_____
44 Display Case, Refrigerated	_____	_____	_____
45 Buffet/Cafeteria, Cashier Station	_____	_____	_____
46 Pos / Register	_____	_____	_____
47 Buffet/Cafeteria, Flat Top	_____	_____	_____
48 Drop-In, Hot/Cold Wells	_____	_____	_____
49 Food Shield, Adjustable	_____	_____	_____
50 Spare - Not Used			
51 Spare - Not Used			
52 Buffet/Cafeteria, Flat Top	_____	_____	_____
53 Drop-In, Heated Shelf	_____	_____	_____
54 Heat Lamp, Decorative	_____	_____	_____
55 Food Shield, Adjustable	_____	_____	_____
56 Buffet/Cafeteria, Flat Top	_____	_____	_____

57 Drop-In, Heated Shelf	_____	_____	_____
58 Heat Lamp, Decorative	_____	_____	_____
59 Food Shield, Adjustable	_____	_____	_____
60 Spare - Not Used			
61 Spare - Not Used			
62 Refrigerator, Pass-Thru, Glass Door	_____	_____	_____
63 Buffet/Cafeteria, Cashier Station	_____	_____	_____
64 Pos / Register	_____	_____	_____
65 Buffet/Cafeteria, Flat Top	_____	_____	_____
66 Drop-In, Hot/Cold Wells	_____	_____	_____
67 Food Shield, Adjustable	_____	_____	_____
68 Refrigerator, Pass-Thru, Glass Door	_____	_____	_____
69 Buffet/Cafeteria, Cashier Station	_____	_____	_____
70 Spare - Not Used			
71 Spare - Not Used			
72 Pos / Register	_____	_____	_____
73 Buffet/Cafeteria, Flat Top	_____	_____	_____
74 Drop-In, Hot/Cold Wells	_____	_____	_____
75 Food Shield, Adjustable	_____	_____	_____
76 Display Case, Refrigerated	_____	_____	_____
77 Table, Work,	_____	_____	_____
78 Existing Warmer	_____	_____	_____
79 Hand Sink, Wall Mount	_____	_____	_____
80 Spare - Not Used			
81 Spare - Not Used			
82 Buffet/Cafeteria, Cashier Station	_____	_____	_____

83 Pos / Register	_____	_____	_____
84 Buffet/Cafeteria, Flat Top	_____	_____	_____
85 Drop-In, Hot/Cold Wells	_____	_____	_____
86 Food Shield, Adjustable	_____	_____	_____
87 Buffet/Cafeteria, Flat Top	_____	_____	_____
88 Drop-In, Hot/Cold Wells	_____	_____	_____
89 Food Shield, Adjustable	_____	_____	_____
90 Existing Refrigeration Rack	_____	_____	_____
91 Pos / Register	_____	_____	_____
92 Service Counter & Base	_____	_____	_____
93 Soda Dispenser	_____	_____	_____
94 Undercounter Bib Rack	_____	_____	_____
95 Airpot Coffee Brewer	_____	_____	_____
96 Table, Enclosed Base, Sliding Doors	_____	_____	_____
97 St. St. Wall Cabinet	_____	_____	_____
98 Display Case, Refrigerated	_____	_____	_____
99 Table, Enclosed Base, Sliding Doors	_____	_____	_____
100 Existing Warmer	_____	_____	_____
101 Refrigerator, Reach-In	_____	_____	_____
102 Portable Ice Cart	_____	_____	_____
108 Field Erection Labor (1-102)	_____	_____	_____
		Sales Tax	_____
		TOTAL BASE BID	_____

ALTERNATE NO. 1

90 Existing Refrigeration Rack	_____	_____	_____
--------------------------------	-------	-------	-------

103 Existing Walk In Ref/Fzr Complex	_____	_____	_____
104 Remote Refrigeration System	_____	_____	_____
105 Freezer Blower Coil	_____	_____	_____
105.1 Heat Tape	_____	_____	_____
106 Refrigerator Blower Coil	_____	_____	_____
107 Refrigerator Blower Coil	_____	_____	_____
108 Field Erection Labor Alt No. 1			_____
		Sales Tax	_____
		Alternate No. 1 Total	_____

END OF SECTION

SECTION 20 0500 - MECHANICAL 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 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; www.aabc.com.
 2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 4. ABMA - American Boiler Manufacturers Association; www.abma.com.
 5. AGA - American Gas Association; www.aga.org.
 6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 7. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 8. ANSI - American National Standards Institute; www.ansi.org.
 9. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.

10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
 11. ASSE - American Society of Sanitary Engineering; www.asse-plumbing.org.
 12. ASTM - ASTM International; www.astm.org.
 13. AWS - American Welding Society; www.aws.org.
 14. AWWA - American Water Works Association; www.awwa.org.
 15. CDA - Copper Development Association; www.copper.org.
 16. CGA - Compressed Gas Association; www.cganet.com.
 17. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
 18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
 19. CSI - Construction Specifications Institute (The); www.csiresources.org.
 20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
 21. FM Approvals - FM Approvals LLC; www.fmglobal.com.
 22. HI - Hydraulic Institute; www.pumps.org.
 23. ICC - International Code Council; www.iccsafe.org.
 24. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
 25. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.okstate.edu.
 26. Intertek - Intertek Group; (Formerly: ETL SEMCO; Intertek Testing Service NA); www.intertek.com.
 27. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry Inc.; www.mss-hq.org.
 28. NADCA - National Air Duct Cleaners Association; www.nadca.com.
 29. NAIMA - North American Insulation Manufacturers Association; www.naima.org.
 30. NEBB - National Environmental Balancing Bureau; www.nebb.org.
 31. NECA - National Electrical Contractors Association; www.necanet.org.
 32. NEMA - National Electrical Manufacturers Association; www.nema.org.
 33. NETA - InterNational Electrical Testing Association; www.netaworld.org.
 34. NFPA - National Fire Protection Association; www.nfpa.org.
 35. NSF - NSF International; www.nsf.org.
 36. NSPE - National Society of Professional Engineers; www.nspe.org.
 37. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
 38. STI - Steel Tank Institute; www.steeltank.com.
 39. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.tema.org.
 40. UL - Underwriters Laboratories Inc.; www.ul.com.
 41. USGBC - U.S. Green Building Council; www.usgbc.org.
- 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 ACTION SUBMITTALS

- A. Submit for review in compliance with Division 01.
- B. 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. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned "Rejected". Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
- D. 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. 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 included with the submittal for approval.

1.12 INFORMATIONAL SUBMITTALS

- A. Shop Drawings:
 - 1. Prepare shop drawings to scale for the Architect/Engineer for review.
 - 2. 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.
 - 3. 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.

- a. 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.
 - b. Contractor is responsible for:
 - 1) Dimensions, which shall be confirmed and correlated at the job site.
 - 2) Fabrication processes and techniques of construction.
 - 3) Quantities.
 - 4) Coordination of Contractor's work with all other trades.
 - 5) Satisfactory performance of Contractor's work.
 - 6) Temporary aspects of the construction process.
- B. Coordination Drawings:
- 1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Instructional Manuals:
- 1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
 - 2. 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.
 - 3. Format: Submit operation and maintenance manuals in the following format:
 - a. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
 - 1) Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
 - 2) Enable inserted reviewer comments on draft submittals.
 - 4. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:
 - a. Routine maintenance procedures.
 - b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
 - c. Trouble-shooting procedures.
 - d. Contractor's telephone numbers for warranty repair service.
 - e. Submittals.
 - f. Recommended spare parts list.
 - g. Names and telephone numbers of major material suppliers and subcontractors.
 - h. System schematic drawings.
- B. Record Drawings:
- 1. Submit record drawings in compliance with Division 01.
 - 2. 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.

3. 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.

C. Warranties:

1. 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.
2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

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. Demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include items such as, but not limited to, existing piping, pumps, ductwork, supports, and equipment where such items are not required for the proper operation of the modified system.
- B. Include draining of piping systems where required for demolition, modification of, or connection to existing systems.

- C. 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.
- D. 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.
 - 1. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived.
 - 2. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner will move and store these materials.
 - 3. 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.
- E. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.
- F. Clean and flush the interior and exterior of existing relocated equipment and its related piping, valves, and accessories that are to be reused of mud, debris, pipe dope, oils, welding slag, loose mill scale, rust, and other extraneous material so that the existing equipment and accessories can be repainted and repaired as required for the proper operation and performance of the relocated equipment.
- G. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling, or at mains.
- H. 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 TEMPORARY SERVICES

- A. Provide temporary service as described in Division 01.

3.03 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.

3.04 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. Heat Pump Loop Water Systems.
 - 4. Domestic Water Booster Systems.

5. Domestic Hot Water Heaters.
 6. Domestic Hot Water Mixing Stations.
 7. Chemical Treatment Systems.
 8. Energy Recovery Systems.
 9. Temperature Controls.
 10. Building Automation System.
 11. 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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SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

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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, sheet metal 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, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and 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.
 - 5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
 - 6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.
- G. The following are industry abbreviations for rubber materials:
 - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 2. NBR: Acrylonitrile-butadiene rubber.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Escutcheons.

1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.06 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 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.
- F. Duct Joint and Seam Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D9.1, "Sheet Metal Welding Code."
- G. Structural 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. AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- H. 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."
- I. Soldering: Qualify processes and operators according to AWS B2.3/2.3M, "Specification for Soldering Procedure and Performance Qualification."
- J. 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.
 - 3. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and qualified to join fiberglass piping with manufacturer-recommended adhesive.

1.07 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.

1.08 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. General: Pipe thread compounds for the fluid service compatible with piping materials provided.
- B. Potable Water Service and Similar Applications: Compounds acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.
- C. Galvanized Steel: Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds to coat raw carbon steel surfaces, in lieu of subsequent painting. Compounds containing lead are prohibited.
 1. Manufacturers:
 - a. Carboline "Carbo-Zinc 12."
 - b. Tnemec.
 - c. Koppers.
- D. Steam and Steam Condensate: Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures.
 1. Manufacturers:
 - a. Cameron; A Schlumberger Company; Key "Graphite Paste."
 - b. Other approved.
- E. Natural Gas System: Use either of the following:
 1. Tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for threaded joints.
 - a. Manufacturers:

- 1) Cadillac Plastic.
 - 2) Permacel.
 - 3) Other approved.
2. Lead-free pipe thread compounds suitable for service.
 - a. Manufacturers:
 - 1) HCC Holdings, Inc.; Hercules Pro Dope.
 - 2) Mill-Rose Company (The); Clean-Fit Products; Blue Monster Thread Sealant.
 - 3) Oatey; Great Blue Pipe Joint Compound.
 - 4) RectorSeal LLC: A CSW Industrials Company; No. 5, No.5 Special, and No. 5 Sub-Zero Pipe Thread Sealants.

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. GF Piping Systems; George Fischer Central Plastics.
 - 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 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. ASC Engineered Solutions; 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 interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless 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. Water Stop: Cast or ductile-iron; fabricated steel; PVC; or rotationally molded HDPE pipe; with plain ends and integral water stop, unless otherwise indicated.
 - 1. Manufacturers:
 - a. Advance Products & Systems, Inc.; Infinity and Gal-Vo-Plast Sleeves.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.

2.09 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 PIPING CONCEALMENT SYSTEM

- A. Manufacturers:
 - 1. ARSCO Manufacturing Company.
 - 2. JG Innovations Inc.
- B. Description: Modular system of support brackets and covers made to protect piping.
- C. Brackets: Glass-reinforced nylon.
- D. Covers: Galvanized steel sections of length, shape, and size required for size and routing of piping.

2.14 PIPE PENETRATION ASSEMBLIES

- A. Contractor may choose from one of the following:
- B. Pipe Roof Penetration Enclosures
 - 1. Manufacturers:
 - a. Pate Company (The); pca Series.
 - b. Portal Plus, Inc.
 - c. Thybar Corporation; Thycurb.
 - 2. Prefabricated roof curb with:
 - a. Minimum 18 gage welded galvanized steel construction.
 - b. Integral base plate.
 - c. Factory installed insect and decay resistant wood nailer.
 - d. EPDM compression molded rubber cap for single or multiple pipes as required. Quantity of molder rubber caps shall be sufficient for no more than one pipe or conduit per cap.
 - e. Stainless steel draw-band clamps.
- C. Pipe Roof Penetration Hood Assembly
 - 1. Manufacturers:
 - a. Pate Company (The); pca Series.
 - 2. Heavy gage aluminum construction.
 - 3. Removable top cover.
 - 4. Fully insulated aluminum mounting base to isolate hood from galvanized curb.
 - 5. Includes prefabricated roof curb with:
 - a. Minimum 18 gage welded galvanized steel construction.
 - b. Integral base plate.
 - c. Factory installed insect and decay resistant wood nailer.

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.
 - 1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.
- M. Slope piping and arrange systems to drain at low points.
- N. Slope horizontal piping containing non-condensable 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/gypsum-board 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.
 1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
 2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.
- LL. 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.
- MM. Verify final equipment locations for roughing-in.
- NN. 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. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- Z. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.
- AA. 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. 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 INSTALLATION OF PIPE CONCEALMENT SYSTEM

- A. Install cover system, brackets, and cover components for piping according to manufacturer's "Installation Manual."

3.07 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.

3.08 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.

3.09 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.
 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.

3.10 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.

3.11 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.

3.12 JACKING OF PIPE

- A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 FLASHING

- A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.18 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.

3.19 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.

3.20 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, steam, condensate 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

TMP Architecture, Inc.
Peter Basso Associates, Inc.

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SECTION 20 0529 - HANGERS AND SUPPORTS

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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 20 Section "Mechanical General Requirements."
 3. Division 20 Section "Basic Mechanical Materials and Methods."
 4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
 5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
 6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
 7. Division 23 Section(s) "Metal Ducts" for duct hangers and support.

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 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel pipe hangers and supports.
 - 2. Thermal-hanger shield inserts.

1.05 INFORMATIONAL SUBMITTALS

- A. 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.

1.06 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, Selection, Application, and Installation.

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-58, 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; ASC Engineered Solutions.
 - 2. B-Line by Eaton.
 - 3. Carpenter & Paterson, Inc.
 - 4. Hilti USA.
 - 5. nVent Electric plc; CADDY.
 - 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-58, 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; Anvil-Strut; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. nVent Electrical plc; ERISTRUT Div.
 4. Power-Strut; a part of Atkore International.
 5. Unistrut; a part of Atkore International.
 6. 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; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. nVent Electric plc; CADDY.
 5. PHD Manufacturing, Inc.
- B. Description: MSS SP-58, 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; ASC Engineered Solutions.
 2. B-Line by Eaton.
 3. Carpenter & Paterson, Inc.
 4. nVent Electric plc; CADDY.
 5. PHD Manufacturing, Inc.
- B. Description: MSS SP-58, 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. Anvil; ASC Engineered Solutions.
 2. Armacell LLC; Insuguard.
 3. B-Line by Eaton; Snap'N Shield.
 4. Hydra-Zorb Company; Bronco.
- B. Description: Polypropylene copolymer protective shields with modular elements designed to snap directly onto strut channel, clevis hangers, or structural members. 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 4: 12 inches long.

2.09 THERMAL-HANGER SHIELDS

- A. Manufacturers:
 1. American Mechanical Insulation Sales Inc. (AMIS).
 2. B-Line by Eaton.
 3. nVent Electric plc; CADDY.
 4. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 5. Rilco Manufacturing Company, Inc.
 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.
 - b. Aeroflex USA, Inc.; Aerofix-U.
 - c. ZSi-Foster, Inc.; Cush-A-Therm.
 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 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.10 FASTENER SYSTEMS

- A. Post-Installed Anchors:

1. 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.
 - a. Manufacturers:
 - 1) B-Line by Eaton.
 - 2) DeWalt Engineered by Powers.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head.
 - 5) MKT Fastening, LLC.
2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.
 - a. UL Listed or FMG approved for fire sprinkler piping.
 - b. Available Sizes: For 1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes
 - c. Manufacturers:
 - 1) B-Line by Eaton; Rapid Rod Hangers.
 - 2) DeWalt Engineered by Powers; Snake+.

2.11 ROOF 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. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Conduit and Condensate Supports, and Rooftop Sleeper Support.
 - e. nVent Electric plc; CADDY.
 - f. 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. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Conduit and Condensate Supports.
 - e. nVent Electric plc; CADDY.
 - f. 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. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Water and Steam Supports.
 - e. nVent Electric plc; CADDY.
 - f. 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. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. nVent Electric plc; CADDY.
 - f. 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. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Gas and Mechanical Supports.
 - e. nVent Electric plc; CADDY.
 - f. 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. MIFAB, Inc.; C-Port.

- d. MIRO Industries; Water and Steam Supports.
 - e. nVent Electric plc; CADDY.
 - f. 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. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; Custom Design Products.
 - e. nVent Electric plc; CADDY.
 - f. 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. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries; HD and LD Mechanical Unit Supports.
 - e. nVent Electric plc; CADDY.
 - f. 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-58 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 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. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer's instructions to maintain listing.
 2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer's instructions to maintain listing.
- O. 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.
- P. Comply with MSS SP-58 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

- Q. 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-58. 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. Secure Type 40 shields to support elements in a manner that prevents movement and damage to insulation and jacket materials.
- G. 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.
- H. 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.
- I. 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.
- J. 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.
- K. Where necessary, brace piping and supports against reaction, sway and vibration.
- L. Do not hang piping from joist pans, floor decks, roof decks, equipment, ductwork, or other piping.
- M. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.
- N. 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.
- O. 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.

- P. 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.
- Q. 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.
- R. 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.
- S. 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.
- T. 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.
- U. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.
- V. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
- W. 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.
- X. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.
- Y. Building structure shall not be reinforced except as approved by the Architect in writing.
- Z. 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.
- AA. Support piping and equipment from concrete building frame, not from roof or floor slabs unless otherwise indicated.
- BB. 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.
- CC. 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.
- DD. 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.

- EE. Trapeze Pipe Hanger Installation: Comply with MSS SP-58. 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.
 - FF. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
 - GG. 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.
 - HH. 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.
 - II. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
 - JJ. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - KK. Install hangers and supports to allow controlled thermal 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.
 - LL. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - MM. 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.
 - NN. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - OO. 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.
 - PP. 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. 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.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22104G
PBA2023.0156.00

SECTION 20 0553 - MECHANICAL 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 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 1. Division 20 Section "Mechanical General Requirements."

1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

- A. Samples: For color, letter style, and graphic representation required for each identification material and device.
- B. Valve numbering scheme.

1.04 CLOSEOUT SUBMITTALS

- A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.05 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.

1.06 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.

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.

2.05 HAZARDOUS MATERIAL IDENTIFICATION DEVICES

- A. Standard: NFPA 704.
- B. Material: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive; or mounting screws.
- C. Size: Minimum 7-1/2 inches by 7-1/2 inches with 3-inch character height.
- D. Content: Appropriate for refrigerant.

2.06 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.

2.07 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.

2.08 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. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
 2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
 3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
 4. Fans, blowers, primary balancing dampers, and mixing boxes.
 5. 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 non-concealed 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 non-accessible 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.
 - d. Gas: 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 HAZARDOUS MATERIAL IDENTIFICATION DEVICES

- A. Mount to wall or door of room containing hazard. Indicate classification of refrigerant or other hazard.

3.08 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.09 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.11 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
Acid Waste	AW	Black on Yellow	Black
Acid Vent	AV	Black on Yellow	Black
Domestic Cold Water	CW	White on Green	Light Green
High Pressure Domestic Cold Water	HPCW	White on Green	Light Green
Non-Potable Cold Water	NPCW	Black on Yellow	
Domestic Hot Water	HW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water	HPHW	Black on Yellow	Dark Green
High Pressure Domestic Hot Water Return	HPHWR	Black on Yellow	Dark Green
Domestic Hot Water Return	HWR	Black on Yellow	Dark Green
Soft Cold Water	SCW	White on Green	Light Green
Soft Hot Water	SHW	White on Green	Dark Green
Soft Hot Water Return	SHWR	White on Green	Dark Green
Natural Gas	G	Black on Yellow	Yellow
Fuel Oil Supply	FOS	Black on Yellow	Yellow
Fuel Oil Return	FOR	Black on Yellow	Yellow
Compressed Air (90psig)	A(90psig)	Black on Yellow	Dark Blue
Compressed Air (25psig)	A	White on Green	Dark Blue
Laboratory Vacuum	LVAC	Black on Yellow	Unpainted
Carbon Dioxide	CO ₂	Black on Yellow	Unpainted
High Purity Water	DI	White on Green	White
Hot Water Htg. Supply	HWHS	Black on Yellow	Dark Blue
Hot Water Htg. Return	HWHR	Black on Yellow	Dark Blue
Terminal Unit Heating Sup.	THS	Black on Yellow	Dark Blue
Terminal Unit Heating Ret.	THR	Black on Yellow	Dark Blue
Animal Heating Supply	AHS	Black on Yellow	Dark Blue
Animal Heating Return	AHR	Black on Yellow	Dark Blue
Energy Recovery Loop Sup.	ERLS	Black on Yellow	Dark Blue
Energy Recovery Loop Ret.	ERLR	Black on Yellow	Dark Blue
Chilled Water Supply	CHWS	White on Green	Light Blue
Chilled Water Return	CHWR	White on Green	Light Blue
Condenser Water Supply	CWS	White on Green	Light Green
Condenser Water Return	CWR	White on Green	Light Green
Process Cooling Water Sup.	PCWS	White on Green	Light Green
Process Cooling Water Ret.	PCWR	White on Green	Light Green

<u>Pipe System Label</u>	<u>Drawing Abbrev.</u>	<u>Labels</u>	<u>Piping</u>
Refrigerant Liquid	RL	Black on Yellow	
Refrigerant Suction	RS	Black on Yellow	
Steam Condensate	LPC	Black on Yellow	Aluminum
Medium Pressure Steam Condensate	MPC	Black on Yellow	Aluminum
High Pressure Steam Condensate	HPC	Black on Yellow	Aluminum
Pumped Steam Condensate	PC	Black on Yellow	Aluminum
Medium Pressure Steam (60 psig)	MPS	Black on Yellow	Aluminum
High Pressure Steam,	HPS	Black on Yellow	Aluminum
Low Pressure Steam (5 psig)	LPS	Black on Yellow	Aluminum
Fire Protection	FP	White on Red	Bright Red
Medical Gases	Refer to Division 22 Section "Medical Gas Systems."		

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 Mechanical 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. PSK: Polypropylene, scrim, kraft paper.
- D. PVC: Polyvinyl Chloride.
- E. 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.
- B. Sanitary Waste Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1-1/2 inches thick.
- C. Hot Service Drains, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.
- D. Hot Service Vents, All Pipe Sizes: Glass-Fiber or Mineral Wool, Preformed Pipe Insulation, Type I or II: 1 inch thick.

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.
- B. Sanitary or Storm Piping Where Heat Tracing Is Installed, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 2 inches thick.
- C. Hot Service Drains, All Pipe Sizes: Glass-Fiber Pipe Insulation, Type I: 1 inch thick.
- D. Hot Service Vents, All Pipe Sizes: Mineral Wool Pipe Insulation, Type II: 1 inch thick.

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 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

- A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.09 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION

- A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe specialty.

- B. Steam Condensate Piping within Air Handling Units: Aluminum, Stucco Embossed: 0.016 inch thick.
- C. Piping Within Energy Recovery Units: Type 304 Stainless Steel, Smooth: 0.010 inch thick. Seams and joints calked with chemically resistant sealer.
- D. Steam Pressure Reducing Valves: Sound Barrier Jacketing: Smooth or stucco embossed.

1.10 ACTION 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.

1.11 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, 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.
- B. 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. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; 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. Johns Manville.
 - b. Owens Corning/Thermafiber.
 - c. Rock Wool Manufacturing Company; Delta PC and PF.
 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, or field-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article. Field-applied jacket requirements are specified in Part 2 "Field-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. Products: Subject to compliance with requirements, provide one of the products specified.
- a. CertainTeed Corp.; Duct Wrap.
 - b. Johns Manville; Microlite EQ.
 - c. Knauf Insulation; Duct Wrap.
 - d. Manson Insulation Inc.; Alley Wrap B.
 - 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. 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 EQUIPMENT 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. Aeroflex USA, Inc.; Aerocel Tube and Sheet.
 - b. Armacell LLC; AP Armaflex.
 - c. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.
- B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in 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.
- C. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. 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.; CrimpWrap.
 - b. Johns Manville; MicroFlex.
 - c. Knauf Insulation; Pipe and Tank Insulation.
 - d. Manson Insulation Inc.; AK Flex.
 - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.05 FIRE-RATED INSULATION SYSTEMS

- A. Grease Duct Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is tested according to ASTM E2336.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Morgan Advanced Materials; Thermal Ceramics; FireMaster FastWrap XL and Pyroscat XL.
 - b. 3M Fire Protection Products; Fire Barrier Duct Wrap 615+.
 - c. Unifrax Corporation; FyreWrap Max 2.0.
- B. Fire-Rated Plenum Wrap: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested, and designed to provide a single-layer, flexible enclosure around combustible items located within fire-rated return air plenums.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Unifrax Corporation; FyreWrap 0.5 Plenum Insulation.
 - b. 3M Fire Protection Products; Fire Barrier Plenum Wrap 5A+.
 - c. Morgan Advanced Materials; Thermal Ceramics; FireMaster PlenumWrap and PlenumWrap+.

2.06 INSULATING CEMENTS

- A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
 - 1. Products: Subject to compliance with requirements, provide one of the 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.

2.07 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. Aeroflex USA, Inc.; Aeroseal and Aeroseal LVOC.
 - b. Armacell LCC; 520 Adhesive.
 - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
- C. 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. Johns Manville Industrial Insulation; S-90/80.
 - d. Marathon Industries, Inc.; 225.
 - e. Mon-Eco Industries, Inc.; 22-25.
- D. 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.

2.08 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. Johns Manville Industrial Insulation; 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. Johns Manville Industrial Insulation; 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.

2.09 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.

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.
 - 4. PSK Jacket: Metalized polypropylene, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.11 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Vimasco Corporation; Elastafab 894.

- b. Or approved equal.
- B. Woven Glass-Fiber Fabric for Duct and Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Childers Products, H.B. Fuller Company; Chil-Glas No. 5.
 - b. Or approved equal.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
 - b. Vimasco Corporation; Elastafab 894.

2.12 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.
 - b. Lewco Products.
 - c. Mid-Mountain.
 - d. TCI.

2.13 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
- C. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
- D. 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. Airex Manufacturing, Inc.; E-Flex Guard.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. Speedline Corporation; SmokeSafe.
 - 2. Adhesive: As recommended by jacket material manufacturer.
 - 3. Color: White.
 - 4. Factory-fabricated tank heads and tank side panels.
- E. 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. Airex Manufacturing, Inc.
 - b. Johns Manville; Zeston and Ceel-Co.
 - c. P.I.C. Plastics, Inc.; FG Series.
 - d. Proto PVC Corporation; LoSmoke.
 - e. 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.
- F. Metal Jacket:
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. PABCO-Childers Metals; Johns Manville Industrial Insulation; 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.
- G. Self-Adhesive Outdoor Jacket for Piping: Laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a fabric reinforced insulation cladding with natural aluminum stucco embossed facing.
 - 1. Products: Subject to compliance with requirements, provide one of the products specified.
 - a. 3M VentureClad; 1579GCW-E.
 - b. Polyguard; Alumaguard.
- H. Self-Adhesive Outdoor Jacket for Ductwork: 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. 3M VentureClad.
- I. 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; Johns Manville Industrial Insulation; 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.

2.14 REMOVABLE AND REUSABLE INSULATION COVERS

- A. Flexible Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of 4 inches of high temperature fiberglass insulation compressed between Teflon impregnated fiberglass inner and outer facing stitched with fiberglass core Teflon thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.
 - 1. Fabricators:
 - a. Apex Energy & Environmental Products Inc.
 - b. 3i Supply Co.; K-Tex.
 - c. Valley Group of Companies.
- B. Rigid Style: Custom fabricated composite jackets for valves, flanges, and expansion joints consisting of rigid foam insulation with silicone impregnated fiberglass outer facing stitched with fiberglass thread and secured with Velcro fasteners and double D-ring cinching. Service temperature range of minus 40 deg F to 500 deg F.
 - 1. Fabricators:
 - a. Valley Group of Companies.

2.15 REMOVABLE AND REUSABLE ACOUSTIC INSULATION COVERS

- A. Flexible Style: Custom fabricated composite jackets consisting of:
 - 1. Two inches of high temperature, high density, needled fiberglass mat insulation.
 - 2. High density mass loaded vinyl
 - 3. Teflon impregnated fiberglass inner and outer facing with double sewn and bonded seams.
 - 4. Extended Velcro flap on closing seams.
 - 5. Stainless steel lacing hardware with wire twist fastener.
 - 6. Include aluminum nameplate having embossed lettering with tag description.
- B. Manufacturer:
 - 1. Shannon Enterprises of W.N.Y. Inc.; INSULTECH; LT450A-TT Series.

2.16 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 728 Cold Seal ASJ or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 - 2. Width: 3 inches.

3. Thickness: 9 mils.
4. Adhesion: 70 ounces force/inch in width.
5. Elongation: 3 percent.
6. Tensile Strength: 45 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 rubber or acrylic adhesive; complying with ASTM C 1136 and UL listed.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 491 FSK or 791 Cold Seal Acrylic FSK, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 6 mils.
 4. Adhesion (Rubber Adhesive): 100 ounces force/inch in width.
 5. Adhesion (Acrylic Adhesive): 90 ounces force/inch in width.
 6. Elongation: 3 percent.
 7. Tensile Strength: 35 lbf/inch in width.
 8. 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. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 370 White PVC tape, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 2 inches.
 3. Thickness: 5 mils.
 4. Adhesion: 20 ounces force/inch in width.
 5. Elongation: 500 percent.
 6. Tensile Strength: 15 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide Ideal Tape Co., Inc., an American Biltrite company; 488 AWF rubber adhesive or 788 Cold Seal acrylic adhesive, or comparable products by one of the following:
 - a. Avery Dennison Corporation, Specialty Tapes Division.
 - b. 3M Venture Tape.
 2. Width: 3 inches.
 3. Thickness: 3.0 to 4.0 mils.
 4. Adhesion (Rubber Adhesive): 90 ounces force/inch in width.
 5. Adhesion (Acrylic Adhesive): 50 ounces force/inch in width.
 6. Elongation: 3 percent.
 7. Tensile Strength: 14 to 20 lbf/inch in width.

2.17 SECUREMENTS

- A. Bands:
 1. Products: Subject to compliance with requirements, provide one of the products specified.

- a. PABCO-Childers Metals; Johns Manville Industrial Insulation; 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; Johns Manville Industrial Insulation.

d. RPR Products, Inc.

2.18 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. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 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. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. 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 through walls and partitions as detailed.
- 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 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.

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. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
 3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
 4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
 1. Install 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. 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.
2. 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.
3. 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.
4. 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.
5. 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 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 3. Protect exposed corners with secured corner angles.
 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
 - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
 - d. Do not over compress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
 7. Stagger joints between insulation layers at least 3 inches.
 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
 2. Seal longitudinal seams and end joints.

- C. Insulation Installation on Pumps:
 - 1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
 - 2. Fabricate boxes from galvanized steel, at least 0.040 inch thick.
 - 3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.10 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 glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
 - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
 - 2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
 - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- C. 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.
- D. 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.
- E. Where self-adhesive jackets are indicated, install according to manufacturer's instructions and details on the drawings. Overlap seams arranged to shed water.
- F. Where sound barrier jackets are indicated, install in accordance with manufacturer's instructions.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, install two layers in strict accordance with manufacturer's instructions, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors in strict accordance with insulation manufacturer's to achieve same fire rating as duct.
- C. Maintain a copy of insulation manufacturer's installation instructions on site for Code Official.
- D. Where fire-rated plenum wrap system is indicated, secure to system piping to maintain a continuous UL-listed fire rating.
- E. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Through-Penetration Firestop Systems."

3.12 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

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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 21 Fire-Suppression Piping and Fire Pump Sections for fire-protection valves.
 - 3. Division 22 Piping Sections for specialty valves applicable to those Sections only.
 - 4. Division 23 Section "General-Duty Valves for HVAC" for HVAC.
 - 5. 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 ACTION 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, 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 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.
 - F. 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.
 - G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
 - 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. Kitz Corporation; Kitz Valves.
 - d. Milwaukee Valve Company; Model UPBA100S/150S.
 - e. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.
 - f. 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-A Series.
 - b. Hammond Valve.

- c. Kitz Corporation; Kitz Valves.
- d. Milwaukee Valve Company; UPBA400S/450S.
- e. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.
- f. Watts Water Technologies, Inc.; Series LFB6080G2/LFB6081G2.

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. 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. ASC Engineered Products.
 - b. NIBCO INC.; Model GD-4765-3/5.
 - c. 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 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.

2.06 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.

2.07 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. 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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SECTION 22 1116 - DOMESTIC WATER PIPING

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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 22 Section "General-Duty Valves for Plumbing."
 5. 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 DEFINITIONS

- A. PEX: Crosslinked polyethylene plastic.

1.04 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. Exception: PEX plastic piping insert fittings specified are limited to 100 psig.

1.05 SYSTEMS DESCRIPTION

- A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.
- B. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 22 Section "Facility Water Distribution."
- C. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Hot-Water-Piping, Balancing Duty: Calibrated balancing valves.
 - 2. Drain Duty: Hose-end drain valves.
 - 3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
 - 4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.
- D. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.06 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings

1.07 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Fire-suppression-water piping.
 - 2. Domestic water piping.
 - 3. Compressed air piping.
 - 4. HVAC hydronic piping.

1.08 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.09 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 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water piping and components. Include marking "NSF-pw" on piping.
- D. 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.
- E. 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.

1.10 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

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. ASC Engineered Solutions; Gruvlok; Fig. 64 CTS SlideLOK.
 - b. 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. Mueller Industries, Inc.; Streamline PRS.
 - d. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
 - e. Apollo Valves; by Conbraco Industries; ApolloXpress.
 - f. ASC Engineered Solutions; Anvil Press.
 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.

2.04 PEX PIPE AND FITTINGS

- A. PEX Distribution System: ASTM F 876 and ASTM F 877, SDR 9 tubing.
 - 1. Fittings for PEX Tube: ASTM F 1807, metal-insert type with copper crimp rings and matching PEX tube dimensions; or plastic-insert type cold expansion fittings and corresponding rings, material meeting requirements of ASTM F 1960.
 - 2. Manifold: Multiple-outlet, plastic or corrosion-resistant-metal assembly complying with ASTM F 877 and with plastic or corrosion-resistant-metal valve for each outlet.

2.05 VALVES

- A. General-duty plumbing valves; and drain valves are specified in Division 22 Section "Plumbing Valves."
- B. Balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."

PART 3 EXECUTION

3.01 EXCAVATION

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

3.02 PIPING SYSTEM INSTALLATION

- A. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. Install under-building-slab copper tubing according to Copper Development Association's "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.
- C. Install 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."
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure gages are specified in Division 20 Section "Meters and Gages," and strainers are specified in Division 22 Section "Domestic Water Piping Specialties."
- F. 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.
- G. 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.
- H. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 22 Section "Domestic Water Piping Specialties."
- I. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 22 Section "Domestic Water Piping Specialties."
- J. Install domestic water piping level without pitch and plumb.

3.03 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- B. PEX Piping Joints: Join according to ASTM F 1807.

3.04 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.
 - 7. NPS 6: 12 feet with 3/4-inch rod.
 - 8. NPS 8 to NPS 12: 12 feet with 7/8-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.
 - 6. NPS 6: 10 feet with 5/8-inch rod.
 - 7. NPS 8: 10 feet with 3/4-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. Install hangers for Schedule 10 stainless steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2: 84 inches with 3/8-inch rod.
 - 2. NPS 2-1/2: 84 inches with 1/2-inch rod.

3. NPS 3: 96 inches with 1/2-inch rod.
4. NPS 4: 10 feet with 5/8-inch rod.
5. NPS 6: 11 feet with 3/4-inch rod.
6. NPS 8: 12 feet with 7/8-inch rod.
7. NPS 10 to NPS 12: 14 feet with 7/8-inch rod.
- L. Install supports for vertical Schedule 10 stainless steel piping every 15 feet.
- M. 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 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. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Plumbing Fixtures."
 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
 3. Booster Pumps: Cold-water suction and discharge piping.
 4. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

3.06 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.

3.07 ADJUSTING

- A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.08 CLEANING AND DISINFECTION

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- B. Clean and disinfect potable and non-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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SECTION 22 1119 - DOMESTIC WATER 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."
 - 3. Division 22 Section "Domestic Water Piping " for water meters.

1.02 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Flow Reports and Settings: For calibrated balancing valves.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.06 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 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type 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.; Watts Regulator Co.
 - d. Zurn Plumbing Products Group; Wilkins Div.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Chrome plated.
- B. 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 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.

2.02 BACKFLOW PREVENTERS

- 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: NPS 1/2 or NPS 3/4.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Chrome plated.
- 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. Beverage-Dispensing-Equipment Backflow Preventers:
 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.
 - c. Zurn Plumbing Products Group; Wilkins Div.
 2. Standard: ASSE 1022.
 3. Operation: Continuous-pressure applications.
 4. Size: NPS 1/4 or NPS 3/8.
 5. Body: Stainless steel or Acetal plastic.
 6. End Connections: Threaded.

2.03 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.
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.
- 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.
 - 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.04 TEMPERATURE-ACTUATED WATER MIXING VALVES

- A. Water-Temperature Limiting Devices:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Controls; Morris Group International; ST70.
 - b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
 - c. Bradley Corporation.
 - d. Lawler Manufacturing Company, Inc.
 - e. Leonard Valve Company; Series 170-LF and 270-LF.
 - f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
 - g. Watts Water Technologies, Inc.; Watts Regulator Co.
 - h. 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: Chrome plated

2.05 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

- 1. Manufacturers:
 - a. Apollo Valves; Conbraco Industries, Inc.
 - b. Keckley Company.
 - c. Metraflex Company.
 - d. Mueller Steam Specialty; a Watts Brand.
 - e. NIBCO, Inc.
 - f. Titan Flow Control, Inc.
 - g. Watts.
 - h. Yarway; Emerson Automation Solutions.
- 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.
- 7. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.033 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.045 inch.
- 8. Drain: Pipe plug.

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 3/8 minimum inlet.
- 6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents:

- 1. Body: Stainless steel.
- 2. Pressure Rating: 150-psig minimum pressure rating.
- 3. Float: Replaceable, corrosion-resistant metal.
- 4. Mechanism and Seat: Stainless steel.
- 5. Size: NPS 3/8 minimum inlet.
- 6. Inlet and Vent Outlet End Connections: Threaded.

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 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.
 4. Install strainer and soft-seated check valve upstream of backflow preventer. Exception: Fire protection backflow preventers.
- C. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Install Y-pattern strainers for water on supply side of pump.
- 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 LABELING AND IDENTIFYING**
- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Pressure vacuum breakers.
 2. Intermediate atmospheric-vent backflow preventers.
 3. Reduced-pressure-principle backflow preventers.
 4. Carbonated-beverage-machine backflow preventers.
 5. Dual-check-valve backflow preventers.
 6. Calibrated balancing valves.
 7. Primary, thermostatic, water mixing valves.
 8. Outlet boxes.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."
- 3.04 FIELD QUALITY CONTROL**
- A. Perform the following tests and prepare test reports:
1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves as follows:
 - 1. Set calibrated balancing valves at calculated presettings.
 - 2. Measure flow each station and adjust where necessary.
 - 3. Record settings and mark balancing devices.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

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TMP22104G
PBA2023.0156.00

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

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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".
 4. Division 22 Section "Sanitary Waste and Vent Piping" for piping outside building.

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 ACTION SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.

1.06 INFORMATIONAL SUBMITTALS

- A. Shop Drawings:
 - 1. Sovent Drainage System: Include plans, elevations, sections, and details.

1.07 CLOSEOUT SUBMITTALS

- A. Field quality-control inspection and test reports.

1.08 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.

1.09 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 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class.
- B. Pipe and Fittings: ASTM A 74, Extra-Heavy class.
- C. Gaskets: ASTM C 564, rubber.

2.03 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. MIFAB, Inc.
- e. Mission Rubber Company; a division of MCP Industries, Inc.
- f. Tyler Pipe; McWane Plumbing Group.
- g. Fernco Inc.
- 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.

2.04 STAINLESS-STEEL PIPE AND FITTINGS

- A. Manufacturer:
 - 1. Blucher-Josam.
- B. Pipe and Fittings: ASME A112.3.1, drainage pattern with socket and spigot ends.
- C. Gaskets: Lip seals shaped to fit socket groove, with plastic backup ring.
 - 1. Material: EPDM, unless NBR is indicated.

2.05 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.
- B. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Cellular-Core, Sewer and Drain Series, PVC Pipe: ASTM F 891, Series PS 100.
 - 1. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Series PS 100 sewer and drain pipe.

2.06 SPECIALTY PIPE FITTINGS

- A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Dallas Specialty & Mfg. Co.
 - b. Fernco, Inc.
 - c. Logan Clay Products Company (The).
 - d. Mission Rubber Co.
 - e. NDS, Inc.
 - f. Plastic Oddities, Inc.
 - 2. Sleeve Materials:
 - a. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Mission Rubber Co.

- C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.
 - 1. Manufacturers:
 - a. ANACO.
- D. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
 - 1. Manufacturers:
 - a. SIGMA Corp.

2.07 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Description: ASTM A 674 or AWWA C105, high-density, crosslaminated PE film of 0.004-inch or LLDPE film of 0.008-inch minimum thickness.
- B. Form: Sheet or tube.
- C. Color: Black or natural.

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. Sanitary sewer piping outside the building is specified in Division 22 Section "Sanitary Sewerage."
- C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
- D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
- E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.
- F. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside the building between wall and floor penetrations and connection to sanitary sewer piping outside the building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 1. Install encasement on piping according to ASTM A 674 or AWWA C105.
- G. 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."
- H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.
- I. 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.
- J. 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.
- K. 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.
- L. Install engineered soil and waste drainage and vent piping systems as follows:
1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- M. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- N. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- O. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- P. Install underground ABS soil and waste drainage piping according to ASTM D 2321.
- Q. 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 hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.
- F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in OD's.
 2. In Drainage Piping: Shielded, nonpressure transition couplings.
 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.

3.05 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 20 Section "Valves."

- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Install gate or full-port ball valve for piping NPS 2 and smaller.
 - 2. Install gate valve or butterfly valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
 - 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type, unless otherwise indicated.
 - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
 - 3. Install backwater valves in accessible locations.
 - 4. Backwater valves are specified in Division 22 Section "Drainage Piping Specialties."

3.06 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.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4: 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: 12 feet with 1/2-inch rod.
- H. Install supports for vertical steel piping every 15 feet.
- I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 2: 84 inches with 3/8-inch rod.
 - 2. NPS 3: 96 inches with 1/2-inch rod.
 - 3. NPS 4: 108 inches with 1/2-inch rod.
- J. Install supports for vertical stainless-steel piping every 10 feet.
- K. 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.
- L. Install supports for vertical copper tubing every 10 feet.
- M. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
 2. NPS 3: 48 inches with 1/2-inch rod.
 3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
- N. Alternate support for plastic piping: Continuous support 18 gauge v-shaped galvanized steel channel, maximum hanger spacing 8 feet.
- O. Install supports for vertical PVC piping every 48 inches.
- P. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.07 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.
- D. Connect force-main piping to the following:
 1. Sanitary Sewer: To exterior force main or sanitary manhole.
 2. Sewage Pumps: To sewage pump discharge.

3.08 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.09 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.
- E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PROTECTION

- A. Exposed Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

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."

1.02 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. PE: Polyethylene plastic.
- C. PP: Polypropylene plastic.
- D. PUR: Polyurethane plastic.
- E. PVC: Polyvinyl chloride plastic.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.

1.04 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.
- B. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.05 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.
 - D. Comply with ASPE/ANSI 45-2013 "Siphonic Roof Drainage" for siphonic roof drainage systems.
- 1.06 COORDINATION**
- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
 - B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.01 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 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.
 6. Wall Access: Round, nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

2.02 FLOOR DRAINS

- A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor's Closet) 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-B.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Specification Drainage Operation.
 2. Standard: ASME A112.6.7.
 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: Square, with vandal proof screws.
 12. Dimensions of Top or Strainer: 7 inch square.
 13. Top Loading Classification: Light Duty.
 14. Inlet Fitting: Gray iron, with spigot outlet.
 15. Trap-Seal Primer Valve Fitting:
 - a. Description: Cast iron, with spigot inlet and spigot outlet, and trap-seal primer valve connection.
 - b. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.03 FLOOR SINKS

A. Stainless-Steel Floor Sink Drains FS-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 3006-12.
 - d. Tyler Pipe; Wade Div.
 - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.6.7.
3. Outlet: Bottom unless otherwise noted.
4. Top or Strainer Material: Stainless steel.
5. Top Shape: Square.
6. Dimensions of Top or Strainer: 12 inch by 12 inch, 14 gage, Type 304 stainless steel ribbed, non-tilt loose set half grate with 1/2 inch square holes and perforated stainless steel sediment bucket.
7. Seepage Flange: Required.
8. Clamping Device: Required.
9. Trap-Seal Primer Valve Fitting:
 - a. Description: Cast iron, with spigot inlet and spigot outlet, and trap-seal primer valve connection.
 - b. Size: Same as floor drain outlet with NPS 1/2 side inlet.

2.04 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

B. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

2.05 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.

PART 3 EXECUTION

3.01 CONCRETE BASES

- A. Anchor interceptors to concrete bases.
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 19-inch centers around full perimeter of base.
 - 2. For installed equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 5. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."
 - 6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.02 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 flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- G. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.
- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install vent caps on each vent pipe passing through roof.
- K. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- M. 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.
- N. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
 - 1. Comply with requirements in Division 07 Section "Penetration Firestopping."

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. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.04 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.

3.05 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Solids interceptors.
 - 2. Grease interceptors.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 20 Section "Mechanical Identification."

3.06 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled grease removal devices and their installation, including piping and electrical connections, and to assist in testing.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.07 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.

3.08 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22104G
PBA2023.0156.00

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. Variable-air-volume systems.
 2. HVAC equipment quantitative-performance settings.
 3. Space pressurization testing and adjusting.
 4. Verifying that automatic control devices are functioning properly.
 5. 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. 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.
- K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- M. 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.
- N. TAB: Testing, adjusting, and balancing.
- O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- P. Test: A procedure to determine quantitative performance of systems or equipment.
- Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 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 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 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. Sample Report Forms: Submit two sets of sample TAB report forms.

1.05 CLOSEOUT SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- B. Warranties specified in this Section.

1.06 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

- B. Approved Balancing Agencies.
 - 1. The TAB firm selected shall be from the following list:
 - a. Airflow Testing Inc.; Lincoln Park, MI.
 - b. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
 - c. Ener-Tech Testing; Holly, MI.
 - d. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
 - e. International Test & Balance Inc.; Southfield, MI.
 - f. Quality Air Service; Portage, MI.
 - C. 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.
 - D. 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.
 - E. 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.
 - F. 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."
 - G. 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.
- 1.07 PROJECT CONDITIONS**
- A. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.08 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.

1.09 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 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. 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. 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 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.

3.08 PROCEDURES FOR SPACE PRESSURIZATION MEASUREMENTS AND ADJUSTMENTS

- A. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable safing, gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
- B. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
- C. Measure space pressure differential where pressure is used as the design criteria, and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
 - 1. For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
 - 2. For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
 - 3. Test room pressurization first, then zones, and finish with building pressurization.
- D. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.
- E. For spaces with pressurization being monitored and controlled automatically, observe and adjust the controls to achieve the desired set point.
 - 1. Compare the values of the measurements taken to the measured values of the control system instruments and report findings.
 - 2. Check the repeatability of the controls by successive tests designed to temporarily alter the ability to achieve space pressurization. Test overpressurization and underpressurization, and observe and report on the system's ability to revert to the set point.
 - 3. For spaces served by variable-air-volume supply and exhaust systems, measure space pressurization at indicated airflow and minimum airflow conditions.
- F. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
- G. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

3.09 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.

3.10 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- 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.

3.11 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. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft.
 - g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
- H. Air-Terminal-Device Reports:
 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. 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.

3.12 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 room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
 - c. Measure space pressure of at least 10 percent of locations.
 - d. Verify that balancing devices are marked with final balance position.
 - e. 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.

3.13 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 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 20 Section "Mechanical General Requirements."
 - 2. 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.

1.03 DEFINITIONS

- A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

- B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.
- 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.
- D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm.
- 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 ACTION SUBMITTALS

- A. Shop Drawings: Drawn to 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.

1.07 INFORMATIONAL SUBMITTALS

- A. 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.

1.08 CLOSEOUT SUBMITTALS

- A. Field quality-control test reports.

1.09 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, unless otherwise indicated.
- C. Duct Liner Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.10 COORDINATION

- A. 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.
- B. 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.
- C. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- D. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and No. 4 for exposed ducts.
- E. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- F. Reinforcement Shapes and Plates:
 1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
 2. Compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods:
 1. Galvanized Steel Duct: Galvanized steel, 3/8-inch minimum diameter.
 2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or less; 3/8-inch diameter for lengths longer than 36 inches.

2.03 ZERO-CLEARANCE PREFABRICATED RANGE HOOD EXHAUST DUCT

- A. Manufacturers:
 1. AMPCO; American Metal Products; Model IVSI-4ZC.
 2. Metal-Fab Inc.; Model IPIC-3G/4G.
 3. Schebler Chimney Systems; FyreGuard.
 4. Selkirk Inc.; Selkirk Metalbestos; ZeroClear Z3.
- B. Description: Factory-fabricated, -listed, and -labeled, double-wall ducts tested according to UL 1978 and rated for 500 deg F continuously, or 2000 deg F for 30 minutes; with positive or

negative duct pressure and complying with NFPA 211, and suitable for zero-clearance installations.

- C. Construction: Inner shell and outer jacket separated by a 3-inch to 4-inch annular space filled with high-temperature, ceramic-fiber insulation.
 - 1. Inner Shell: ASTM A 666, Type 304 stainless steel.
 - 2. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors. Seams shall be fully welded.
- D. Gaskets and Flanges: Ensure that gaskets and sealing materials are rated at 1500 deg F minimum.
- E. Hood Connectors: Constructed from same material as grease duct with internal or external continuously welded or brazed joints.
- F. Accessories: Tees, elbows, increasers, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly. Include unique components required to comply with NFPA 96 including cleanouts, transitions, adapters, and drain fittings.
- G. Grease Duct Supports: Construct duct bracing and supports from non-combustible material.
 - 1. Design bracing and supports to carry static and seismic loads within stress limitations of the International Building Code.
 - 2. Ensure that bolts, screws, rivets and other mechanical fasteners do not penetrate duct walls.

2.04 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.
 - 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.

Thickness Inches	Sound absorption coefficients at octave band center frequencies, Hz						NRC
	125	250	500	1000	2000	4000	
1	.08	.31	.59	.84	.91	.90	.70

2.05 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. 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.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
- E. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.
- F. 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.

2.06 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. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. 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. B-Line by Eaton; KwikWire.
 - b. Ductmate Industries, Inc.; Clutcher and EZ-Lock.
 - c. Duro Dyne Corp.; Dyna-Tite System.
 - d. 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.

2.07 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 by Eaton.
 - b. Eco Support Products.
 - c. MIFAB, Inc.; C-Port.
 - d. MIRO Industries.
 - e. Pentair Electrical & Fastening Solutions; CADDY.
 - f. 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.

2.08 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" unless otherwise indicated. For metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible", unless otherwise indicated.
 - 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 Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- 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. 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.

2.09 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. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- 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. Where double-wall rectangular duct is indicated:
 - 1. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
 - 2. 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.

2.10 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, 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.
- C. 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.
- D. 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.
 - 6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

- E. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)
 - 1. Fabricate according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" unless otherwise indicated.
- F. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)
 - 1. Geometry of fittings shall be according to SMACNA's HVAC Duct Construction Standards--Metal and Flexible unless otherwise indicated.
 - 2. Fittings shall be continuously welded, and shall be 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.
 - 3. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
- G. 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.
- H. Diverging-Branch Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- I. Fabricate elbows using die-formed, gored, pleated, or mitered construction. 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.

PART 3 EXECUTION

3.01 DUCTWORK APPLICATION SCHEDULE

- A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 DUCT INSTALLATION

- A. 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."
 1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.
- 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.

3.03 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.

3.04 RANGE HOOD EXHAUST DUCTS, SPECIAL INSTALLATION REQUIREMENTS

- A. Install ducts to allow for thermal expansion through 2000 deg F temperature range.
- B. Install ducts without dips or traps that may collect residues unless traps have continuous or automatic residue removal.
- C. Install access openings at each change in direction and at intervals defined by NFPA 96; locate on sides of duct a minimum of 1-1/2 inches from bottom; and fit with grease-tight covers of same material as duct.
- D. Install welded test ports or prefabricated test port section in the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- E. Do not penetrate fire-rated assemblies except as permitted by applicable building codes.
- F. Field Quality Control:
 - 1. Prior to use or concealment of any portion of grease duct system, perform leakage test in presence of Code Official.
 - 2. Light test or approved equivalent test method shall be performed to determine that welded and brazed joints are liquid tight.
 - 3. Lamp shall be not less than 100 watts and shall be open to emit light equally in all directions perpendicular to duct walls.

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 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

- C. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- 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

SECTION 23 3300 - DUCT ACCESSORIES

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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 ACTION 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.

1.04 INFORMATIONAL SUBMITTALS

- A. 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.
- B. 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.
- C. Source quality-control reports.

1.05 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.06 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.

1.07 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.
- C. Stainless Steel: ASTM A 480/A 480M, Types 304 and 316 as indicated.
- D. Extruded Aluminum: ASTM B 221, alloy 6063, temper T6.
- E. 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 PRESSURE RELIEF DOORS

- A. Manufacturers:
 1. KEES, Inc.
 2. Pottorff.
 3. Ruskin Company.

- B. Description: Designed to open automatically to prevent exploding or imploding ductwork in the event dampers close while fan is still operating. Doors open outward for positive pressure relief, or inward for negative pressure relief.
- C. Frame: 12 gage galvanized steel.
- D. Door: 12 gage galvanized steel.
- E. Seal: Polyurethane foam around door perimeter.
- F. Pressure Relief Setting: Factory set, field adjustable, minimum 1.0 inch wg above normal system pressure.
- G. Springs: Negator springs for door closure upon pressure relief and system shutdown.
- H. Temperature Limits: Minus 40 deg F minimum, and 120 deg F maximum.

2.04 LOW PRESSURE MANUAL VOLUME DAMPERS

- A. Manufacturers:
 - 1. American Warming and Ventilating; Mestek, Inc.
 - 2. Arrow United Industries; Mestek, Inc.
 - 3. Greenheck Fan Corporation.
 - 4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 - 5. Louvers and Dampers, Inc.; Mestek, Inc.
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Co., Inc.
 - 9. Young Regulator Co.
- 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.
- I. Positive-Locking Damper Hardware:
 - 1. Manufacturers:
 - a. Duro Dyne Corporation; Dyna-Click.
 - b. Rossi Hardware; Everlock.
 - c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
 - 2. Quadrant Material: 18 gage galvanized steel with 11 to 15 locking positions.
 - 3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
 - 4. Include center hole to suit damper operating-rod size.
 - 5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.05 LOW PRESSURE MANUAL VOLUME DAMPERS (STAINLESS STEEL)

- A. Manufacturers:
 - 1. American Warming and Ventilating; Mestek, Inc.
 - 2. Arrow United Industries; Mestek, Inc.
 - 3. Greenheck fan corporation.
 - 4. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 - 5. Louvers and Dampers, Inc.; Mestek, Inc
 - 6. Nailor Industries Inc.
 - 7. Ruskin Company.
 - 8. Vent Products Co., Inc.
 - 9. Young Regulator Co.
- 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, stainless 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, stainless sheet steel.
 - 3. Blade Axles: Stainless steel.
 - 4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
 - 5. Tie Bars and Brackets: Aluminum.
- 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.
- I. Positive-Locking Damper Hardware:
 1. Manufacturers:
 - a. Duro Dyne Corporation; Dyna-Click.
 - b. Rossi Hardware; Everlock.
 - c. Windgate Products Co., Inc.; Sure-Loc & Sure-Loc HD.
 2. Quadrant Material: 18 gage galvanized steel with 11 to 15 locking positions.
 3. Handle material: Die-cast aluminum or flame-retardant high-strength polymer.
 4. Include center hole to suit damper operating-rod size.
 5. Include elevated platform for insulated duct mounting on either round or rectangular duct.

2.06 MOTORIZED CONTROL DAMPERS

- A. Refer to Division 23 Section "Temperature Controls."

2.07 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 Sound Control; H-E-P Turning Vanes & Rail.
 - b. Ductmate Industries, Inc.
 - c. Duro Dyne Corporation.
 - d. Ward Industries, Inc.; a JCI Company.
- 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 JCI Company.

2.08 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.; Mestek, Inc.
 - b. Greenheck Gan Corporation.
 - 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.; a Masterduct Company.
 - 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.
- 2.09 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 minimum 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 20 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.
- 2.10 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE**
- A. Manufacturers:
 - 1. Flexmaster U.S.A.; a Masterduct Company; Type 1M Acoustical.
 - 2. Hart & Cooley.
 - 3. Thermaflex; part of the Flexible Technologies Group.
 - 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: UL 181, Class 1, 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	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
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	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
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	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
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.

2.11 FLEXIBLE DUCT ELBOW SUPPORTS

- A. Manufacturer:
1. Titus; Air Distribution Technologies, Inc.; a JCI Company; FlexRight.
 2. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
 3. Hart and Cooley, Inc.; 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.

2.12 DUCT ACCESSORY HARDWARE

- A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.13 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 at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install stainless steel volume dampers in stainless steel ducts.
 - 3. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install fire dampers, combination fire and smoke dampers, and smoke dampers according to UL listing.
- G. Install duct silencers rigidly to ducts.
- H. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. On upstream side of duct coils.
 - 2. Upstream from duct filters.
 - 3. At outdoor-air intakes and mixed-air plenums.
 - 4. At drain pans.
 - 5. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
 - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
 - 7. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
 - 8. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. 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.
- K. Install pressure relief doors vertically and level in accordance with manufacturer's instructions, between the fan and first operable damper.
- L. Label access doors according to Division 20 Section "Mechanical Identification."
- M. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- N. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to low pressure ducts flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with plenum-rated draw bands.
- R. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.
- S. 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 dampers, combination fire and smoke dampers, 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

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TMP22104G
PBA2023.0156.00

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 01 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
 - 2. Division 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 ACTION 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.

1.03 INFORMATIONAL SUBMITTALS

- A. 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. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
 - 2. Nailor Industries, Inc.
 - 3. Price Industries.
 - 4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
 - 5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

- 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. Finish:
 - 1. Device Face and Visible Trim: Standard off white baked enamel finish unless noted otherwise.
 - 2. Device Interior Surfaces, Including Blank-Offs and Boots: 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.
2. ASTM - ASTM International; www.astm.org.
3. CSI - Construction Specifications Institute (The); www.csiresources.org.
4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.
 - a. NECA 1-2000, "Practices for Good Workmanship in Electrical Contracting (ANSI)."
8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; 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 complementary, 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 if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.
- 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: Avoid interference with the work of other trades. Remove and relocate 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. Comply with rules of local utility companies. 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 outlined 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 that exceed 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, apart from 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, be standard products of manufacturers regularly engaged in the production of electrical equipment and 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 the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included 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 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 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 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 related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.
 - 1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.
- 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 otherwise, removed materials shall not be reused in the work.
 - 1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
 - 2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.
 - 3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived 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, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.
- E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. 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 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 specifically indicated on the drawings or approved by the Architect/Engineer.
- H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, and reconditioned suitable for satisfactory operation and appearance.

3.03 INSTALLATION OF EQUIPMENT

- A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.
- B. Device Location:
 - 1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10' radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

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 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 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, following 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 before 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. Upon 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 additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.
- B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, V4000 wiremold, and fittings, fire alarm audible/visual notification appliance and visual notification appliance, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

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

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TMP22104G
PBA2023.0156.00

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 ACTION SUBMITTALS

- A. Submit letter of compliance (intent) for copper building wire.
- B. Provide product data for the following:
 - 1. Metal-Clad Cable, Type MC

1.04 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Test Reports.

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.

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 120V control circuits.

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.

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. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- H. Provide a separate neutral conductor for each circuit unless multi-wire branch circuits are specifically indicated on the drawings.
- I. 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.
- J. Type MC cable shall be supported and secured at intervals not exceeding 4'-0" in new construction.
- K. MC cable shall not be used for home runs to receptacle or distribution panels.
- L. Where MC cable is permitted by the specifications, MC cable shall not be bundled.
- M. 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.
- N. Do not route conductors across roof without prior approval from engineer.
- O. Install and terminate power cable for variable frequency- controlled motors according to cable manufacturer's recommendations.

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 piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger only for taps to existing feeders. Do not use piercing connectors in new construction.
- H. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
- I. 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.
- J. Provide lugs suitable for bussing and conductor material used.
- K. Use appropriately sized compression pin adapters to make terminations at equipment where equipment lugs cannot accommodate conductors that are oversized for voltage drop or similar conditions.

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 insulation resistance test on each conductor with respect to ground and adjacent conductors. Applied potential to be 1000 volts dc for 1 minute.
 - b. Perform continuity test to insure proper cable connection.
 - 4. Test Values
 - a. Minimum insulation resistance values shall be not less than fifty mega-ohms.
- 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 0526 - GROUNDING AND BONDING

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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 grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. Related Sections include the following:
1. Division 26 Section "Electrical General Requirements".
 2. Division 26 Section "Conductors and Cables".

1.03 REFERENCES

- A. ASTM B 3: Specification for Soft or Annealed Copper Wire.
- B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
- C. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.
- D. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- E. IEEE 142: Grounding of Industrial and Commercial Power Systems.
- F. IEEE C2: National Electrical Safety Code.
- G. NETA MTS – 2001: Maintenance Testing Specifications.
- H. NFPA 70: National Electrical Code.
- I. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.
- J. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.
- K. UL 467: Grounding and Bonding Equipment.
- L. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.04 ACTION SUBMITTALS

- A. Product Data: For the following:

1. Ground rods.
2. Exothermic Connectors
3. Compression-type connectors.

1.05 INFORMATIONAL SUBMITTALS

- A. Field Quality Control Test Reports: Submit written test reports to include 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.
 4. Indicate overall system resistance to ground.
 5. Indicate overall Telecommunications system resistance to ground.

1.06 CLOSEOUT SUBMITTALS

- A. Project Record Documents
1. Submit under provisions of Division 26 "Electrical General Requirements".
 2. Accurately record actual locations of grounding electrodes and connections to building steel.

1.07 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. Comply with UL 467.
- B. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- C. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- D. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".
- E. Comply with ANSI/IEEE 1100 -1992 "Powering and Grounding Sensitive Electronic Equipment".

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Grounding Conductors and Cables:
 - a. Refer to Division 26 Section "Conductors and Cables".
 2. Mechanical Connectors:
 - a. American Electric-Blackburn.
 - b. Burndy.
 - c. Chance/Hubbell.
 3. Compression-type Connectors:
 - a. Burndy HyGround
 - b. Blackburn EZ Ground.
 - c. Panduit.

2.02 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Conductors and Cables."
- B. Equipment Grounding Conductors: Insulated with green-colored insulation.
- C. Grounding Electrode Conductors: Stranded cable.
- D. Bare Copper Conductors: Comply with the following:
1. Solid Conductors: ASTM B 3.

2. Assembly of Stranded Conductors: ASTM B 8.
- E. Copper Bonding Conductors: As follows:
 1. Bonding Conductor: Stranded copper conductor; size per the NEC.
 2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.
- F. Electrical Grounding Busbar
 1. 24" (min) x 2" x 1/4" tin plated, copper busbar with two rows of 1/4" x 20 tapped holes 1" on center.

2.03 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.
- C. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

PART 3 EXECUTION

3.01 EQUIPMENT GROUNDING

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. In raceways, use insulated equipment grounding conductors. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
 1. Where existing branch circuits are using conduit as equipment grounding conductor and are extended, provide grounding bushing on existing conduit and provide new equipment grounding conductor with new branch circuit.
- C. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.
- D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.
- E. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and anti-frost heating cable. Bond conductor to heater units, piping, connected equipment, and components.
- F. Verify specific equipment grounding requirements with the manufacturer's recommendations.

3.02 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.
 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Equipment Grounding Conductor Terminations
 1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
 2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- C. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding

bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

- D. Tighten screws and bolts for grounding and bonding 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.
- E. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Connections shall be non-reversible. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- F. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.03 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.
- B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors or non-reversing compression-type connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- C. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- D. Bond interior metal piping systems, including any portions of metal piping systems separated by non-metal piping, and metal air ducts to equipment grounding conductors of associated pumps, fans, blowers, electric heaters, and air cleaners. Use braided-type bonding straps.
- E. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.
- F. Bond together metal building elements not attached to grounded structure; bond to ground.
- G. Provide a flexible braid bonding jumper at each set of columns at expansion joints.

3.04 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.

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.
 2. Construction requirements for concrete bases.

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.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 ACTION SUBMITTALS

- A. Submit letter of compliance (intent) for hangers and supports for electrical 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.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

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. 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.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.03 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

- A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. B-Line by Eaton; Dura-Blok.
 2. MIRO Industries.
 3. Pentair Electrical & Fastening Solutions; Caddy Pyramid.
 4. Pipe Pier Support Systems; Pipe Piers.
- C. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.
- D. Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and conduit supports, for roof installation without membrane penetration.
 1. Bases: One or more adjustable compact stand bases.
 2. Vertical Members: Two or more protective-coated-steel channels.
 3. Horizontal Member: Protective-coated-steel channel.
 4. Supports: Standard strut clamps, hangers, and accessories.

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

- 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. Outdoors and indoor, dry, damp and wet locations: Galvanized Steel
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.
- G. Do not fasten supports to floor decks, roof decks, pipes, ducts, mechanical equipment, or 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 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.04 INSTALLATION OF ROOF MOUNTED SUPPORTS

- A. Install in accordance with manufacturer's instructions.
- B. If gravel top roof, gravel must be removed around and under support.
- C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.
- D. Utilize properly sized clamps and accessories to suit conduit sizes.
- E. Provide vertical steel channel members as required for elevated conduit supports where required for clearances, coordination with other roof mounted systems or derating.

3.05 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

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TMP22104G
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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.

1.03 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. PVC: Polyvinyl Chloride.
- I. HDPE: High Density Polyethylene.

1.04 ACTION 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: 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, set-screw or compression type.
 - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.02 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. Arnco 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.

2.03 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.

2.04 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.
- C. Floor Boxes: Cast metal, fully adjustable, rectangular.
- D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.
- F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
- G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.05 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.06 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. 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.

2.07 GROUT

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

PART 3 EXECUTION

3.01 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, Exterior Aboveground: NEMA 250, Type 3R.
- C. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- D. Minimum Raceway Size: 3/4-inch trade size.
- E. 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, steel or 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.
- F. Do not install aluminum conduits in contact with concrete.
- G. Install surface raceways only where indicated on Drawings.
- H. 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 three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
 - 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 rigid steel 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. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where conduits route through, to, or from a hazardous classified space (Class I or II), provide proper seal offs when exiting or entering the hazardous classified space.
 - 3. Where conduits pass between spaces that are maintained at two different vapor pressures.
 - 4. Where otherwise required by NFPA 70.
- W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.
- X. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semi-recessed 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.
- Y. 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.
- Z. 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.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. 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.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

- EE. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.
- FF. Install hinged-cover enclosures and cabinets plumb. Support at each corner.
- GG. Do not route feeders across roof unless approved in writing by Engineer.
- HH. Provide a pull box for each conduit run that exceeds 250 feet. Provide two pull boxes for runs that exceed 500 feet.
- II. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

3.03 SLEEVE INSTALLATION FOR ELECTRICAL 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. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.04 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.05 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."

3.06 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.

3.07 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

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 this Section.

1.02 SUMMARY

- A. This Section includes the following:
1. Identification for raceway and metal-clad cable.
 2. Warning labels and signs.
 3. Instruction signs.
 4. Equipment identification labels.
 5. Miscellaneous identification products.

1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

1.04 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.145.

1.05 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 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. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.04 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.05 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.

2.06 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.

2.07 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.
- B. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- C. 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.
- D. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.
- E. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.
- F. 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.
- G. 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 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.
- H. Instruction Signs:
 - 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- I. 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. Outdoor Equipment: Stenciled.

- c. 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. Electrical switchgear and switchboards.
 - d. Disconnect switches.
 - e. Remote-controlled switches, dimmer modules, and control devices.
 - f. Fire-alarm control panel and annunciators.
 - g. Monitoring and control equipment.
 - h. Breakers or switches at distribution panels.
- J. 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.
- 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. 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. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.
- 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 red colored band on each fire alarm conduit and junction box.
- Q. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22104G
PBA2023.0156.00

SECTION 26 0573 - OVERCURRENT DEVICE COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

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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.

1.02 SCOPE

- A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer or approved testing agency.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D prepared by the electrical equipment manufacturer.
- C. The scope of the studies shall include all new distribution equipment supplied by the equipment manufacturer under this contract as well as all directly affected existing distribution equipment at the customer facility.

1.03 REFERENCES

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
 4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
 5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations
- B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
 2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
 3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
 4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- C. The National Fire Protection Association (NFPA)
1. NFPA 70 -National Electrical Code, latest edition
 2. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition.

1.04 ACTION SUBMITTALS

- A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 INFORMATIONAL SUBMITTALS

- A. The results of the short-circuit, protective device coordination, and arc flash hazard analysis studies shall be summarized in a final report. Report shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections.
- B. The report shall include the following sections:
1. Executive Summary.
 2. Descriptions, purpose, basis and scope of the study.
 3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
 4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
 5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
 6. Details of the incident energy and flash protection boundary calculations.
 7. Recommendations for system improvements, where needed.
 8. One-line diagram.
- C. Arc flash labels shall be provided in full size representation in PDF format and submitted with the study.
- D. The report shall be signed and sealed by the Professional Engineer supervising the study.

1.06 QUALIFICATIONS

- A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or testing agency.
- C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.

- D. The equipment manufacturer shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 COMPUTER SOFTWARE PROGRAMS

- A. Computer Software Programs: Subject to compliance with requirements, provide products by one of the following:
1. EDSA Micro Corporation.
 2. SKM Systems Analysis, Inc.
 3. ESA Inc.
 4. CGI CYME.
 5. Operation Technology, Inc.

PART 2 PRODUCTS

2.01 STUDIES

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.
- B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D prepared by the equipment manufacturer.

2.02 DATA COLLECTION

- A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data to satisfy the study requirements.

2.03 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
1. Calculation methods and assumptions
 2. Selected base per unit quantities
 3. One-line diagram of the system being evaluated
 4. Source impedance data, including electric utility system and motor fault contribution characteristics
 5. Tabulations of calculated quantities
 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
1. Electric utility's supply termination point
 2. Incoming switchgear
 3. Unit substation primary and secondary terminals
 4. Low voltage switchgear

5. Motor control centers
 6. Standby generators and automatic transfer switches
 7. Branch circuit panelboards
 8. Other significant locations throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
 2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
 3. Notify design engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.04 PROTECTIVE DEVICE COORDINATION STUDY

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device
 2. Medium voltage equipment overcurrent relays
 3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
 4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
 6. Conductor damage curves
 7. Ground fault protective devices, as applicable
 8. Pertinent motor starting characteristics and motor damage points, where applicable
 9. Pertinent generator short-circuit decrement curve and generator damage point
 10. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. For emergency and standby distribution paths, provide selective coordination tables to demonstrate tested upstream/downstream breaker pairs selectively coordinate across the full range of over currents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associate with those fault currents.

2.05 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.

- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.
- C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal./cm².
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06 REPORT SECTIONS

- A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
 2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
 3. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance ($X''d$), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
 4. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.
- B. Short-Circuit Output Data shall include, but not be limited to the following reports:
1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Equivalent impedance
 2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. Calculated asymmetrical fault currents
 - 1) Based on fault point X/R ratio
 - 2) Based on calculated symmetrical value multiplied by 1.6
 - 3) Based on calculated symmetrical value multiplied by 2.7
 - e. Equivalent impedance
 3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
 - a. Voltage
 - b. Calculated symmetrical fault current magnitude and angle
 - c. Fault point X/R ratio
 - d. No AC Decrement (NACD) Ratio
 - e. Equivalent impedance
 - f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
 - g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis
- C. Recommended Protective Device Settings:
1. Phase and Ground Relays:
 - a. Current transformer ratio
 - b. Current setting
 - c. Time setting
 - d. Instantaneous setting
 - e. Recommendations on improved relaying systems, if applicable.
 2. Circuit Breakers:
 - a. Adjustable pickups and time delays (long time, short time, ground)

- b. Adjustable time-current characteristic
 - c. Adjustable instantaneous pickup
 - d. Recommendations on improved trip systems, if applicable.
- D. Incident energy and flash protection boundary calculations
 - 1. Arcing fault magnitude
 - 2. Protective device clearing time
 - 3. Duration of arc
 - 4. Arc flash boundary
 - 5. Working distance
 - 6. Incident energy
 - 7. Hazard Risk Category
 - 8. Recommendations for arc flash energy reduction

PART 3 EXECUTION

3.01 FIELD ADJUSTMENT

- A. The contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.
- B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- C. Notify design engineer in writing of any required major equipment modifications.

3.02 ARC FLASH WARNING LABELS

- A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- C. The label for equipment where arc incident energy is calculated shall include the following, at a minimum:
 - 1. Location designation
 - 2. Nominal system voltage
 - 3. Arc flash boundary
 - 4. Incident energy
 - 5. Working distance
 - 6. Engineering report number, revision number and issue date.
- D. The label for equipment where arc incident energy is not calculated shall include the following, at a minimum:
 - 1. Location designation
 - 2. Nominal system voltage
 - 3. Arc flash boundary from NFPA 70E 2018 Table 130.7(C) 15(a)
 - 4. Arc flash PPE category from NFPA 70E 2018 Table 130.7(C) 15(a)
 - 5. Engineering report number, revision number and issue date.
- E. Labels shall be machine printed, with no field markings.
- F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 480 and 208 volt panelboard, one arc flash label shall be provided.
 - 2. For each motor control center, one arc flash label shall be provided.
 - 3. For each low voltage switchboard, one arc flash label shall be provided.

4. For each switchgear, one flash label shall be provided.
 5. For medium voltage switches one arc flash label shall be provided
- G. Labels shall be field installed by the contractor.

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. 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 ACTION 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.

1.06 INFORMATIONAL SUBMITTALS

- A. Field quality-control test reports.

1.07 CLOSEOUT SUBMITTALS

- A. 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.

1.08 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.

1.09 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.

1.10 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 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-M0W.
 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. 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."

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

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TMP22104G
PBA2023.0156.00

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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 ACTION 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. Submit qualifications of commissioning agent and draft functional test plans for review and approval.

1.05 INFORMATIONAL SUBMITTALS

- A. 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.
- B. Field quality-control test reports and commissioning reports at project closeout.

1.06 CLOSEOUT SUBMITTALS

- A. Software licenses and upgrades required by and installed for operation and programming of digital devices.
- B. 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.
- C. Warranty: Special warranty specified in this Section.

1.07 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.

1.08 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. Coordinate lighting controls with devices specified in Division 26 Section "Lighting Control Devices".

1.09 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.

1.10 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 – Cooper Lighting

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. 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. 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. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.
 - d. 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. 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 Graphic Wall Stations
 - 1. Device shall have a full color touch screen.
 - 2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
 - 3. Graphic wall stations shall support the following device options:
 - a. Number of control zones: Minimum of 16
 - b. Number of scenes: Minimum of 16
 - c. Optional password protection for setup screens.
- C. 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.

- D. 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.
- E. Wired Networked Wall Switch Sensors
 - 1. Wall switches sensors shall support the following device options:
 - a. User Input Control Types Supported: On/Off or On/Off/Dimming
 - b. Occupancy Sensing Technology: PIR only or Dual Tech
 - c. Daylight Sensing Option: Inhibit Photosensor
- F. 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
- G. 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.
- H. 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 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 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.

3.03 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.

3.04 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.

3.05 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.

3.06 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.

3.07 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.

3.08 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.

3.09 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.

3.10 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

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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 26 Section "Electrical General Requirements."
 - 2. Division 26 Section "Conductors and Cables."
 - 3. Division 26 Section "Grounding and Bonding."
 - 4. Division 26 Section "Enclosed Switches."
 - 5. Division 26 Section "Panelboards."

1.02 SECTION INCLUDES

- A. Perform all tests and inspections as specified herein. All references made to "testing firm" shall apply to the work of the Contractor.
- B. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
- C. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.
- D. The test and inspections shall determine suitability for energization.
- E. Equipment to be tested and inspected shall be the equipment shown on the one line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.03 REFERENCES

- A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.
 - 1. National Electrical Manufacturer's Association - NEMA
 - 2. American Society for Testing and Materials - ASTM
 - 3. Institute of Electrical and Electronic Engineers - IEEE
 - 4. InterNational Electrical Testing Association - NETA Acceptance Testing Specifications - ATS-2017
 - 5. InterNational Electrical Testing Association - NETA Maintenance Testing Specifications- MTS-2015
 - 6. American National Standards Institute - ANSI C2: National Electrical Safety Code
 - 7. State and Local Codes and Ordinances
 - 8. Insulated Cable Engineers Association - ICEA

9. Association of Edison Illuminating Companies - AEIC
10. Occupational Safety and Health Administration
11. National Fire Protection Association - NFPA
 - a. ANSI/NFPA 70: National Electrical Code
 - b. ANSI/NFPA 70B: Electrical Equipment Maintenance
 - c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces
 - d. ANSI/NFPA 101: Life Safety Code

1.04 QUALIFICATIONS

- A. The testing firm shall be corporately independent and function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
- B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
- C. The lead, on site, technical person and at least 50% of the on site crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.
- D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.
- E. The Contractor shall submit proof of the above qualifications with bid proposal.
- F. The terms test agency, test contractor, testing laboratory, test organization, or contractor test company, shall be construed to mean the testing firm.
- G. Acceptable Testing Firms:
 1. Potomac Testing; Phone (248) 689-8980.
 2. Utilities Instrumentation Services; Phone (734) 424-1200.
 3. High Voltage Maintenance Corporation; Phone (248) 305-5596.
 4. Powertech Services, Inc.; Phone (810) 720-2280.
 5. Power Plus Engineering, Inc.; Phone (800) 765-3120.
 6. Premier Power Maintenance, Inc.; (517) 230-6629

1.05 PERFORMANCE REQUIREMENTS

- A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.
- B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
- C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.
- D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.
- E. The testing firm shall maintain a written record of all tests and shall assemble and certify a final test report.
- F. Safety and Precautions
 1. Safety practices shall include, but are not limited to, the following requirements:
 - a. Occupational Safety and Health Act.
 - b. Accident Prevention Manual for Industrial Operations, National Safety Council.
 - c. Applicable state and local safety operating procedures.
 - d. NETA Safety/Accident Prevention Program.
 - e. Owner's safety practices.
 - f. National Fire Protection Association - NFPA 70E.
 - g. American National Standards for Personnel Protection.

2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
3. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

1.06 TEST INSTRUMENT CALIBRATION

A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instruments shall be calibrated in accordance with the following frequency schedule:
 - a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
 - b. Laboratory instruments: 12 months
 - c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by Lessor)
4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

B. Field Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
 - a. Maintained in good visual and mechanical condition.
 - b. Maintained in safe, operating condition.

C. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

1.07 TEST REPORTS

A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:

1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.
2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.

3. Summary and interpretation of test results detailing problems located and recommended corrective measures.
 4. Record of infrared scan and photos showing potential problem locations.
 5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.
- B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 THERMOGRAPHIC SURVEY

- A. Visual and Mechanical Inspection
 1. Remove all necessary covers prior to scanning.
 2. Inspect for physical, electrical, and mechanical condition.
- B. Equipment to be Scanned
 1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.
- C. Provide report indicating the following:
 1. Problem area (location of "hot spot").
 2. Temperature rise between "hot spot" and normal or reference area.
 3. Cause of heat rise.
 4. Phase unbalance, if present.
 5. Areas scanned.
- D. Test Parameters
 1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
 2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
 3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.
- E. Test Results
 1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
 - a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.
 - b. Temperature gradients of 44.6°F to 59°F indicate deficiency; repair as time permits.
 - c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION

SECTION 26 2416 - PANELBOARDS

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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. Lighting and appliance branch-circuit panelboards.

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. AFCI: Arc-fault circuit interrupter.
- E. RFI: Radio-frequency interference.
- F. RMS: Root mean square.
- G. SPDT: Single pole, double throw.

1.04 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Related Submittals:
 - 1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.

- C. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 2. Wiring Diagrams: Power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS

- A. 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.

1.06 CLOSEOUT SUBMITTALS

- A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- B. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

1.08 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
 - 1. Ambient Temperature: Not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner's representative no fewer than seven days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without written permission from Owner's representative.

1.09 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

1.10 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. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
 - a. Square D by Schneider Electric (Must be included in base bid)
 - b. Eaton.
 - c. ABB.
 - d. [Siemens Industries, Inc.](#)

2.02 MANUFACTURED UNITS

- A. Enclosures: Mounting as noted on panel schedules. NEMA PB 1, Type 1.
 1. Cabinet Front: Flush or surface cabinet as noted on the Drawings.
 - a. Eaton LTDD (Piano hinge trim)
 - b. ABB – FGB (front hinge to box).
 - c. Square D – Continuous piano hinge trim.
 - d. Siemens – Figure 4 hinge to box w/piano hinge.
 2. Finishes:
 - a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 3. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.
- B. Phase and Ground Buses:
 1. Material: Aluminum.
 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.
- C. Conductor Connectors: Suitable for use with conductor material.
 1. Main and Neutral Lugs: Mechanical type.
 2. Ground Lugs and Bus Configured Terminators: Compression type.
- D. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

2.03 PANELBOARD SHORT-CIRCUIT RATING

- A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Main bus bars, neutral and ground, shall be sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

- B. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

2.05 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: NEMA AB 3, 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.
 - a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.
 - 2. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 - 3. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
- B. 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 materials.
 - 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - 3. Do not use tandem circuit breakers.
 - 4. Provide lock on devices for circuit breakers when called out on panel schedules with "LOD" designation.
 - 5. Provide type GFEP circuit breakers for all self-regulating heating (snow melting and heat trace) cables branch circuits and where noted on panel schedules with "GFEP" designation
 - 6. Provide GFCI circuit breaker when called out on panel schedules with "GFCI" designation.

2.06 ACCESSORY COMPONENTS AND FEATURES

- A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
- D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- E. Install overcurrent protective devices and controllers.
- F. Install filler plates in unused spaces.
- G. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.02 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Owner's representative.

- C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding."
- B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Testing: Perform the following field quality control tests in accordance with Division 26 section "Electrical Testing"
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.
- D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.
 - 1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 CLEANING

- A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

TMP Architecture, Inc.
Peter Basso Associates, Inc.

TMP22104G
PBA2023.0156.00

SECTION 26 2726 - WIRING 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:
 - 1. Single and duplex receptacles
 - 2. Ground-fault circuit interrupter receptacles
 - 3. Device wall plates.
 - 4. Floor service fittings

1.03 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. PVC: Polyvinyl chloride.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge protective devices.
- F. UTP: Unshielded twisted pair.
- G. USB: Universal serial bus.

1.04 REFERENCES

- A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.
- B. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes

- C. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
- D. NEMA WD 1: General Requirements for Wiring Devices.
- E. NEMA WD 6: Wiring Device – Dimensional Requirements.
- F. UL 20: General-Use Snap Switches.
- G. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
- H. UL 486B: Wire Connectors for Use with Aluminum Conductors.
- I. UL 498: Electrical Attachment Plugs and Receptacles.
- J. UL 943: Ground Fault Circuit Interrupters.
- K. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.05 ACTION SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.06 INFORMATIONAL SUBMITTALS

- A. Field quality control test reports

1.07 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

1.08 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 1. Cord and Plug Sets: Match equipment requirements.

PART 2 PRODUCTS

2.01 GENERAL WIRING DEVICE REQUIREMENTS

- A. Comply with NFPA 70, NEMA WD 1, NEMA WD 6, and UL498.
- B. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.
- C. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: White, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wall Switches: White, unless otherwise indicated.

2.02 STANDARD GRADE RECEPTACLES

- A. Tamper-Resistant Duplex Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Wiring Device-Kellems: BR20TR
 - b. Eaton/Arrow Hart Wiring Devices: TRBR20
 - c. Leviton: TBR20
 - d. Legrand, Pass & Seymour: TR5352

2.03 GFCI RECEPTACLES

- A. General:
 - 1. Comply with UL 943
- B. Tamper-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFTRST20
 - b. Eaton/Arrow Hart Wiring Devices: TRSGF20
 - c. Leviton: GFTR2
 - d. Legrand, Pass & Seymour: 2097TR
- C. Tamper- and Weather-Resistant Duplex GFCI Receptacle, NEMA 5-20R:
 - 1. Safety mechanism to energize contacts only when both openings are simultaneously engaged.
 - 2. Manufacturers: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell Wiring Device-Kellems: GFTWRST20
 - b. Eaton/Arrow Hart Wiring Devices: TWRSGF20
 - c. Leviton: GFWT2
 - d. Legrand, Pass & Seymour: 2097TRWR

2.04 STRAIGHT BLADE AND TWIST-LOCK RECEPTACLES, OTHER THAN NEMA 5-20R

- A. Provide commercial specification grade straight blade and twist-lock receptacles with standard NEMA configurations in accordance with the "Special Receptacles" schedule included on the drawings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Wiring Device-Kellems
 - 2. Eaton/Arrow Hart Wiring Devices
 - 3. Leviton
 - 4. Legrand, Pass & Seymour

2.05 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, device configurations as indicated on drawings, heavy-duty grade.
- B. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

2.06 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 WALL PLATES

- A. Manufacturers:
 - 1. Provide wall plates and corresponding wiring devices from same manufacturer.
- B. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces:
 - a. 0.035-inch- thick, satin-finished stainless steel

3. Material for Unfinished Spaces:
 - a. Galvanized steel
4. Material for Wet Locations: Gasketed Non-Metallic with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
 - a. Manufacturers:
 - 1) Hubbell: MM420
 - 2) Legrand, Pass & Seymour: WIUC10FRED
 - 3) Eaton/Arrow Hart: WIU-1VX
 - 4) Red Dot: CKPS
 - 5) Intermatic: WP5000

2.08 FLOOR SERVICE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hubbell Wiring Device-Kellems
 2. Legrand, Wiremold
 3. Steel City
- B. Refer to Floor Service Fitting Schedule on Plan.
- C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.
- D. Provide a blank bracket for any unused gangs.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.
- C. Install devices and assemblies level, plumb, and square with building lines.
- D. Arrangement of Devices:
 1. Coordinate locations of outlet boxes provided under Division 26 Section "Raceways and Boxes" to obtain mounting heights indicated on Drawings.
 2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
 3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
 4. Install horizontally mounted receptacles with grounding pole on the left.
 5. Install GFCI receptacles so that the "Push To Test" and "Reset" designations can be read correctly. If printed in both directions, install with ground pole on top.
- E. Install cover plates on switch, receptacle, and blank outlets in finished areas.
- F. Install weather-resistant type receptacles in all damp and wet locations, including pool environments.
- G. Install weatherproof cover plates on receptacles in damp locations.
- H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.
- I. Install tamper-resistant type receptacles in all locations as required by the NEC (406.12) and as indicated on plan.
- J. Use oversized plates for outlets installed in masonry walls.

- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- L. Remove wall plates and protect devices and assemblies during painting.
- M. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.
- N. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

- A. Comply with Division 26 Section "Electrical Identification."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

- A. Ground equipment according to Division 26 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.
- B. Connect wiring according to Division 26 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.
- C. 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.

3.04 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Inspect each wiring device for defects.
 - 2. Operate each wall switch with circuit energized and verify proper operation.
 - 3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
 - 4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.
- B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION

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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.
- B. Related Sections include the following:
 - 1. Division 26 Section "Hangers and Supports for Electrical Systems".

1.02 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Non-fusible switches.
 - 2. Molded-case circuit breakers.
 - 3. Enclosures.

1.03 DEFINITIONS

- A. GD: General duty.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault circuit-interrupter for equipment protection.
- D. GFLS: Ground-fault circuit-interrupter for life safety.
- E. HD: Heavy duty.
- F. RMS: Root mean square.
- G. 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 KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- F. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- G. NFPA 70: National Electrical Code.
- H. UL 50: Enclosures for Electrical Equipment, Non-Environmental Considerations.
- I. UL 50E: Enclosures for Electrical Equipment, Environmental Considerations
- J. UL 98: Enclosed and Dead-Front Switches
- K. UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
- L. UL 1053: Standard For Ground-Fault Sensing and Relaying Equipment.
- M. UL 1077: Supplementary Protectors for Use in Electrical Equipment
- N. UL 508: Industrial Control Equipment

1.05 ACTION SUBMITTALS

- A. Product Data:
 - 1. 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.
 - 2. Enclosure types and details for types other than UL 50E, Type 1.
 - 3. Current and voltage ratings.
 - 4. Short-circuit current rating.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.06 INFORMATIONAL SUBMITTALS

- A. 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.

1.07 CLOSEOUT SUBMITTALS

- A. 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.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2.02 NONFUSIBLE SWITCHES

- A. Manufacturers:
 - 1. Square D by Schneider Electric. (Must include in base bid)
 - 2. Eaton.
 - 3. ABB.
 - 4. Siemens Industries, Inc.
- B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers:
 - 1. Square D by Schneider Electric. (Must include in base bid)
 - 2. Eaton.
 - 3. ABB.
 - 4. Siemens Industries, Inc.
- B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.
- C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker.
- E. MCCBs must be equipped with device for locking in isolated position.
- F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.
- G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.
- H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits.
- I. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Application Listing: Appropriate for application.
 - 3. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

2.04 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish:
 - 1. Gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1)
- C. Operating Mechanism:
 - 1. Directly operable through front cover of enclosure (UL 50E Type 1).

2.05 TOGGLE DISCONNECT SWITCH

- A. Manufacturers:
 - 1. Double Pole:
 - a. Hubbell 1372.
 - b. Leviton 3032-2W.
 - c. Pass & Seymour 7812.
 - d. Bryant 30102.
 - 2. Three Pole:
 - a. Hubbell 1379.
 - b. Leviton MS303-DSW.
 - c. Pass & Seymour 7813.
 - d. Bryant 30103.
- B. Description: Heavy duty, 30A, 600 volts, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

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 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, Type 1.
- B. Outdoor Locations: UL 50E, Type 3R.
- C. Kitchen and Wash-Down Areas: UL 50E, Type 4X, stainless steel.
- D. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.

3.03 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- D. Install switches with off position down.

- E. Install NEMA KS 1 enclosed switch for motor loads ½ HP and larger and equipment loads greater than 30A.
- F. Install toggle disconnect switch, surface mounted, for motor loads less than ½ HP and equipment loads 30A. and less.
- G. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.
- H. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.
- I. Support enclosures independent of connecting conduit or raceway system.
- J. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Electrical Identification."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.
 - 3. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.05 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 field quality control tests in accordance with Division 26 section "Electrical Testing":
- C. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - f. Verify correct phase barrier installation.
 - g. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 - 2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - b. Measure contact resistance across each switchblade fuse holder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."
- D. Tests and Inspections for Molded-Case Circuit Breakers:
- 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that unit is clean.
 - e. Operate circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply

voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

- c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω .
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.
 - f. Verify operation of charging mechanism. Investigate units that do not function as designed.
- 3. Test and adjust controls, remote monitoring, and safeties.
- E. Nonconforming Work:
 - 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
 - F. Collect, assemble, and submit test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- 3.06 ADJUSTING**
- A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.
- 3.07 PROTECTION**
- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.08 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
 - 1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
 - 3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
 - 4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

3.09 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

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 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, 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.

1.05 INFORMATIONAL SUBMITTALS

- A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Sample warranty.

1.06 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.

1.07 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.
 - 4. Globes and Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.

1.08 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.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 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.

1.11 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 LUMINAIRES (LIGHTING FIXTURES)

- A. Provide Luminaires as included on the Luminaire schedule shown on the drawings.
- B. Acceptable alternate manufacturers are indicated on the Luminaire schedule. 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.
- C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 26 5700 shall govern.

2.02 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 70,000 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.

2.03 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.
- C. Provide edge lit signs with a mirror plaque background.

2.04 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.

2.05 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. Glass: Annealed crystal glass unless otherwise indicated.
 3. 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.

2.06 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.

2.07 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 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.
- D. Install recessed luminaires to permit removal from below.
- E. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- F. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- G. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.
- H. 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.
- I. 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.
- J. Ceiling-Mounted Luminaire Support:
 - 1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.
- K. Suspended Luminaire Support:

1. Continuous Rows of Luminaires: Use wire support for suspension for each unit length of luminaire chassis, including one at each end.
2. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

- L. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.
- M. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.
- N. 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 Division 26 Section "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

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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 fire alarm system.
- B. Related Sections include the following:
 - 1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the 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.
- B. Fire alarm system shall consist of the following:
 - 1. System smoke detection in areas identified on plans

1.05 PERFORMANCE REQUIREMENTS

- A. Comply with NFPA 72.
- B. Comply with NFPA 70.
- C. Comply with NFPA 720.
- D. 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.
- E. Coordinate and avoid conflicts with casework, markerboards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.
- F. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.
- G. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.
- 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.
- I. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.06 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product indicated.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.
 - 7. Include battery-size calculations.
 - 8. Include input/output matrix.
 - 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 - 10. Include performance parameters and installation details for each detector.

11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
 - D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
 1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.
- 1.07 INFORMATIONAL SUBMITTALS**
- A. Qualification Statements: For Installer.
 - B. Field quality-control test reports.
 - C. Sample Warranty: Submittal must include line item pricing for replacement parts and labor.
- 1.08 CLOSEOUT SUBMITTALS**
- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
 - g. Record copy of site-specific software.
 - h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - i. Manufacturer's required maintenance related to system warranty requirements.
 - j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.
 - B. Software and Firmware Operational Documentation:
 1. Software operating and upgrade manuals.
 2. Program Software Backup: On USB media and approved online or cloud solution.

3. Device address list.
4. Printout of software application and graphic screens.

1.09 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Smoke Detectors and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 2. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 3. Keys and Tools: One extra set for access to locked or tamper-proofed components.

1.10 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.

1.11 PROJECT CONDITIONS

- A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
1. Notify the Owner's representative no fewer than seven days in advance of proposed interruption of fire alarm service.
 2. Do not proceed with interruption of fire alarm service without written permission from the Owner's representative.

1.12 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.

1.13 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. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
 2. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
 3. Keys and Tools: One extra set for access to locked and tamperproofed components.

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.

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 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.
 6. 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.
- 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.

2.04 ADDRESSABLE MONITORING MODULE

- 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.

2.05 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.

2.06 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 monitoring equipment as necessary to extend the existing control and 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.
 2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
 3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.
- C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
- D. 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.

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.
 - a. Detectors that are outside their marked sensitivity range shall be replaced.
 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.

3.09 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION