PROJECT MANUAL

PROJECT:

NEW SMITH MIDDLE SCHOOL

OWNER:

TROY SCHOOL DISTRICT
4400 Livernois Road
Troy, Michigan 48098

TMP PROJECT NO.: 22102
BID PACKAGE NO.: 03B

DATE: June 18, 2024

ISSUED FOR: Construction Documents

ARCHITECT

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CONSTRUCTION MANAGER

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CIVIL ENGINEER CONSULTANT

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STRUCTURAL ENGINEER CONSULTANT

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MECHANICAL ENGINEER CONSULTANT

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THEATRICAL CONSULTANT

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New Smith Middle School

TMP22102

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

Seal	*Seal*	*Seal*
TMP Architecture, Inc. *Architect*	***William A. Kibbe & Associates*** *Structural Engineer*	***Peter Basso Associates, Inc.*** *Mechanical Engineer*

Seal	*Seal*	
Peter Basso Associates, Inc. *Electrical Engineer*	***PEA Group*** *Civil Engineer*	

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Not Used

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Not Used

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Not Used

APPENDIXES

APPENDIX 1

Geotechnical Investigation – Dated March 12, 2024 **CD**

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 NEW SMITH MIDDLE SCHOOL, dated 06-18-2024 and any subsequent Addenda and Contract modifications which may occur.

END OF SECTION

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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

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SECTION 00 8200 - AVAILABILITY OF ELECTRONIC FILES

PART 1 GENERAL

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: $0.00 / No Charge.
7. A signed copy of the Release Form 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 , allow five working days for processing.
3. Transmission of Drawings will be provided electronically .

1.03 RELEASE FORM

A. Release Form is located immediately after this Section. Refer to Section 00 8200.02 Electronic Files Release Form.

END OF SECTION

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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

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SECTION 01 2300 - ALTERNATES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Owner-Contractor Agreement.

B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

A. Alternate 1 - Decorative Stain and Polished Floors (Add Alternate)

1. Base Bid: Decorative Stain and Polished Floors at the listed rooms to be CONCD1. Control joint locations as indicated on A11._ series drawings. Rooms: Visual Arts B144, Active Studio E121, Active Studio E138, Active Studio F121, Active Studio F138, Active Studio E221, and Active Studio E238.
2. Alternate: Add Decorative Stain and Polished Floor patterning and additional colors CONCD2 and CONDC3 at listed rooms in addition to CONCD1. Control joint locations as indicated on A11._ series drawings. Rooms: Visual Arts B144, Active Studio E121, Active Studio E138, Active Studio F121, Active Studio F138, Active Studio E221, and Active Studio E238.

B. Alternate 2 - Portable Kiosk and Equipment

1. Base Bid: No portable kiosk cart and equipment.
2. Alternate: Provide portable kiosk cart and equipment items 74, 75, 76, 77, 78, & 79 as indciated wtihin specification section 11 4000 and as located on Food Service Equipment Plans.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 2500.01 - TMP SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST NUMBER: _____ DATE SUBMITTED: _____
TMP PROJECT NUMBER 22102 PROJECT NAME: NEW SMITH MIDDLE SCHOOL

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 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

SUBMITTAL AND SAMPLE TRANSMITTAL FORM

01 3000.01

CONST. MANAGER / CONTRACTOR	PROJECT	TMP PROJECT NO.	DATE SUBMITTED	SUBMITTAL NO.
Name and Address:	Title:	**22102, BP03B**		
	Troy Smith Middle School	* ACTION CODES		Initial Submittal ☐
		R Reviewed – No Exceptions Taken		Resubmittal ☐
Email:	Location:	RN Reviewed with Corrections Noted		REVIEWED BY
	Troy, Michigan	RR Revise and Resubmit		TMP ☐
Phone:		X Not Approved – Resubmit		Consultant ☐
		NA No Action Taken – Not Reviewed		Reviewer:

SPECIFICATION SECTION NO.	SUBCONTRACTOR / MANUFACTURER	ITEM DESCRIPTION	NO. OF SAMPLES	NO. OF SAMPLES RETURNED	ACTION CODE *	DATE REVIEWED	DATE RETURNED
Transmittal shall be for one specification section only; do not submit items from multiple sections under the same transmittal. Multi-section submittals will be returned; stamped "X - Not Approved - Resubmit"							

Submittal Stamps may be placed on subsequent blank page.

CONTRACTOR COMMENTS	ARCHITECT COMMENTS	The undersigned certifies that the above submitted items have been reviewed in detail and are correct and in strict conformance with the Contract Documents except as otherwise noted. NOTE: Approval of items submitted does not relieve Contractor from complying with all requirements of the Contract Documents.
		CONTRACTOR NAME
		SIGNATURE

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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

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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; 2021.
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; 2018.
   5. Mechanical Code: Michigan Mechanical Code; 2015.
   6. Electrical Code: NFPA 70 - National Electric Code; 2017.
      a. Includes 2017 Michigan Construction Code - Part 8 Electrical Code Rules.
   7. Elevator Code: Comply with the following:
      a. ASME A17.1 - Safety Code for Elevators and Escalators; 2010.
      b. ASME A18.1- Safety Standard for Platform Lifts and Stairway Chairlifts; 2011.
      c. Michigan Elevator Safety Board General Rules.
   8. Boiler Code: Michigan Boiler Code.
      a. Includes the following:
         1) ASME Boiler and Pressure Vessel Codes; 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.

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

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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

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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

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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; 2021.

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

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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

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SECTION 01 7000 - EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Examination, preparation, and general installation procedures.
B. Requirements for alterations work, including selective demolition.
C. Pre-installation meetings.
D. Cutting and patching.
E. Surveying for laying out the work.
F. Cleaning and protection.
G. Starting of systems and equipment.
H. Demonstration and instruction of Owner personnel.
I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
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 Architectand 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 a 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 03 3003 - CAST-IN-PLACE CONCRETE REQUIREMENTS FOR FLOOR SLABS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Underslab vapor retarder.
B. Moisture vapor reduction admixture (MVRA) for cast-in-place concrete floor slabs receiving moisture sensitive floor finishes.
C. Concrete mix design requirements for concrete stain and polished finish systems.
D. Reinforcing and jointing requirements for cast-in-place concrete floor slabs receiving hard tile floor finishes.
E. Floor flatness and levelness tolerances; slabs on grade and suspended slabs.
F. Concrete curing requirements for concrete stain and polished finish systems.
G. Liquid densifier/hardener.

1.02 REFERENCE STANDARDS

A. ACI 211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
B. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).
C. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
D. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).
E. 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.
F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
G. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2020.
H. ASTM E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers (Metric); 2014.
I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of floor slab installation and the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
C. Mix Design: Submit proposed concrete mix design.
D. Field Quality Control Reports: Provide the following:
   1. F(F) Floor Flatness and F(L) Floor Levelness measurements as specified.
E. Submit documentation from manufacturers certifying that curing products and methods are compatible with concrete staining and polishing materials and methods.
F. Manufacturer's Qualification Statement.
G. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.

B. Obtain moisture vapor reduction admixture from a single manufacturer.

C. In addition to requirements of this Section comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

1. If there is a conflict between sections, comply with the more stringent requirement unless otherwise indicated by Architect.

D. Concrete Curing:

1. Prior to installing and curing concrete floor slabs to be stained and polished, verify with polished concrete materials manufacturer that curing products and methods are compatible with concrete staining and polishing.

1.06 WARRANTY

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

B. Slabs with Moisture Vapor Reduction Admixture (MVRA): Provide warranty to cover the cost of flooring failures due to moisture migration from slabs for ten years.

1. Include cost of repair or removal of failed flooring, placement of topical moisture remediation system, and replacement of flooring with comparable flooring system.

PART 2 PRODUCTS

2.01 UNDERSLAB VAPOR RETARDER

A. Underslab Vapor Retarder: Sheet material complying with ASTM E1745, Class A; stated by manufacturer as suitable for installation in contact with soil or granular fill under concrete slabs. The use of single ply polyethylene is prohibited.

1. Installation: Comply with ASTM E1643.
2. Accessory Products: Vapor retarder manufacturer's recommended tape, adhesive, mastic, prefabricated boots, etc., for sealing seams and penetrations.
3. Minimum Thickness: 15 mil.
4. 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.

2.02 MOISTURE VAPOR REDUCTION ADMIXTURE

A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.

B. 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. Locations: Provide at concrete floor slabs receiving moisture sensitive floor finishes.
   a. Moisture sensitive floor finishes include the following:
      1) Resilient tile and sheet.
      2) Carpet tile and sheet carpeting.
      3) Wood gymnasium flooring.
      4) Wood stage flooring.

5) Epoxy matrix terrazzo flooring.
6) Other adhesive applied floor finishes.

2. Water Vapor Permeance: 0.03 perms, maximum, when tested in accordance with ASTM E96/E96M.
3. 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: Not permitted.

2.03 CONCRETE MIX DESIGN

A. General: Comply with requirements of Section 03 3000 - Cast-in-Place Concrete and as follows.

B. Moisture Vapor Reduction Admixture (MVRA):
   1. Where required add admixture as recommended in ACI 211.1 and at rates required by manufacturer.

C. 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. Concrete Compressive Strength: 4,000 psi, minimum, at 28 days.
   5. Water-to-Cement Ratio: Not to exceed 0.45.

2.04 REINFORCEMENT MATERIALS

A. Comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

2.05 DENSIFIERS AND HARDENERS

A. Liquid Densifier/Hardener: Penetrating chemical compound that reacts with concrete, filling the pores and dustproofing; for application to concrete after set.
   1. Composition: Sodium silicate.
   2. Products:
      a. Dayton Superior Corporation; Densifier J13: www.daytonsuperior.com.
      b. Euclid Chemical Company; EUCO DIAMOND HARD: www.euclidchemical.com.
      c. Kaufman Products Inc; SureHard: www.kaufmanproducts.net.
      d. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; SEAL HARD: www.lmcc.com.
      e. W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.
   3. Locations:
      a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using liquid densifier/hardener.

PART 3 EXECUTION

3.01 INSTALLATION - GENERAL

A. In addition to requirements of this Section comply with requirements of Section 03 3000 - Cast-in-Place Concrete.

3.02 UNDERSLAB VAPOR RETARDER

A. Interior Slabs on Grade: Install vapor retarder under interior slabs on grade. Lap joints minimum 6 inches. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions. Repair damaged vapor retarder before covering.
   1. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings.

3.03 MOISTURE VAPOR REDUCTION ADMIXTURE (MVRA)

A. Dispense MVRA according to concrete mix designs.
B. Add MVRA to concrete according to manufacturer's written instructions.

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.
C. Control Joints and Slab Jointing: None permitted.

3.05 FLOOR FLATNESS AND LEVELNESS TOLERANCES

A. General: Unless more stringent requirements are indicated or specified in Section 03 3000 - Cast-in-Place Concrete, comply with floor flatness and levelness values specified in this section.
B. Minimum F(F) Floor Flatness and F(L) Floor Levelness Values:
   1. Exposed to View and Foot Traffic: F(F) of 25; F(L) of 20, on-grade only.
   2. Under Thick-Bed Tile: F(F) of 20; F(L) of 15, on-grade only.
   3. Under Carpeting: F(F) of 25; F(L) of 20, on-grade only.
   4. Under Thin Resilient Flooring and Thinset Tile: F(F) of 35; F(L) of 25, on-grade only.
   5. Under Wood Gymnasium Floors and Stage Floors: F(F) of 50.
      a. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/8 inch in 10 feet.
   6. Stained and Polished Concrete Floors: F(F) of 50; F(L) of 30, on-grade only.
C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155 (ASTM E1155M), within 48 hours after slab installation; report both composite overall values and local values for each measured section.
D. Correct the slab surface if composite overall value is less than specified and if local value is less than two-thirds of specified value or less than F(F) 13/F(L) 10.
E. Correct defects by grinding or by removal and replacement of the defective work. Areas requiring corrective work will be identified. Re-measure corrected areas by the same process.

3.06 CONCRETE CURING REQUIREMENTS

A. At Slabs for Stained and Polished Concrete Floors: Cure with evaporation control and wet curing methods.
   1. Chemically reactive curing agents, membrane curing agents, and other topically applied curing compounds are not permitted.

3.07 LIQUID DENSIFIER/HARDENER

A. Apply liquid densifier/hardener in accordance with manufacturer's instructions.

B. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
C. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by liquid densifier/hardener manufacturer according to ASTM D4263 and ASTM F2170.
D. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.

3.08 FIELD QUALITY CONTROL

A. Slab Testing: Cooperate with manufacturer of specified moisture vapor reduction admixture (MVRA) to allow access for sampling and testing concrete for compliance with warranty requirements.

END OF SECTION

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SECTION 03 3511 - CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface treatments for concrete floors, slabs and other traffic surfaces. Includes the following:
   1. Liquid densifier/hardener.
   2. Concrete stain and polished finish system.

1.02 REFERENCE STANDARDS

A. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces; 2015.
B. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 2018.
C. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces; 2018.
D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019.

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
      a. Owner.
      b. Architect.
      c. Contractor's superintendent.
      d. Concrete producer.
      e. Cast-in-place concrete subcontractor.
      f. Polished concrete finishing Subcontractor.
   2. Review concrete mix, curing procedures, Projected 3, 14, and 28 day compressive strength test for finished floor, concrete protection prior to polishing and staining, construction joints, concrete finishing, and protection of polished concrete.
      a. Project phasing and scheduling for each step of grinding, honong and polishing operations including, but not limited to:
         1) Quality of qualified personnel committed to project.
         2) Quality and size of grinders committed to project.
         3) Proper disposal of concrete slurry and/or dust.
      b. Details of each step of grinding, honing and polishing operations.
         1) Application of color
         2) Application of liquid applied products

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
C. Shop Drawings:
   1. Concrete stain and polished finish system: Provide lay-out of concrete stain patterns and designs; indicate locations of each stain color.
D. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

H. Maintenance Data: Provide data on maintenance and renewal of applied finishes.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experienceand approved by manufacturer.

C. Polished Concrete Finishes shall be defined according to the Concrete Polishing Council (CPC), a specialty council of the American Society of Concrete Contractors, as follows:

1. Aggregate Exposure: Denotes the surface exposure after grinding and polishing.
   a. Class A: Cement Fines.
      1) Surface Exposure:
         (a) Cement Fines: 85 to 95 percent.
         (b) Fine Aggregates: 5 to 15 percent.
   b. Class B: Fine Aggregate.
      1) Surface Exposure:
         (a) Fine Aggregates: 85 to 95 percent.
         (b) Blend of Cement Fines and Coarse Aggregates: 5 to 15 percent.
   c. Class C: Coarse Aggregate.
      1) Surface Exposure:
         (a) Coarse Aggregates: 80 to 90 percent.
         (b) Blend of Cement Fines and Fine Aggregates: 10 to 20 percent.
2. Polished Concrete Appearance:
   a. Definitions:
      1) DOI: Directness-of-Image Gloss; the sharpness of images of objects by reflection at a polished surface, sometimes called image clarity.
      2) Image Clarity Value: DOI range from 0 to 100 percent where 100 represents a perfect DOI.
         (a) Comply with ASTM D5767.
      3) Haze Index:
         (a) Haze is the cloudiness or milky appearance of images or objects produced by reflection in a polished surface.
         (b) Haze index is obtained from testing per ASTM D4039; calculated from numeric difference between the value of specular gloss at 60 degrees and the value of specular gloss at 20 degrees.
   b. Level 1: Flat (Ground).
      1) DOI: Images of objects being reflected have a flat appearance.
      2) Image Clarity Value: 0 to 9
      3) Haze Index: Less than 10.
   c. Level 2: Satin (Honed).
      1) DOI: Images of objects being reflected have a matte appearance.
      2) Image Clarity Value: 10 to 39
      3) Haze Index: Less than 10.
   d. Level 3: Polished.
      1) DOI: Images of objects being reflected do not have a sharp or crisp appearance but can be easily identified.
      2) Image Clarity Value: 40 to 69
      3) Haze Index: Less than 10.
   e. Level 4: Highly Polished.
      1) DOI: Images of objects being reflected have a sharp and crisp appearance as would be seen in a near-mirror like reflection.
      2) Image Clarity Value: 70 to 100.
      3) Haze Index: Less than 10.

1.06 MOCK-UP

A. Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, edge conditions, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
      a. At location on Project selected by Architect, place and finish a 100 square foot area of dye stained ground and polished concrete
   2. Demonstrate curing, finishing, and protecting of polished concrete.
   3. Mockup shall be produced by the individual workers who will perform the work for the Project.
   4. Mock-up shall be representative of work to be expected.
      a. Color and finish shall match Architect's sample.
   5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
   6. Include example of transition or border between one stain color to another.

1.07 COORDINATION

A. A. Coordinate installation of concrete floor slabs with concrete staining and polishing.
   1. Verify that concrete design mixture is acceptable and will meet the design intent of the selected concrete stain and polish.
   2. Verify with polished concrete materials manufacturer that concrete curing products and methods are compatible with the concrete staining and polishing specified.
   3. Coordinate concrete installation and arrange for temporary protective covering to be promptly installed at the proper time.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.09 FIELD CONDITIONS

A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.

B. Maintain ambient temperature of 50 degrees F minimum.

C. A. Damage and Stain Prevention: It is the responsibility of all in the project to prevent damage and staining of concrete surfaces to be polished.
   1. Prohibit use of markers, spray paint and soapstone.
   2. Prohibit improper application of liquid membrane film forming curing compounds.
   3. Prohibit vehicle or lift parking over concrete surfaces.
   4. Prohibit pipe-cutting operations over concrete surfaces.
   5. Prohibit storage of any items over concrete surfaces for not less than 28 days after concrete placement.
   6. Prohibit ferrous metals storage over concrete surfaces.
   7. Protect from petroleum, oil, hydraulic, or other liquid dripping from equipment working over concrete surfaces.
   8. Protect from acids and acidic detergents contacting concrete surfaces.
   9. Protect from paint activities over concrete surfaces.

D. Environmental Limitations: Comply with manufacturer’s written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting liquid applied product application.

1.10 WARRANTY

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

PART 2 PRODUCTS

2.01 CONCRETE FLOOR FINISH APPLICATIONS

A. Concrete Sealing Stains Finish:
   1. As specified in Section 09 9123 - Interior Painting.
B. Decorative Concrete Stain and Polished Finish: CONCD
   1. Use at following locations: As indicated on Drawings.

2.02 DECORATIVE CONCRETE STAIN AND POLISHED FINISH

A. CONCD Decorative Concrete Stain and Polished Finish System:
   1. Provide materials, equipment, and procedures designed and furnished by a single manufacturer to produce dense polished concrete of the specified colors and gloss.
B. Dye/Stain: Penetrating, acetone soluble or dilutable dye.
   1. Colors: Up to 3 custom colors
      a. Design Intent:
         1) CONCD1: Medium grey
         2) CONCD2: Dark grey
         3) CONCD3: Light grey
   2. Products:
      a. Basis-of-Design Product: Subject to compliance with requirements, provide indicated products as manufacturered by Sika Corp./Scofield; Scofield Formula One Liquid Dye Concentrate: www.scofield.com., or a comparable product by one of the following:
      b. Curecrete Distribution Inc.; RetroPlate Concrete Dye Concentrates/Helix Color System: www.retroplatesystem.com.
      c. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc.; Vivid Dye: www.laticrete.com
      d. Substitutions: See Section 01 6000 - Product Requirements.
C. Densifier: Low VOC, lithium silicate or sodium silicate solution, penetrating densifier; increases concrete surface compressive strength and reduces concrete dusting.
   1. Products: Basis-of-Design Product: Sika Corp./Scofield; Scofield Formula One Lithium Densifier MP: www.scofield.com.
      a. Curecrete Distribution Inc.; RetroPlate 99: www.retroplatesystem.com.
      b. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc.; FGS Hardener Plus: www.laticrete.com.
      c. Prosoco; Consolideck LS: www.prosoco.com
      d. Substitutions: See Section 01 6000 - Product Requirements.
D. Sealer: Low VOC, lithium silicate, silane-siloxane, or fluoropolymer solution, penetrating, non-film forming, and colorless; designed to reduce concrete porosity and resist water penetration and staining; vapor permeable.
   1. Products: Basis-of-Design Product: Sika Corp./Scofield; Scofield Formula One Finish Coat: www.scofield.com.
      a. Curecrete Distribution Inc.; RetroPel: www.retroplatesystem.com.
      b. L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc.; Petrotex: www.laticrete.com.
      c. Prosoco, Inc.: Consolideck LA Guard: www.prosoco.com
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 MISCELLANEOUS MATERIALS

A. For Decorative Concrete Stain and Polished Finish:
   1. Crack Filler and Saw Joint Filler:
      a. Colors: Match adjacent concrete color/stain.
   2. Grout Material: Mortar used for filling minor voids and spaces in concrete substrates.
      a. Mortar shall have sufficient bonding capabilities to adhere after polishing to concrete surfaces and provide abrasion resistance equal to or greater than the surrounding concrete substrates.

b. Color: To match adjacent concrete.
c. Provide one of the following:
1) Silicate binders or latex/acrylic binders mixed with cement dust from previous concrete grinding.
2) Epoxy or polyurethane resins.
3. Temporary Protective Covering:
a. Sheet Material: One of the following:
1) Multi-ply textured membrane laminated to non-woven polypropylene geotextile; 18 mils thick.
2) Cellulose fabric; un-dyed.
b. Seaming Tape: As recommended by sheet manufacturer.
c. Materials not permitted:
1) Single ply polyethylene or other plastic sheet materials.
2) Dyed materials.
d. Products: Includes, but is not limited to, the following:
1) McTech Group, Inc.; EZcover: www.mctechgroup.com.
2) Ram Board Corp.; Ram Board: www.ramboard.com.
3) Sika Corp./Scofield; Proguard Duracover: www.scofield.com.

PART 3 EXECUTION

3.01 CONCRETE CURING AND PROTECTION

A. Prior to installing and curing concrete floor slabs to be stained and polished, verify with polished concrete materials manufacturer that curing products and methods are compatible with concrete staining and polishing.
B. Proceed with concrete installation and curing only after unsatisfactory conditions have been corrected.
C. After concrete has cured for 72 hours, cover concrete floors slabs to be stained and polished with a temporary protective covering to prevent concrete from staining and soiling during construction period.
1. Install according to protective covering manufacturer’s instructions and as follows:
a. Overlap seams at least 3 inches.
b. Tape all seams; do not apply tape directly to concrete.

3.02 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work
1. Concrete must be in place a minimum of 28 days or as directed by the manufacturer before application can begin.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 GENERAL

A. Apply materials in accordance with manufacturer's instructions.

3.04 CONCRETE STAIN AND POLISHED FINISH

A. General: Execute using materials, equipment, and procedures specified by manufacturer, using manufacturer approved installer.
B. Concrete Curing and Protection:
1. Prior to installing and curing concrete floor slabs to be stained and polished, verify with polished concrete materials manufacturer that curing products and methods are compatible with concrete staining and polishing.
a. Proceed with concrete installation and curing only after unsatisfactory conditions have been corrected.
2. After concrete has cured for 72 hours, cover concrete floors slabs to be stained and polished with a temporary protective covering to prevent concrete from staining and soiling during construction period.

a. Install according to protective covering manufacturer's instructions and as follows:
1) Overlap seams at least 3 inches.
2) Tape all seams; do not apply tape directly to concrete.

C. Examination:
1. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work
a. Concrete must be in place a minimum of 28 days or as directed by the manufacturer before application can begin.
b. **Verify that concrete requirements of Section 03 3003 have been met.**
2. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Preparation:
1. Remove temporary protective covering and clean concrete substrates of substances that might impair application and performance of polished concrete floor finishes, including oil, grease, and curing compounds.
a. Clean according to floor polishing manufacturer's recommendations.
b. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by floor polishing manufacturer. Rinse until water is clear and allow surface to dry.
1) Do not use acidic solutions to clean surfaces.
2. Crack Treatment: Cracks more than 3/32 inch wide shall be routed and filled as follows:
a. Route out the cracks to 1/4 inch wide by 1/2 inch deep profile.
b. Do not fill cracks and joints until the proper time during the grinding and polishing of the concrete floor.
1) Fill the voids with crack filler material and allow to cure according to the manufacturer's instructions.
2) At all saw joints, install saw cut joint filler at a minimum depth of one inch and allow to cure according to the manufacturer's instructions.
3) Trim the excess material from the slab surface.
3. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by polishing and staining manufacturer according to ASTM D4263 and ASTM F2170.

E. Polishing and Staining:
1. General:
a. Polish shall be a consistent appearance across entire polished concrete surface.
b. Stains shall be a consistent appearance across entire stained concrete surface.
1) Stain concrete in patterns and designs as indicated.
c. Polish and stain entire concrete floor slab before equipment, casework, and other fixed items are installed.
d. Grind and polish to within 1/2 inch of any vertical surfaces.
e. Thoroughly clean floor after each grinding and polishing pass using dust extraction equipment to remove all loose dust and debris.
f. Control and dispose of waste products produced by grinding and polishing operations.
g. After final polished finish is achieved, neutralize and clean polished floor surfaces.
2. Final Polished Finish Appearance: As defined by the CPC, polish concrete to meet the following:
a. Aggregate Exposure: Class C.
b. Appearance Level 2: Satin (Honed).
3. Polishing and Staining: Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.
a. Machine grind floor surfaces to receive polished finishes level and smooth and to depth required to reveal aggregate to match approved mockup.

b. Grout grinding: Perform when required to fill surface imperfections and achieve appearance matching approved mock-up.
   1) In proper polishing sequence apply grout; using grinding equipment, force grout into the pore structure of the concrete substrate filling surface imperfections.
c. Apply penetrating liquid floor treatments for polished concrete in proper polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
   1) Allow concrete surface to dry before applying penetrating liquid floor treatments.
   2) Clean concrete thoroughly immediately prior to application.
   3) Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by additional grinding, sanding, or abrasive blasting. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
   4) Dyes/Stains:
      (a) Apply stains in patterns and designs indicated.
      (b) Repeat stain applications until colors are consistent with approved mockup.
   5) Densifiers: Apply 2 coats, minimum.
   6) Sealers: Apply 2 coats, minimum.
d. Polish concrete with progressively finer grits until polished appearance matches approved mockup.
e. Install joint and crack filler in proper polishing sequence and according to manufacturer's written instructions.

4. In general, grind and polish floors in the following sequence unless indicated otherwise by product manufacturer’s or installer's recommendations.
   a. Floor Grinding and Polishing.
      1) Grind concrete.
      2) Grout grinding.
      3) Polish concrete.
      4) Apply stain.
      5) Polish concrete.
      6) Apply densifier.
      7) Polish concrete.
      8) Apply densifier.
      9) Polish concrete.
      10) Install joint and crack filler.
      11) Apply sealer; 2 coats.
      12) Polish and burnish concrete to final finish appearance.

3.05 CLEANING AND PROTECTION:

A. Cleaning:
   1. Concrete finishes shall be kept clean and free of debris at all times.
   2. Remove spatter from adjoining surfaces, as necessary.
   3. Repair damage to surfaces caused by operations.
   4. Remove debris from Project site and legally dispose of them.

B. Protection:
   1. Protect concrete finishes and maintain conditions, in a manner acceptable to Installer and manufacturer that ensure concrete floor finish is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 03 4500 - PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural precast concrete accessories.
B. Supports, anchors, and attachments.
C. Grouting under panels.

1.02 REFERENCE STANDARDS

A. ACI 301 - Specifications for Concrete Construction; 2020.
B. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
C. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.
D. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
F. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2021a.
G. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2021a.
H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
I. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
J. ASTM A775/A775M - Standard Specification for Epoxy-Coated Steel Reinforcing Bars; 2017.
K. ASTM A884/A884M - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement; 2019, with Editorial Revision (2020).
L. ASTM C1602/C1602M - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete; 2022.
M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
N. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
O. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
P. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
Q. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
R. ASTM D3963/D3963M - Standard Specification for Fabrication and Jobsite Handling of Epoxy-Coated Steel Reinforcing Bars; 2021.
S. PCI MNL-116 - Manual for Quality Control for Plants and Production of Structural Precast Concrete Products; 2021.
T. PCI MNL-117 - Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products; 2013.
U. PCI MNL-120 - PCI Design Handbook; 2017, with Errata (2021).
V. PCI MNL-122 - Architectural Precast Concrete: Fully Revised Manual Including New Sections, Extensive Updates, and Detailed Specifications to Meet Today's Construction Needs.; 2007.
W. PCI MNL-123 - Connections Manual: Design and Typical Details of Connections for Precast and Prestressed Concrete; 1988.
X. PCI MNL-135 - Tolerance Manual for Precast and Prestressed Concrete Construction; 2000.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

B. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction by others.

1. Provide locations, setting diagrams, instructions and templates required for proper installation.

1.04 SUBMITTALS

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

B. Product Data: Manufacturer's information on accessory products, including pigments, admixtures, inserts, plates, etc.

C. Shop Drawings: Indicate layout, unit locations, configuration, connection details, support items, dimensions, openings, and relationship to adjacent materials.

1. Include details of mix designs.
2. Include structural design calculations.

D. Samples: Submit 3 samples, 12 by 12 inch in size, illustrating surface finish, color and texture.

1. Contact Face Brick Type A Manufacturer for control sample. See 04 2000 - Unit Masonry.

E. Designer's Qualification Statement.

F. Fabricator Qualification Statement: Provide documentation showing precast concrete fabricator is PCI Group A Plant certified or APA certified.

G. Integrally Insulated Panel System Design Data:

1. Thermal Resistance: Submit calculations complying with ASHRAE Std 90.1 I-P, isothermal planes method, and demonstrating thermal resistance of integrally insulated panel system.
2. Dew Point: Submit calculations complying with ASHRAE (FUND). Demonstrate condensation prevention, prevention of frost or ice formation on panels surfaces, and inner wall condensation potential of _____ ounce per day per square foot or less.
3. Thermal Bowing and Crack Mitigation: Submit drawing details and written procedures for mitigation and repair of bowing and cracking in insulated concrete panels without full-thickness concrete sections or metallic connectors between wythes.

H. Maintenance Data: Indicate surface cleaning instructions.

1.05 QUALITY ASSURANCE

A. Design Engineer Qualifications: Design precast concrete units under direct supervision of a Professional Structural Engineer experienced in design of precast concrete and licensed in the State in which the Project is located.

B. Fabricator Qualifications:

1. Firm having at least 5 years of documented experience in production of precast concrete of the type required.
2. Plant certified under Precast/Prestressed Concrete Institute (PCI) Plant Certification Program; product group and category A1 - Architectural Precast Concrete.
3. Plant certified under Architectural Precast Association (APA) Plant Certification Program for production of architectural precast concrete.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handling: Lift and support precast units only from support points.

B. Blocking and Lateral Support During Transport and Storage: Use materials that are clean, non-staining, and non-harmful to exposed surfaces. Provide temporary lateral support to prevent bowing and warping.

C. Protect units to prevent staining, chipping, or spalling of concrete.

PART 2 PRODUCTS

2.01 PRECAST UNITS, GENERAL

A. Precast Architectural Concrete Units: Comply with PCI MNL-120, PCI MNL-122, PCI MNL-123, PCI MNL-135, and ACI 318.
   1. Concrete: Minimum 5000 psi, 28 day strength, air entrained to 5 to 7 percent; comply with ACI 301.
   2. Design Loads: Static loads, anticipated dynamic loading, including positive and negative wind loads, thermal movement loads, and erection forces as defined by applicable code.
   3. Calculate structural properties of units in accordance with ACI 318.
   4. Accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
   5. Provide connections that accommodate building movement and thermal movement and adjust to misalignment of structure without unit distortion or damage.

B. Finish: Ensure exposed-to-view finish surfaces of precast units are uniform in color, texture, and appearance.
   1. Color and Texture: Design Intent: Integral color to match Face Brick Type A. Contact Face Brick Manufacturer for control sample.

C. Size and Shape: As indicated on drawings.

D. Placement: Cap at masonry column enclosures at entry canopies.

2.02 REINFORCEMENT

A. Reinforcing Steel: ASTM A615/A615M, Grade 40 (40,000 psi).
   1. Deformed billet-steel bars.
   2. Epoxy coated in accordance with ASTM A775/A775M.

B. Steel Welded Wire Reinforcement (WWR): Class A epoxy coated, deformed type, ASTM A884/A884M.
   1. Form: Flat Sheets.

2.03 CONCRETE MATERIALS

A. Cement: ASTM C150/C150M, Type IA - Air Entraining Portland type.

B. Fine and Coarse Structural Aggregates: ASTM C33/C33M.

C. Surface Finish Aggregate: Complying with sample in office of Architect.

D. Color Additives: Pure, concentrated mineral pigments specifically intended for mixing into concrete and complying with ASTM C979/C979M.
   1. Concentration: Base dosage rates on weight of Portland cement, fly ash, silica fume, and other cementitious materials but not aggregate or sand.
   2. Color(s): To match Architect's sample(s) when incorporated into specified mix design(s).
      a. Design Intent: Integral color to match Face Brick Type A. Contact Face Brick Manufacturer for control sample.
   3. Manufacturers:
      a. Davis Colors: www.daviscolors.com.
      b. Lambert Corporation: www.lambertusa.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

E. Water: ASTM C1602/C1602M; clean, potable, and not detrimental to concrete.

F. Air Entrainment Admixture: ASTM C260/C260M.

G. Waterproofing Admixture: Admixture formulated to reduce permeability to liquid water, with no adverse effect on concrete properties.
   1. Admixture Composition: Crystalline, functioning by growth of crystals in capillary pores.
   2. Products:
      a. Euclid Chemical Company; Eucon Vandex AM-10: www.euclidchemical.com/#sle.
      b. Specialty Products Group; Vapor Lock 20/21: www.spggogreen.com/#sle.
      c. Xypex Chemical Corporation; XYPEX Admix C-500: www.xypex.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

H. Grout:
   1. Non-shrink, non-metallic, minimum 10,000 psi, 28 day strength.
I. Mortar: Portland cement-lime, as specified in Section 04 2000 - Unit Masonry.

2.04 SUPPORT DEVICES

A. Connecting and Support Devices; Anchors and Inserts: ASTM A666 Type 304 stainless steel.
   1. Clean surfaces of rust, scale, grease, and foreign matter.
B. Bolts, Nuts, and Washers: ASTM A307 heavy hex bolts, Type A, hot-dip galvanized, with matching ASTM A563 (ASTM A563M) nuts and matching washers.
C. Provide integral anchors as required for anchoring to exposed architectural steel columns.

2.05 DESIGN MIXES

A. Prepared by Architectural Precast Concrete manufacturer.
   1. All mix designs shall include waterproofing admixture.
   2. All mix designs shall include air entrainment admixture.
      a. Comply with PCI MNL-116.
B. Compressive Strength (28 Days): 5,000 psi, minimum.
C. Maximum Water-Cementitious Materials Ratio: 0.45.
D. When recommended by architectural precast concrete manufacturer, add other admixtures to concrete mixtures according to manufacturer's instructions.

2.06 FABRICATION

A. Fabricate in compliance with PCI MNL-117 and PCI MNL-135.
B. Fabricate and handle epoxy-coated reinforcing bars in accordance with ASTM D3963/D3963M.
C. Use rigid molds, constructed to maintain precast unit uniform in shape, size, and finish.
D. Maintain consistent quality during manufacture.
E. Fabricate connecting devices, plates, angles, items fit to steel framing members, inserts, bolts, and accessories. Fabricate to permit initial placement and final attachment.
F. Embed reinforcing steel, anchors, inserts plates, angles, and other cast-in items.
G. Locate hoisting devices to permit removal after erection.
H. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
I. Minor patching in plant is acceptable, providing structural adequacy and appearance of units is not impaired.
J. Coordination:
   1. Coordinate relationship of architectural precast concrete units to adjacent materials.

2.07 FABRICATION TOLERANCES

A. Comply with PCI MNL-117 and PCI MNL-135, except as specifically amended below.
   1. Maximum Variation From Nominal Face Dimensions: Plus or minus 3/32 in.
   2. Maximum Variation From Square or Designated Skew: Plus or minus 1/8 inch in 10 feet.
   3. Maximum Variation from Thickness: Plus or minus 1/8 in.
   4. Maximum Misalignment of Anchors, Inserts, Openings: Plus or minus 1/8 inch.
   5. Maximum Bowing of Members: Plus or minus length/360.

2.08 ACCESSORIES

A. Bond Break/Slip Plane Material:
   1. Building Paper: ASTM D226/D226M, Type I ("No.15") asphalt felt.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building structure, anchors, devices, and openings are ready to receive work of this section.

3.02 INSTALLATION AND ERECTION

A. Erect units without damage to shape or finish. Replace or repair damaged panels.

B. Erect units level and plumb within allowable tolerances.
C. Align and maintain uniform horizontal and vertical joints as erection progresses.
D. When units require adjustment beyond design or tolerance criteria, discontinue affected work; advise Architect.

3.03 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.
B. Architectural precast concrete manufacturer should develop appropriate repair mixtures and techniques during production sample approval process.
C. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
D. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.04 CLEANING

A. Clean surfaces of precast concrete units exposed to view.
B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove markings, dirt, and stains.
C. Perform cleaning procedures, if necessary, according to architectural precast concrete manufacturer's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.
D. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials

3.05 PROTECTION

A. Protect installed architectural precast concrete units from subsequent construction operations.

END OF SECTION

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SECTION 04 2000 - UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.
B. Clay facing brick.
C. Reinforcement and anchorage.
D. Flashings.
E. Cavity wall insulation.
F. Lintels.
G. Accessories.
H. Products installed under this section:
   1. Loose steel lintels in unit masonry; furnished by Section 05 5000 - Metal Fabrications.
   2. Manufactured reglets embedded in unit masonry; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.
I. Products furnished under this section:
   1. Structural steel anchor sections for connecting masonry to structural steel; installed by Section 05 1200 - Structural Steel Framing.

1.02 REFERENCE STANDARDS

A. ACI 315 - Guide to Presenting Reinforcing Steel Design Details; 2018.
B. ASTM D1056 - Standard Specification for Flexible Cellular Materials—Sponge or Expanded Rubber; 2020.
C. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
D. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.
E. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
F. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023.
G. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
H. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
I. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2022.
J. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units; 2022.
K. ASTM C91/C91M - Standard Specification for Masonry Cement; 2023.
L. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar; 2018.
M. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale); 2023.
N. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2018.
P. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
Q. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.
R. ASTM C1072 - Standard Test Methods for Measurement of Masonry Flexural Bond Strength; 2022.

S. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2023a.
T. ASTM C 1329 - Standard Specification for Mortar Cement - 2016.
U. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.
V. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
W. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2020.
X. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
Y. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
Z. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.04 SUBMITTALS

A. Product Data: Provide data for the following:
   1. Masonry Units:
      a. Include data on material properties.
      b. Masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
   2. Brick units:
      a. For exposed brick, include test report for efflorescence according to ASTM C 67.
      b. Include size-variation data verifying that the actual range of sizes falls within specified tolerances.
   3. Cementitious materials. Include name of manufacturer, brand name and type.
   4. Mortar admixturers.
   5. Preblended, dry mortar mixes. Include description of type and proportion of ingredients.
   6. Grout mixes. Include description of type and proportion of ingredients.
   7. Sound Isolating anchors.
   8. Anchors, ties, weep/cavity vent, preformed control-joint gaskets, cavity drainage material, and metal accessories.
B. Shop Drawings: Indicate pertinent dimensions, materials, anchorage, size and type of fasteners, and accessories for masonry.
   1. Masonry Units: Indicate sizes, profiles, coursing, and locations of special units.
   2. Reinforcing: Indicate bending, lap lengths, and placement of unit masonry reinforcing bars.
      a. Comply with ACI 315.
   3. Flashings: Provide details of embedded flashings including end dams, corners, drips, weeps.
C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C91/C 91M for air content.
   2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirements.

D. Samples: Submit 3 samples of standard block, decorative block, facing brick, ceramic glazed facing brick, and ceramic glazed structural clay facing tile units to illustrate color, texture, and extremes of color range.
E. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.
F. Test Reports:
    1. Concrete masonry manufacturer's test reports for units with integral water repellent admixture.
    2. Masonry Veneer Anchors: At wall cavities greater than 4-1/2 inches, provide masonry veneer anchor manufacturer's test reports indicating compliance with TMS 402/602 for lateral load requirements; wall cavity depth includes airspace and cavity wall insulation thickness.
G. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.
H. Manufacturer's Qualification Statement.
I. Installer's Qualification Statement.
J. Cold-Weather and Hot-Weather Procedures: Detail description of methods, material, and equipment to be used to comply with requirements.

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.
B. Fire Rated Assemblies: Comply with applicable codes and UL Assembly Numbers indicated.
C. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section with minimum 5 years of documented experience.
D. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.06 MOCK-UPS

A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for material and execution.
B. Construct a masonry wall as a mock-up panel sized 8 feet long by 6 feet high; include mortar, accessories, structural backup, wall openings, flashings (with lap joint, corner, and end dam), through-wall flashing (omit masonry above half of flashings, wall insulation, and sealant-filled joint at least 16 inches long in exterior wall in mock-up.
C. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
D. Locate where directed.
E. Where masonry is to match existing, erect mockups adjacent and parallel to existing surface.
F. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
G. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
    1. Approval of mockups is also for other materials and construction qualities specifically approved by Architect in writing.
    2. Approval of mockups does not constitute approval of deviations from Contract Documents contained in the mock-ups unless Architect specifically approves such deviations in writing.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Store masonry units on elevated platforms in a dry location. If units are not stored in a enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

C. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

F. Handle and store ceramic glazed masonry units in protective cartons or trays. Do not remove from protective packaging until ready for installation.

1.08 FIELD CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, protections, and sills with waterproof sheeting at end of each days's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches (600 mm) down both sides of walls, and hold cover securely in place.
2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches (600 mm) down face next to unconstructed wythe, and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in **TMS 602/ACI 530.1/ASCE 6**.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in **TMS 602/ACI 530.1/ASCE 6**.

PART 2 PRODUCTS

2.01 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6, except as modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work and will be within 20 feet (6 m) vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS (CMU)

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, control joint edges, and other detailed conditions.
   3. Exposed Outside Block Corners: Provide bullnose, radiused, corners unless otherwise indicated on Drawings.
      a. Field-ground radiused corners are not permitted.
      b. Stop bullnose at bulkhead/soffits.
      c. Provide square corners at door frame even with block and bullnose where door frame is set back from corner.
   4. Load-Bearing and Non-Loadbearing Units: ASTM C90, normal weight.
      a. Standard Units:
         1) Exposed Faces: Manufacturer's standard color and texture as approved by Architect per ASTM C90.
         2) Manufacturers:
            (a) Consumers Concrete Corp.: www.consumersconcrete.com.
            (b) Echelon by Oldcastle: www.echelonmasonry.com.
            (c) Fendt Builder’s Supply, Inc.: www.fendtproducts.com.
            (d) Grand Blanc Cement Products: www.grandblanccementproducts.com.
            (e) Michigan Certified Products, Inc.: www.micertconcrete.com.
            (f) National Block Company: www.nationalblock.com.
            (g) Substitutions: See Section 01 6000 - Product Requirements.
   5. Units with Integral Water Repellent: Concrete block units as specified in this section with polymeric liquid admixture added to concrete masonry units at the time of manufacture.
      a. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
      b. Performance of Units with Integral Water Repellent:
         1) Water Permeance: When tested per ASTM E514/E514M and for a minimum of 72 hours.
            (a) No water visible on back of wall above flashing at the end of 24 hours.
            (b) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
            (c) No more than 25 percent of wall area above flashing visibly damp at end of test.
         2) Flexural Bond Strength: ASTM C1072; minimum 10 percent increase.
         3) Compressive Strength: ASTM C1314; maximum 5 percent decrease.
      c. Limitations:
         1) Use only in combination with mortar containing integral water repellent admixture.
         2) Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
      d. Products:
         1) BASF Corp.; MasterPel 240: www.master-builders-solutions.basf.us.

2) 04 2 (The); an RPM company; Eucon Blocktite Admixture: www.euclidchemical.com.
3) GCP Applied Technologies Inc.; Dry-Block Block Admixture: www.gcpat.com.
4) Substitutions: See Section 01 6000 - Product Requirements.

2.03 BRICK UNITS

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:
1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Manufacturers: Provide products from the manufacturer listed for each brick type.
1. Substitutions: Not permitted.

C. Facing Brick:
1. Special shapes: Provide molded units as required by conditions indicated, unless standard units can be sawn to produce equivalent effect.
2. Type A: Field Brick.
a. Manufacturer: Glen-Gery Corp.: www.glengery.com..
1) Substitutions: Not permitted.
b. ASTM C216, Type FBS, Grade SW.
c. Size (Actual): 3-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long (Utility).
d. Color/Blend: Ebonite.
e. Texture: Smooth.
3. Type B: Accent Brick.
a. Manufacturer: Belden Brick Company: www.beldinbrick.com.
1) Substitutions: Not permitted.
b. ASTM C216, Type FBS, Grade SW.
c. Size (Nominal): 3-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long (Utility).
d. Color/Blend: Belden Custom Blend with Iron Spot to match Architect's Sample. Design Intent: Panton 2409 & Pantone 2341.
e. Texture: Glazed.
4. Type C: Accent Brick.
a. Manufacturer: Glen-Gery Corp.: www.glengery.com..
1) Substitutions: Not permitted.
b. ASTM C216, Type FBS, Grade SW.
c. Size (Actual): 3-5/8 inches wide by 3-5/8 inches high by 11-5/8 inches long (Utility).
d. Color/Blend: Ebonite.
e. Texture: Tuscan.
f. Install proud of surrounding face brick as indicated on drawings.

2.04 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M.
B. Mortar Cement: ASTM C1329.
C. Mortar Aggregate: ASTM C144.
D. Grout Aggregate: ASTM C404.
E. Pigments for Colored Mortar: Pure, concentrated mineral pigments specifically intended for mixing into mortar and complying with ASTM C979/C979M.

1. Manufacturers:
   a. Davis Colors: www.daviscolors.com.
   b. Lambert Corporation: www.lambertusa.com.
   c. Solomon Colors: www.solomoncolors.com/sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

F. Water: Clean and potable.

G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
   1. Locations: Provide at exposed exterior concrete block and elsewhere as indicated.
   2. Limitations:
      a. Use only in combination with masonry units manufactured with integral water repellent admixture.
      b. Source Limitations: Use water repellent admixtures for masonry units and mortar from a single manufacturer.
   3. Meet or exceed performance specified for water repellent admixture used in masonry units.
   4. Products:
      a. BASF Corp.; MasterPel 210MA: www.master-builders-solutions.basf.us.
      b. Euclid Chemical Company (The); an RPM company; Blocktite Mortar Admixture: www.euclidchemical.com.
      c. GCP Applied Technologies Inc.; Dry-Block Mortar Admixture: www.gcpat.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

H. Packaged Dry Material for Mortar for Unit Masonry:
   1. At Contractor's option, prepackaged dry material for mortar may be used subject to compliance with mortar requirements of this section including, but not limited to, the following:
      a. Mortar Types: As indicated.
      b. Color(s): As selected by Architect from manufacturer's full range.
      c. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
   2. Portland Cement Based: Premixed Portland cement, hydrated lime, and sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
      a. Manufacturers:
         1) Amerimix, an Oldcastle brand; www.amerimix.com.
         2) The QUIKRETE Companies; wwwquikcrete.com.
         3) SPEC MIX, Inc.: www.specmix.com.
         4) Substitutions: See Section 01 6000 - Product Requirements.
   3. Masonry Cement Based: Premixed masonry cement and mason's sand; complying with ASTM C1714/C1714M and capable of producing mortar of the specified strength in accordance with ASTM C270 with the addition of water only.
      a. Manufacturers:
         1) Amerimix, an Oldcastle brand; www.amerimix.com.
         2) The QUIKRETE Companies; wwwquikcrete.com.
         3) SPEC MIX, Inc.: www.specmix.com.
         4) Substitutions: See Section 01 6000 - Product Requirements.

I. Packaged Dry Material for Grout for Masonry: Premixed cementitious materials and dried aggregates; capable of producing grout of the specified strength in accordance with ASTM C476 with the addition of water only.
   1. At Contractor's option, prepackaged dry material for grout may be used subject to compliance with grout requirements of this section.
   2. Manufacturers:
      a. Amerimix, an Oldcastle brand; www.amerimix.com.

b. The QUIKRETE Companies; wwwquikcrete.com.
c. SPEC MIX, Inc.: www.specmix.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
1. Basis-of-Design Product: The design for each item specified is based on the product named. Provide either the named product or a comparable product by one of the following:
a. Fero Corp.; www.ferocorp.com.
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Hohmann & Barnard, Inc.; www.h-b.com.
d. Wire-Bond; www.wirebond.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; uncoated.

C. Reinforcing Bar Positioners: 0.156 inch, ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: RB and RB-Twin Rebar Positioners.

D. Reinforcing Bar Lap Joint Ties: ASTM A1064/A1064M steel wire, mill galvanized to 16 CFR 1201 Class 3.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: Spyra-Lox Rebar Lap-Joint Tie.

E. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to 16 CFR 1201 Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 120 Truss-Mesh or 220 Ladder-Mesh.

F. Adjustable Multiple Wythe Joint Reinforcement: Truss or ladder type with adjustable ties or tabs spaced at 16 in on center ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods and adjustable components of 0.1875 inch wire; width of components as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from each masonry face.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 170 Truss LOX-ALL Adjustable Eye Wire or 270 Ladder LOX-ALL Adjustable Eye Wire with 2X-HOOK.

G. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches; hot dip galvanized to ASTM A153/A153M Class B.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 344 Rigid Partition Anchor.

H. Partition Top Anchors: 0.1875 inch thick metal plate with a 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube; hot dip galvanized to ASTM A153/A153M Class B.
1. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: PTA-420-HS and PTA Tubes.

I. Dovetail Anchor Slots for Connecting to Concrete: 2-piece anchors that permit differential movement between masonry and concrete frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
1. Concrete frame: Dovetail anchors of bent steel, nominal 1 inch width by 1 inch deep by 0.03 in thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.

a. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 305 Dovetail Slot with 315 Flexible Dovetail Brick Ties.

J. Adjustable Anchors for Connecting to Structural Steel Framing: 2-piece anchors that permit differential movement between masonry and steel frame, sized to provide not more than 1 inch and not less than 1/2 inch of mortar coverage from masonry face.
1. Crimped wire anchors for welding to frame, 0.25 inch thick, with trapezoidal wire ties 0.1875 inch thick, hot dip galvanized to ASTM A 153/A 153M, Class B.
2. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: 359/359FP anchors with 301W or VBT ties.

K. Adjustable Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
1. For cold-formed metal framing and sheathing back-up.
2. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners.
3. Wire ties: Rectangular shape, 0.1875 inch thick.
4. Vertical adjustment: Not less than 2 inches.
5. Basis-of-Design Product: Hohmann & Barnard, Inc.; www.h-b.com: HB-213 anchors with 2X-HOOK.

L. Sound Isolating Anchors.
1. Provide as indicated on the Drawings.
a. Basis of Design Product: Provide PSB-M isolators as manufactured by Kinetics. Texture Wire cut or as follows:
1) Mason Industries AB-716.

2.06 FLASHINGS

A. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M; 2 mil type 304 stainless steel sheet bonded on one side to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
1. Type 304 stainless steel.
a. Thickness: 2 mils, minimum.
2. Manufacturers:
a. Hohmann & Barnard, Inc; Mighty-Flash Stainless Flashing SA: www.h-b.com/#sle.
b. WIRE-BOND; Bond-N-Flash SA: www.wirebond.com/#sle.
c. York Manufacturing, Inc; York 304 SA: www.yorkmfg.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

B. Factory-Fabricated Inside and Outside Flashing Corners and End Dams: Stainless steel.
1. Manufacturer shall be the same as flexible fabric flashing manufacturer.

C. Factory-Fabricated Drip Plates including Inside and Outside Corners: Stainless steel.
1. Pre-formed smooth drip plates with hemmed edges.
2. Manufacturer shall be the same as stainless steel/polymer fabric flashing manufacturer.

D. Flashing Sealant/Adhesives: Silicone, polyurethane, or silyl-terminated polyether/polyurethane or other type required or recommended by flashing manufacturer; type capable of adhering to type of flashing used.
1. Manufacturer shall be the same as flexible fabric flashing manufacturer.

2.07 CAVITY WALL INSULATION

A. Refer to Section 07 2100 Thermal Insulation.

2.08 ACCESSORIES

A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints. ASTM D2000, 2AA-805.
1. Manufacturers:
a. Hohmann & Barnard, Inc: www.h-b.com/sle.

b. WIRE-BOND: www.wirebond.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

B. Compressible Joint Filler: Closed cell neoprene; oversized 50 percent to joint width; self expanding; in maximum lengths available. ASTM D1056, Grade 2A1.
1. Manufacturers:
a. Hohmann & Barnard, Inc: www.h-b.com/sle.
b. WIRE-BOND: www.wirebond.com/#sle.
c. Substitutions: See Section 01 6000 - Product Requirements.

C. Cavity Mortar Control/Drainage Material: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
a. Full depth of cavity and 10 inches high, with dovetail-shaped notches 7 inches deep that prevent clogging with mortar droppings.
b. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; Mortar Trap or a comparable product by one of the following:
1) Advanced Building Products Inc.; www.advancedbuildingproducts.com.
2) Heckmann Building Products; www.heckmannbuildingprods.com.
3) Mortar Net Solutions; www.mortarnet.com.
4) Wire-Bond; www.wirebond.com.
5) Substitutions: See Section 01 6000 - Product Requirements.

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

E. Termination Bars: Stainless steel, 1/8 inch thick by 1-1/2 inch high with 3/8 inch sealant flange at top; compatible with flashing membrane and adhesives.
1. Manufacturers:
a. Advanced Building Products Inc.; www.advancedbuildingproducts.com
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Hohmann & Barnard, Inc.; www.h-b.com.
d. Wire-Bond; www.wirebond.com.
e. York Manufacturing, Inc.; www.yorkmfg.com
f. Substitutions: See Section 01 6000 - Product Requirements.

F. Weep Inserts and Cavity Vents:
1. Type: Plastic cellular/honeycomb design.
2. Color(s): As selected by Architect from manufacturer's full range.
3. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; QV Quadro-Vent or a comparable product by one of the following:
a. Advanced Building Products Inc.; www.advancedbuildingproducts.com.
b. Heckmann Building Products; www.heckmannbuildingprods.com.
c. Mortar Net Solutions; www.mortarnet.com.
d. Wire-Bond; www.wirebond.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

G. Mortar and Grout Screen: 1/4 inch square, polypropylene monofilament screening for preventing grout flow; width sized to match masonry widths.
1. Basis-of-Design Product: Provide Hohmann & Barnard, Inc.; www.h-b.com; MGS or a comparable product by one of the following:
a. Heckmann Building Products; www.heckmannbuildingprods.com.
b. Wire-Bond; www.wirebond.com.
c. Substitutions: See Section 01 6000 - Product Requirements.

H. Masonry Cleaners:

1. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
    a. Basis-of-Design Products: Provide PROSOCO, Inc.; www.prosoco.com: Sure Klean 600 or Sure Klean Vana Trol or a comparable product by one of the following:
        1) Diedrich Technologies, Inc.; www.diedrichtechnologies.com.
        2) Substitutions: See Section 01 6000 - Product Requirements.

2.09 LINTELS

A. Masonry Lintels: Masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and weight classification; reinforcing bars as indicated, and filled with grout.

B. Loose Steel Lintels: Refer to Section 05 5000 - Metal Fabrications.

2.10 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
1. Masonry below grade and in contact with earth: Type S.
2. Exterior, loadbearing masonry: Type S.
3. Exterior, non-loadbearing masonry: Type N.
4. Interior, loadbearing masonry: Type S.
5. Interior, non-loadbearing masonry: Type N.
6. Precast concrete units: Same Type as wall masonry in which unit is set.
7. Limestone units: Same Type as wall masonry in which unit is set.
8. Pointing Mortar: Type N.

B. Colored Mortar: Proportion selected pigments and other ingredients to match Architect's sample, without exceeding manufacturer's recommended pigment-to-cement ratio.

C. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
1. Grout Strength: 3000 psi at 28 days, unless otherwise indicated.

D. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

E. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify that foundations are within tolerances specified.

C. Verify that related items provided under other sections are properly sized and located.

D. Verify that built-in items are in proper location, and ready for roughing into masonry work.

E. Verify that reinforcing dowels are properly placed.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

3.03 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures. Mix units from several pallets or cubes as they are placed.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.
B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
C. Concrete Masonry Units: Unless otherwise indicated:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.
   4. Mortar Joint Thickness: 3/8 inch.
D. Brick Units: Unless otherwise indicated:
   1. Bond: As indicated for different locations.
      a. Running Bond, Stacked Bond, Soldier Course.
   2. Coursing: Two units and two mortar joints to equal 8 inches.
   3. Mortar Joints: Concave.
   4. Mortar Joint Thickness: 3/8 inch.

3.05 PLACING AND BONDING

A. Lay hollow masonry units with face shell bedding on head and bed joints.
B. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
C. Remove excess mortar and mortar smears as work progresses.
D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
E. Interlock intersections and external corners.
F. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.
G. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
H. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
I. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
J. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
K. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.
L. Isolate cast stone units and precast architectural concrete units from clay masonry with building paper or similar method of providing a continuous bond break/slip plane.
M. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.
   4. Rake out mortar joints for pointing with sealant.

3.06 WEEPS INSERTS/CAVITY VENTS

A. Install weep inserts in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

B. Install cavity vents in veneer and cavity walls at 24 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. Provide not less than 2 inches of airspace between back of masonry veneer and face of insulation.

1. Keep airspace clean of mortar droppings and other materials during construction. Bevel beds away from airspace, to minimize mortar protrusions into airspace. Do not attempt to trowel or remove mortar fins protruding into airspace.

C. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

D. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 HORIZONTAL JOINT REINFORCEMENT AND ANCHORAGE - SINGLE WYTHE MASONRY AND CAVITY WALL MASONRY

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

E. Masonry to Structural Steel and Concrete:

1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Unless otherwise indicated on drawings or closer spacing is indicated under specific wall type, space anchors at maximum of 24 inches horizontally and 24 inches vertically.

F. Embed ties and anchors in mortar joint and extend into masonry unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.09 MASONRY VENEER REINFORCEMENT AND ANCHORAGE

A. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

B. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 16 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

C. Embed ties and anchors in mortar joint and extend into masonry veneer unit a minimum of 1-1/2 inches with at least 5/8 inch mortar cover to the outside face of the anchor.

3.10 MASONRY FLASHINGS

A. General:

1. Install masonry flashings according to manufacturer's instructions and as indicated on the Drawings.
2. Remove or cover protrusions or sharp edges that could puncture flashings.
3. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.
4. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.

a. Extend flashings full width at such interruptions and at least 6 inches, minimum, into adjacent masonry or turn up at least 8 inches, minimum, to form watertight pan at non-masonry construction.

5. Terminate flashing up 8 inches minimum on vertical surface of backing:
   a. Install vertical leg of flashing over fluid-applied or self-adhered air/vapor barriers over backing or per manufacturer's direction, unless otherwise indicted.
   b. Anchor vertical leg of flashing into backing with a termination bar and sealant.
6. Install flashing in accordance with manufacturer's instructions and BIA Technical Notes No. 7, unless more stringent requirements are specified in this section.

B. Flexible Fabric Flashing:
1. Use factory-fabricated drip plates, corners and end dams.
2. Extend flexible fabric flashing to within 1/4 inch of exterior face of masonry overlapping metal drip plate.
3. Extend flexible fabric flashing full width of cavity space and turn up inner masonry wythe or sheathing at least 14 inches.
4. Secure flexible fabric flashing to wall with continuous termination bar and apply sealant across top of termination bar.

3.11 LINTELS

A. Install loose steel lintels over openings.
B. Install reinforced unit masonry lintels over openings where steel lintels are not scheduled.
1. Unless otherwise indicated, reinforce as follows:
   a. Openings to 48 inches: Place two, No. 4 reinforcing bars 1 inch from bottom web.
   b. Openings from 48 inches to 80 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
   c. Openings over 80 inches: Reinforce openings as detailed.
2. Do not splice reinforcing bars.
3. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
4. Place and consolidate grout fill without displacing reinforcing.
5. Allow masonry lintels to attain specified strength before removing temporary supports.

C. Where the Drawings do not indicate otherwise, provide reinforced unit masonry lintels at all openings and penetrations wider than 12 inches in brick and 24 inches in CMU.
D. Maintain minimum 8 inch bearing on each side of opening unless otherwise indicated.

3.12 BOND BEAMS

A. Bond Beams: At bond beams or other locations for horizontally reinforced masonry, provide special masonry units.
B. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web unless otherwise indicated.
C. Lap reinforcing bar splices minimum 24 bar diameters, unless otherwise indicated.
D. Place and consolidate grout fill without displacing reinforcing.

3.13 VERTICAL MASONRY REINFORCEMENT

A. Reinforcement: Size and place vertical masonry reinforcement to comply with TMS 402/602 requirements and as indicated on Drawings.
B. Place and consolidate grout fill without displacing reinforcing.

3.14 GROUTING

A. Reinforced Hollow Unit Masonry: Keep vertical cores to be grouted clear of mortar, including bed area of first course.
B. Perform grouting by means of high-lift technique, except in locations that mandate use of low-lift grouting technique.
1. Do not use high-lift grouting where size of cavities mandates use of fine grout.

C. Low-Lift Grouting:
1. Limit height of pours to 12 inches.

2. Limit height of masonry to 16 inches above each pour.
3. Pour grout only after vertical reinforcing is in place; place horizontal reinforcing as grout is poured. Prevent displacement of bars as grout is poured.
4. Place grout for each pour continuously and consolidate immediately; do not interrupt pours for more than 1-1/2 hours.

D. High-Lift Grouting:
1. Verify that horizontal and vertical reinforcement is in proper position and adequately secured before beginning pours.
2. Clean out masonry cells and other cavities to be grouted by high pressure water spray or compressed air. Remove debris, allow to dry, and inspect before sealing cleanout openings.
3. Hollow Masonry: Limit lifts to maximum 4 feet and pours to maximum height of 24 feet.
4. Place grout for spanning elements in single, continuous pour.

3.15 GROUTED COMPONENTS

A. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
B. Place and consolidate grout fill without displacing reinforcing.
C. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.16 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.
B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
1. Refer to Section 07 9200 - Joint Sealants for sealant installation.

3.17 BUILT-IN WORK

A. As work progresses, install built-in metal door frames, glazed frames, anchor bolts, plates, and reglets and other items to be built into the work and furnished under other sections.
B. Install built-in items plumb, level, and true to line.
C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

3.18 TOLERANCES

A. Dimensions and Locations of Elements:
1. Location of elements in plan; do not vary from that indicated on Drawings by more than:
a. Plus or minus 1/2 inch.
2. Dimensions in cross section; do not vary from that indicated on Drawings by more than:
a. Minus 1/4 inch.
b. Plus 1/2 inch.

B. Maximum Variation from Alignment of Columns and Pilasters: 1/4 inch.
C. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
D. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
E. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
F. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
H. Lines and Levels:
1. Maximum variation from level:
a. Includes, but is not limited to, the following:
1) Lintels.
2) Sills.

3) Parapets.
4) Reveals.
5) Other conspicuous lines.

b. Do not vary from level by more than:
1) 1/4 inch in 20 feet.
2) 1/2 in in 40 feet or more.

2. Maximum variation from plumb:
a. Includes, but is not limited to, the following:
1) External corners.
2) Control and expansion joints.
3) Reveals.
4) Other conspicuous lines.

b. Do not vary from plumb by more than:
1) 1/4 inch in 20 feet.
2) 1/2 in in 40 feet or more.

I. Mortar Joint Thickness: Do not vary thickness indicated by more than plus or minus 1/8 inch.

3.19 FIELD QUALITY CONTROL

A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.

3.20 CLEANING

A. Protect surrounding elements and finishes from damage due to cleaning procedures.
B. Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 10 feet away, subject to Architect's approval.
C. Remove excess mortar and mortar droppings.
D. Clean soiled surfaces with cleaning solution.
E. Apply masonry cleaners to masonry surfaces according to manufacturer's written instructions; use brush or spray application.
1. Periodically during rinsing, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.
a. Repeat rinsing until tested pH of water runoff is between 6.7 and 7.5.

END OF SECTION

SECTION 05 4000 – COLD FORMED METAL FRAMING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

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

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data and installation instructions for each item of cold-formed metal framing and accessories.

C. Shop drawings showing layout, spacings, sizes, thickness, and types of cold-formed metal framing, fabrication, fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachments to other units of work.
   1. Include structural analysis data sealed and signed by the qualified professional engineer who was responsible for its preparation.

1.04 QUALITY ASSURANCE

A. Component Design: Calculate structural properties of studs and joists in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."

B. Welding: Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."

C. Pre-Installation Conference: Prior to start of installation of metal framing systems, meet at project site with installers of other work including door and window frames and mechanical and electrical work. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.
   1. Coordinate with provisions of Division 1 Section "Project Meetings."

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   1. ClarkDietrich Building Systems; www.clarkdietrich.com.
   2. Jaimes Industries Inc. ; www.jaimesind.com.
   3. Marino\WARE; www.marinoware.com.
   4. State Building Products; www.statebp.com.

5. Steel Stud Solutions, LLC; www.steelstudsolutions.com.
6. Telling Industries; www.buildstrong.com.

2.02 METAL FRAMING

A. Structural Performance: Engineer, fabricate, and erect cold-formed metal framing to withstand design loads within limits and under conditions required.
   1. Design framing systems to withstand wind load per current BOCA without deflections greater than l/600 of the wall height.
   2. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change (range) of 120 Deg F (67 Deg C).
   3. Design framing system to accommodate deflection of primary building structure and construction tolerances, and to maintain clearances at openings.
   4. Design exterior framing to accommodate lateral deflection without regard to contribution of sheathing materials.
   5. Engineering Responsibility: Engage a fabricator who assumes undivided responsibility for engineering cold-formed metal framing by employing a qualified professional engineer to prepare design calculations, shop drawings, and other structural data.
   6. Provide Cee studs of depth indicated at maximum 16" on center, 20-gage minimum.
   7. Provide deep leg slip track connection as required under structural steel framing.

B. For 16-gage and heavier units, fabricate metal framing components of structural quality steel sheet with a minimum yield point of 50,000 psi; ASTM A 446, A 570, or A 611.

C. For 18-gage and lighter units, fabricate metal framing components of commercial quality steel sheet with a minimum yield point of 33,000 psi; ASTM A 446, A 570, or A 611.

D. Provide galvanized finish on metal framing components complying with ASTM A525 for minimum G 60 coating.
   1. Finish of installation accessories to match that of main framing components, unless otherwise indicated.

E. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish.

F. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.

G. Galvanizing Repair: Where galvanized surfaces are damaged, prepare surfaces and repair in accordance with procedures specified in ASTM A 780.

2.03 FABRICATION

A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.

B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.

C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.

D. Wire tying of framing components is not permitted.

E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 10 feet.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.

B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.

C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges.

D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.

E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.

F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.

G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.

H. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.

I. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c. Weld at each intersection.

J. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
   1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

K. Field Painting: Touch-up damaged shop-applied protective coatings. Use compatible primer for prime-coated surfaces; use galvanizing repair system for galvanized surfaces.

END OF SECTION -

SECTION 05 5000 - METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items, including:
   1. Loose steel lintels.
   2. Bent metal restraints at top of interior masonry walls.
   3. Steel framing supports for the following:
      a. Roof openings.
      b. Folding panel partitions (operable partitions).
      c. Mechanical and electrical equipment.
      d. Applications where framing and supports are not specified in other Sections.
      e. Other items as indicated on Drawings.
   4. Metal ladders.
   5. Elevator pit ladder.
   6. Elevator hoist beam.
   7. Bollards.
   8. Other items as indicated on Drawings.
B. Prefabricated metal items, including:
   1. Alternating tread stairs.
C. Slotted channel framing.

1.02 REFERENCE STANDARDS

A. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
B. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
D. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
G. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
H. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
I. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
K. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
L. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
N. NAAMM MBG 531 - Metal Bar Grating Manual; 2017.
O. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
P. SSPC-SP 2 - Hand Tool Cleaning; 2018.

Q. ASTM B209/B209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014. ****ADD3****
R. ASM B210/B210M – Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
S. ASTM B211/B211M – Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
T. ASTM B221/B221M – Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wires, Profies, and Tubes; 2021.

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 5years 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 LOOSE STEEL LINTELS

A. General:
   1. Fabricate loose steel lintels from steel angles, plates, and other shapes as indicated.
      a. Weld adjoining members together to form a single unit.
   2. Size loose steel lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
   3. Galvanize loose steel lintels located in exterior walls.
   4. Prime loose steel lintels located in interior walls.
   5. Provide lintels at openings for all equipment and ductwork.
B. See Structural Drawings and/or Specifications for masonry and loose steel lintel schedules.

2.04 BENT METAL RESTRAINTS

A. Bent Metal Restraints: Bent metal restraints that restrain top of interior masonry walls.
   1. Fabricate bent metal restraints from 12 gage, 0.108 inch, thick galvanized sheet steel.
      a. L-shaped: 4 inches wide; each leg 4 inches long. Minimum.
   2. Finish: Prime painted.
   3. Fasteners: As appropriate for indicated substrates.

2.05 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.

2.06 LADDERS

A. Ladders: Steel; in compliance with ANSI A14.3, including landings; with mounting brackets and attachments; prime paint finish, except galvanized at exterior locations and elsewhere as indicated.
   1. Elevator pit ladders: Comply with ASME A17.1.
   2. Side Rails: 3/8 x 2 inches members spaced at 18 inches, unless otherwise indicated.
   3. Rungs: 1 inch diameter solid round bar spaced 12 inches on center, unless otherwise indicated. Slip-resistant surface, Grade 2 - Medium.
      a. Space rungs 7 inches from wall surface, unless otherwise indicated.
      b. Basis-of-Design Product: Provide SlipNOT, Division of W.S. Molnar Company; SlipNOT Ladder Rung: www.slipnot.com, or a comparable product by one of the following:
         1) Brown- Campbell Corp.: www.brown-campbell.com.
         2) Substitutions: See Section 01 6000 - Product Requirements.
      c. Where galvanized finish is required, rungs shall be galvanized by rung manufacturer.
   4. Support brackets: At top and bottom of ladder, and not more than 60 inches on center.
   5. Landings and Crossovers: Provide steel bar grating platforms supported by steel angles with railings.
      a. Grating: NAAMM MBG 531, welded type.
         1) Top Surface: Non-slip, Grade 2 - Medium.
            (a) Basis-of-Design Product: Provide SlipNOT, Division of W.S. Molnar Company; SlipNOT Grip Grate: www.slipnot.com, or a comparable product by one of the following:
               (1) Substitutions: See Section 01 6000 - Product Requirements.
         2) Fabricate to accommodate design loads.
         3) Limit openings to no more than 1/2 inch in least dimension.
         4) Where galvanized finish is required, grating shall be galvanized by grating manufacturer.

B. Ladder Safety Swing Gates: Steel; ladder safety swing gates shall securely close over ladder and rungs preventing unauthorized use of ladder until gate is unlocked and swung open providing clear access to ladder rungs; prime paint finish, except galvanized at exterior locations and elsewhere as indicated.
   1. Gate Frame: Minimum 1-1/2 inch steel tubing with welded corners.
   2. Gate Infill Panel: Expanded metal shall completely fill gate frame and be welded securely to gate frame along it's entire perimeter.
      a. Standard Expanded Metal:
         1) Style: 1/2 inch, No. 13.
         2) Open Area: 57 percent.
         3) Weight: 1.47 lbs/sq ft.
         4) SWD (Short Way of Design): 0.5 inches.
         5) LWD (Long Way of Design): 1.2 inches.
   3. Gate Size: Width of ladder by 80 inches high, minimum, unless otherwise indicated.
   4. Hardware:
      a. 5 knuckle steel hinges welded to gate frame and ladder siderails; three minimum.
      b. Padlock hasp made of steel plates welded to ladder siderail and gate frame as required to enable the hasp to secure and lock gate across ladder rungs preventing ladder use.

C. Ladders: Aluminum; in compliance with ANSI A14.3, with mounting brackets and attachments. Anodized finish. ****ADD3****
   1. Side Rails: 3/8" x 2 inches minimum members spaced at 18 inches, unless otherwise indicated.
   2. Rungs: 1 inch diameter tubular rod spaced 12 inches on center, unless otherwise indicated. Slip-resistant surface, Grade 2 – Medium.
      a. Rungs to be minimum 7 inches from wall surface, unless otherwise indicated.
   3. Support bracket: Anchor at bottom of ladder with stainless steel bolt

2.07 BOLLARDS

A. Bollards:
   1. Standard Fixed Bollards: Steel pipe, concrete filled, crowned cap, as detailed; galvanized finish.
      a. Steel Pipe: Schedule 40 steel pipe.
      b. Concrete Fill: Refer to Section 03 3000 - Cast-in-Place Concrete.
   2. Surface Mounted Bollards: Steel pipe with minimum 3/8 inch thick steel baseplate welded to bollard base for bolting to concrete slab. Drill baseplates at each corner for 3/4 inch anchor bolts. Galvanized finish.
      a. Steel Pipe: Schedule 40 steel pipe.
      b. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.
   3. Covers: High-density polyethylene thermoplastic (HDPE) sleeves with rounded domed top.
      a. Wall Thickness: 1/4 inch.
      b. Color: As selected by Architect from manufacturer's standard colors.
      c. Provide complete with manufacturer's standard adhesive tape for securing sleeve to bollard.
      d. Provide covers for all bollards.
      e. Basis-of-Design Product: Provide Ideal Shield; 1/4" Bollard Cover: www.idealshield.com, or a comparable product by one of the following:
         1) Substitutions: See Section 01 6000 - Product Requirements.

2.08 ELEVATOR HOISTWAY BEAMS

A. Elevator Hoistway Beams: Beam sections; prime paint finish. Size as indicated.

2.09 PREFABRICATED ALTERNATING TREAD STAIRS

A. Alternating Tread Stairs: Open-type alternating tread stair with plate stringers, formed metal treads, and pipe and tube railings; treads shall be slip resistant and shed water.
   1. Material: Steel; connections may be welded or bolted.
   2. Stair Angle: 68 degrees.
   3. Finish: Safety yellow color in powder coat finish.
   4. Manufacturer:
      a. Basis-of-Design: Provide product as manufactured by Lapeyre Stair, Inc: www.lapeyrestair.com, or a comparable product by one of the following:
         1) Substitutions: See Section 01 6000 - Product Requirements.

2.10 MISCELLANEOUS

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

2.11 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.

2.12 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.

2.13 MATERIALS – ALUMINUM **ADD3**

A. Extruded Aluminum: ASTM B221 (ASTM 221M), 6063 alloy, T6 temper.
B. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
C. Aluminum-Alloy Bars: ASTM B211/B211M/ 6061 alloy, T6 temper.
D. Bolts, Nuts, and Washers: Stainless Steel.
E. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

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 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 5100 - METAL STAIRS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stairs with concrete treads.
B. Stairs with metal treads.
C. Stairs with grating treads.
D. Structural steel stair framing and supports.

1.02 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
B. ASTM A6/A6M - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling; 2021.
C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
E. 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.
F. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
G. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.
H. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
I. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
J. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
K. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate placement of metal anchors and fabrications in concrete and masonry.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories.
    1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
    2. Include the design engineer's seal and signature on each sheet of shop drawings.
C. Design Data: As required by authorities having jurisdiction.
D. Welders' Certificates.
E. Designer's Qualification Statement.
F. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is certified under AISC 201.

1.05 QUALITY ASSURANCE

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

B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

C. Fabricator Qualifications:

1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
2. A company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

PART 2 PRODUCTS

2.01 METAL STAIRS - GENERAL

A. Metal Stairs: Provide stairs of the design specified, complete with landing platforms, vertical and horizontal supports, railings, and guards, fabricated accurately for anchorage to each other and to building structure.

1. Regulatory Requirements: Provide stairs and railings that comply with most stringent requirements of local, state, and federal regulations; where requirements of Contract Documents exceed those of regulations, comply with Contract Documents.
2. Handrails: Comply with applicable accessibility requirements of ADA Standards.
3. Structural Design: Provide complete stair and railing assemblies complying with the applicable local code.
4. Dimensions: As indicated on drawings.
5. Shop assemble components; disassemble into largest practical sections suitable for transport and access to site.
6. No sharp or rough areas on exposed travel surfaces and surfaces accessible to touch.
7. Separate dissimilar metals using paint or permanent tape.

B. Metal Jointing and Finish Quality Levels:

1. Commercial: Exposed joints as inconspicuous as possible, whether welded or mechanical; underside of stair not covered by soffit IS considered exposed to view.
   a. Welded Joints: Intermittently welded on back side, filled with body putty, and sanded smooth and flush.
   b. Welds Exposed to View: Ground smooth and flush.
   c. Mechanical Joints: Butted tight, flush, and hairline.
   d. Bolts Exposed to View: Countersunk flat or oval head bolts; no exposed nuts.
   e. Exposed Edges and Corners: Eased to small uniform radius.
   f. Metal Surfaces to be Painted: Sanded or ground smooth, suitable for satin or matte finish.

C. Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.

D. Anchors and Related Components: Same material and finish as item to be anchored, except where specifically indicated otherwise; provide all anchors and fasteners required.

2.02 METAL STAIRS WITH CONCRETE TREADS

A. Jointing and Finish Quality Level: Commercial, as defined above.

B. Risers: Closed.

C. Treads: Metal pan with field-installed concrete fill.

1. Concrete Depth: 1-1/2 inches, minimum.
2. Tread Pan Material: Steel sheet.
3. Pan Anchorage to Stringers: Welded to carrier angles welded to stringers.
4. Concrete Reinforcement: None.
5. Concrete Finish: Steel troweled.

D. Risers: Same material and thickness as tread pans.
   1. Riser/Nosing Profile: Sloped riser with rounded nosing of minimum radius.
   2. Nosing Depth: Not more than 1-1/2 inch overhang.
   3. Nosing Return: Flush with top of concrete fill, not more than 1/2 inch wide.
E. Stringers: Rolled steel channels or HSS.
   1. Stringer Depth: 12 inches, minimum.
   2. End Closure: Sheet steel of same thickness as risers welded across ends.
F. Landings: Same construction as treads, supported and reinforced as required to achieve design load capacity.
G. Railings: As indicated on Drawings.
H. Finish: Shop- or factory-prime painted.

2.03 HANDRAILS AND GUARDS

A. Wall-Mounted Rails: See Section 05 5213.
B. Guards: As specified in Section 05 5213.

2.04 MATERIALS

A. Steel Sections: ASTM A36/A36M.
B. Steel Plates: ASTM A6/A6M or ASTM A283/A283M.
C. Ungalvanized Steel Sheet: Hot- or cold-rolled, except use cold-rolled where finished work will be exposed to view.
   1. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Designation SS (structural steel), Grade 33.
   2. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Designation SS (structural steel), Grade 33, Type 1.
D. Concrete Fill: See Section 03 3000.

2.05 ACCESSORIES

A. Steel Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.
B. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
C. Shop and Touch-Up Primer: SSPC-Paint 15, and comply with VOC limitations of authorities having jurisdiction.

2.06 SHOP FINISHING

A. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
B. Do not prime surfaces in direct contact with concrete or where field welding is required.
C. Prime Painting: Use specified shop- and touch-up primer.
   1. Preparation of Steel: In accordance with SSPC-SP 2 Hand Tool Cleaning.
   2. Number of Coats: One.
   3. Locations: All locations.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. When field welding is required, clean and strip primed steel items to bare metal.
B. Supply items required to be cast into concrete and embedded in masonry with setting templates.

3.03 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortion or defects.
B. Provide anchors, plates, angles, hangers, and struts required for connecting stairs to structure.
C. Allow for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Provide welded field joints where specifically indicated on drawings. Perform field welding in accordance with AWS D1.1/D1.1M.
E. Other field joints may be either welded or bolted provided the result complies with the limitations specified for jointing quality levels.
F. Obtain approval prior to site cutting or creating adjustments not scheduled.
G. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.

3.04 TOLERANCES

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

END OF SECTION

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Steel pipe and tube railings.
B. Includes:
   1. Wall mounted handrails.
   2. Stair railings and guardrails.
   3. Free-standing railings at steps.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
E. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
F. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
G. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
H. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
I. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
K. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
L. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

C. Fabricator Qualifications:

1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
2. A company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.

B. Railing Configurations and Layout: As indicated.

C. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 50 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

D. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935

E. Allow for expansion and contraction of members and building movement without damage to connections or members.

F. Dimensions: See drawings for configurations and heights.

1. Top Rails and Wall Rails: 1-1/2 inches diameter, round, unless otherwise indicated.
2. Intermediate Rails: 1-1/2 inches diameter, round, unless otherwise indicated.
3. Posts: 1-1/2 inches diameter, round, unless otherwise indicated.
4. Balusters: 1/2 inch round solid bar, unless otherwise indicated.

G. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

H. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.

B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.

C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.

D. Exposed Fasteners: No exposed bolts or screws.

E. Galvanizing: In accordance with requirements of ASTM A123/A123M.

1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type II - Organic.
2. Locations: All exterior locations and elsewhere as indicated.

F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

1. Locations: All locations except where galvanizing is required.

2.03 MISCELLANEOUS MATERIALS

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

B. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.

C. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; minimum 0.015 inch dry film thickness per coat.

2.04 FABRICATION

A. Accurately form components to suit specific project conditions and for proper connection to building structure.

B. Fit and shop assemble components in largest practical sizes for delivery to site.

C. Fabricate components with joints tightly fitted and secured.

D. Welded Joints:

1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
2. Interior Components: Continuously seal joined pieces by continuous welds.
3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

E. Removable Railings: Fabricate slip-fit metal sockets from same metal as removable railing.

1. Sockets shall be cast into concrete or grouted into core-drilled holes.
2. Size for a close fit with posts, minimizing movement.
   a. Limit movement of post to one-fortieth of post height when measured from top of railing.
3. Provide socket coverplates to cover opening when railings are removed.
   a. Covers shall resist casual contact such as foot or wheeled traffic and remain in place.
4. Where walking surface changes in elevation/height on either side of the removable railing or there is a ledge or drop off of any height, provide chain across gaps formed by removable railings.
   a. Secure chain with snap hooks that fasten to post mounted eyes/staples.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.

C. Install railings in compliance with ADA Standards for accessible design at applicable locations.

D. Anchor railings securely to structure.

E. Anchoring Posts in Concrete:

1. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete.
2. Insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed in accordance with grout manufacturer's instructions.

3. Leave anchorage joint exposed with 1/8 inch buildup sloped away from post.
4. Install removable railing where indicated in slip-fit metal sockets.
    a. Slip-fit metal sockets shall be either cast in concrete or grouted into core-drilled holes.
        1) Grout shall be finished flush with face of concrete.

F. Weld connections that cannot be shop welded due to size limitations.
1. Weld in accordance with AWS D1.1/D1.1M.
2. Match shop welding and bolting.
3. Clean welds, bolted connections and abraded areas.
4. Touch up shop primer and factory applied finishes.
5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

G. Isolate dissimilar materials with bituminous coating, bushings, grommets or washers to prevent electrolytic corrosion.

H. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.

I. Gates:
1. Install level, plumb, and properly aligned with railing posts.
2. Adjust hardware for smooth and noiseless operation.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.05 PROTECTION

A. Protect installed components and finishes from damage after installation.

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

END OF SECTION

SECTION 05 7000 - DECORATIVE METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Screen Wall Divider

1.02 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Schedule and conduct a preinstallation meeting one week before starting work of this section. Attendees shall include, but not be limited to:

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
C. Shop Drawings: Indicate screen panel system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
D. Samples: Submit one (1) of each item below for each type and condition shown.
    1. Post with Bracket: 12 inch long section illustrating color, finish, and connection detail.
    2. Metal Panel: 6 inch by 6 inch sample of each type, illustrating color, finish, and cut pattern.
E. Test Reports: Submit test reports from an independent testing agency showing compliance with specified design and performance requirements.
F. Manufacturer's Installation Instructions.
G. Maintenance Data: Manufacturer's instructions for care and cleaning.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.
J. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.
B. Protect materials against damage during transit, delivery, storage, and installation at site.
C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.

D. Prior to installation, store materials and components under cover in a dry location.

1.07 FIELD CONDITIONS

A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65 degrees F and maximum 95 degrees F.

B. Maintain ambient temperature of space at minimum 65 degrees F and maximum 95 degrees F for 24 hours before, during, and after railing installation.

1.08 WARRANTY

A. Warranty: Manufacturer's standard one year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SCREENWALL SYSTEM

A. Room Dividing Screenwall System: Divider solution in configuration as indicated on drawings.
   1. Posts:
      a. FInish: Painted Aluminum to match Panel.
      b. Size: 2 inch round post, 4 inch round baseplate at floor and ceiling.
   2. Grippers and Plates:
      a. Finish: Painted Aluminum to match panel.
      b. Number of Grippers: Minimum 6 grippers per panel. Provide more grippers as required based upon manufacturer's recommendations.
   3. Laser Cut Panel:
      a. Sizes: As indicated on drawings.
      b. Secure with grippers to posts.
      c. Material: 0.25 inch thick aluminum
      d. Pattern: Grove Series.
         1) Panels A, B, C located as indicated on drawings.
      e. Finish: Standard Powder Coat with 5-year warranty.
      f. Color: Silver.

B. Basis-of-Design:
   1. Moz Designs; Moz Dividers: Post with Grippers, www.mozdesigns.com.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Aluminum Components: ASTM B221 or ASTM B221M.
   1. Tubes: Schedule 40 pipe.
   2. High-Performance Organic Finish: AAMA 2604; multiple coats, thermally cured fluoropolymer system.

2.03 ACCESSORIES

A. Anchors and Fasteners: Provide anchors and other materials as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
   1. For anchorage to concrete, provide inserts to be cast into concrete for bolt anchors.
   2. For anchorage to masonry, provide brackets to be embedded in masonry for bolt anchors.
   3. For anchorage to stud walls, provide backing plates for bolt anchors.
   4. Exposed Fasteners: No exposed bolts or screws.

B. Carbon Steel Bolts and Nuts: ASTM A307.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.

B. Verify field dimensions of locations and areas to receive work.

C. Notify Architect immediately of conditions that would prevent satisfactory installation.

D. Do not proceed with work until detrimental conditions have been corrected.

E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates, and supports for attachment of anchors.

3.02 PREPARATION

A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.

B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.03 INSTALLATION

A. Comply with manufacturer's drawings and written instructions.

B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.

C. Anchor securely to structure.

D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

E. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

B. Maximum Offset From True Alignment: 1/4 inch.

C. Maximum Out-of-Position: 1/4 inch.

3.05 FIELD QUALITY CONTROL

A. Field Services: Provide the services of the manufacturer for field observation of installation of railings.

3.06 CLEANING

A. Remove protective film from exposed metal surfaces.

B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage the material or finish.

3.07 PROTECTION

A. Protect installed components and finishes from damage after installation.

B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.

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

END OF SECTION

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SECTION 05 7300 - DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Railing systems.

1.02 REFERENCE STANDARDS

A. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
E. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing; 2021.
F. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
G. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
H. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
I. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2022.
J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
K. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
L. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
M. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
N. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene preinstallation meeting one week before starting work of this section. Attendees include:
   1. Contractor.
   2. Other subcontractors of adjacent work.
B. Coordination: Coordinate installation of the following:
   1. Placement of anchors in concrete and masonry.
   2. Placement of backing plates in stud wall construction.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Submit manufacturer's product data, including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
C. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
   1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
   2. Include design engineer's seal and signature on each sheet of shop drawings.

D. Samples: Submit one of each item below for each type and condition shown.
E. Test Reports: Submit test reports from independent testing agency showing compliance with specified design and performance requirements.
F. Manufacturer's Instructions: Indicate installation.
G. Designer's qualification statement.
H. Fabricator's qualification statement.

1.05 QUALITY ASSURANCE

A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located or personnel under direct supervision of engineer.
B. Fabricator Qualifications: Certified in accordance with AISC 201 and IAS AC172.
   1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
   2. A company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
C. Welder Qualifications: Welding processes and welding operators certified in accordance with AWS B2.1/B2.1M within 12 months of scheduled welding work.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Provide mock-up of railing system, Four feet long, indicating each type of material, cladding, and finish.
C. Mock-up may remain as part of work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in factory-provided protective coverings and packaging.
B. Protect materials against damage during transit, delivery, storage, and installation at site.
C. Inspect materials upon delivery for damage. Replace damaged items.
D. Prior to installation, store materials and components under cover in dry location.

PART 2 PRODUCTS

2.01 RAILING SYSTEMS

A. General: Factory- or shop-fabricated to suit project conditions, for proper connection to building structure, and in largest sizes practical for delivery to site.
B. Performance Requirements: Applying loads simultaneously not required; design and fabricate railings and anchorages to resist loads without failure, damage, or permanent set, including:
   1. Lateral Force: 75 lb minimum, when tested in accordance with ASTM E935.
   2. Distributed Load: 50 lbf/ft minimum, applied vertically and horizontally at top of handrail, when tested in accordance with ASTM E935.
   3. Concentrated Loads: 200 lb minimum, applied to handrail horizontally and vertically, in accordance with ASTM E935.
C. Assembly: Use slip-on, nonweld mechanical fittings, flanges, escutcheons, and wall brackets to join lengths, seal open ends, and conceal exposed mounting bolts and nuts.
D. Joints: Machined smooth with hairline seams; tightly fitted and secured.
E. Field Connections: Provide sleeves to accommodate site assembly and installation.
F. Metal Railing: Engineered, post-supported railing system with metal infill.
   1. Configuration: Guardrail with separate handrail.
   2. Top Rail: 3/8- by 1-1/2-inch rectangular bar stock, steel.
   3. Grip Rail: Round, stainless steel, 1-1/2-inch diameter.
   4. Decorative Flanges for Embedded Posts: Circular, collared cover plate without screw holes.

5. Wall-Mounted Components: Support railing with 2-1/4-inch clearance from wall using the following:
   a. Underslung Support Brackets: Supports at 60 inches, maximum.
6. Handrail Brackets: Same metal as railing.
7. Fasteners: Concealed.
8. Infill at Picket Railings: Vertical pickets.
   a. Horizontal Spacing: Maximum 4 inches on center.
   b. Material: Solid steel bar.
   c. Shape: Rectangular.
   d. Size: 3/8 inch by 1-1/2" rectangular.
   e. Top Mounting: Welded to underside of top rail.
   f. Bottom Mounting: Welded to side of fascia plate.

2.02 MATERIALS

A. Stainless Steel Components: ASTM A666, Type 304.
   1. Stainless Steel Tubing: ASTM A554, Type 304, 16-gauge, 0.0625-inch minimum metal thickness, 1-1/2-inch diameter.
B. Steel Components:
   1. Sections, Shapes, Plate and Bar: ASTM A36/A36M.
   2. Iron Castings: ASTM A47/A47M, malleable.
   3. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, galvanized in accordance with ASTM A153/A153M.
   4. Welding Materials: AWS D1.1/D1.1M.

2.03 FABRICATION

A. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
   1. Ease exposed edges to small uniform radius.
   2. Welded Joints:

2.04 FINISHES

A. General: Comply with NAAMM AMP 500-06.
   1. Complete mechanical finishes before fabrication. After fabrication, finish joints, bends, abrasions, and surface blemishes to match sheet.
   2. Protect mechanical finishes on exposed surfaces from damage.
   3. Apply organic and anodic finishes to formed metal after fabrication.
   4. Appearance: Limit variations in appearance of adjacent pieces to one-half of range represented in approved samples. Noticeable variations in same piece are not acceptable. Install components within range of approved samples to minimize contrast.
B. Steel Finishes:
   1. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils, 0.015 inch.
   2. Color: As selected by Architect from manufacturer's standard range.
C. Stainless Steel Finishes:
   1. Remove tool marks, die marks, and stretch lines before finishing.
   2. Directional Satin: No.4.
   3. After polishing, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

2.05 ACCESSORIES

A. Nonweld Mechanical Fittings for Stainless Steel Railings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; joints and seams ground smooth.

C. Anchors and Fasteners: Provide anchors, fasteners, and other attachment devices required to attach to structure. Ensure attachment devices are of same material as components unless indicated otherwise.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate and site conditions are acceptable and ready to receive work.
B. Verify field dimensions of locations and areas to receive work.
C. Notify Architect immediately of conditions that would prevent satisfactory installation.
D. Do not proceed with work until detrimental conditions are corrected.

3.02 PREPARATION

A. Protection of In-Place Conditions: Protect existing work before proceeding with installation.
B. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions, and directions for installation of anchorages and fasteners.
C. Clean surfaces to receive railings. Remove materials and substances detrimental to installation.
D. Stainless Steel: After polishing, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install components plumb and level, accurately fitted, free from distortion or defects, and with tight joints, except where necessary for expansion.
C. Anchor securely to structure.
D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
E. Weld connections that cannot be shop welded due to size limitations.
    1. Weld in accordance with AWS D1.1/D1.1M.
    2. Match shop welding and bolting.
    3. Clean welds, bolted connections, and abraded areas.
    4. Touch up shop primer and factory-applied finishes.
    5. Repair galvanizing with galvanizing repair paint in accordance with ASTM A780/A780M.
F. Isolate dissimilar materials with bituminous coating, bushings, grommets, or washers to prevent electrolytic corrosion.

3.04 TOLERANCES

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

3.05 CLEANING

A. Remove protective film from exposed metal surfaces.
B. Metal: Clean exposed metal finishes with potable water and mild detergent in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents, or other substances that may damage material or finish.

3.06 PROTECTION

A. Protect installed components and finishes from damage after installation.
B. Repair damage to exposed, making finishes indistinguishable from undamaged areas.
C. Replace finishes and components that have irreparable damage. Ensure damaged areas are indistinguishable from undamaged finishes and surfaces.

END OF SECTION

SECTION 05 7500 - DECORATIVE FORMED METAL

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior fabrications made of formed metal sheet, secondary supports, and anchors to structure, including:
   1. Closures, trim, and filler panels.
   2. Factory fabricated column covers.
   3. Beam and column covers.

1.02 REFERENCE STANDARDS

A. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use; 2014 (Reapproved 2020).
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
E. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).
F. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).
G. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
H. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
I. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
J. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
K. NAAMM AMP 500-06 - Metal Finishes Manual; 2006.
L. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
M. SSPC-SP 5 - White Metal Blast Cleaning; 2007.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data - Sheet Metal Material: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Specimen warranty.
C. Product Data - Metal Composite Material (MCM) Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.
D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Show actual field measurements on shop drawings.
   2. Differentiate between shop and field fabrication.

3. Indicate substrates and adjacent work with which the fabrications must be coordinated.
4. Include large-scale details of anchorages and connecting elements.
5. Include large-scale details or schematic, exploded or isometric diagrams to fully explain flashing at a scale of not less than _____ inches per _____ inches.

E. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

F. Verification Samples: For each finish product specified, minimum size 12 inches square, representing actual product in color and texture.

G. Installer's Qualification Statement.

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

I. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Company specializing in fabricating products specified in this section.
1. With not less than three years of documented experience.
2. Approved by MCM sheet manufacturer.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section.
1. With minimum 3 years of documented experience.
2. Approved by fabricator.

C. Mock-Up: Provide a mock-up for evaluation of fabrication workmanship.
1. Locate where directed.
2. Provide products finished as specified.
3. Mock-up may remain as part of the Work.

1.05 DELIVERY, STORAGE, AND HANDLING

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

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

1.06 WARRANTY

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

B. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 5 years:
1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material Sheet Manufacturers:
   1. Refer to Section 07 4213.23 - Metal Composite Material Wall Panels.
B. Factory Fabricated Column Covers:
   1. ATAS International, Inc: www.atas.com/#sle.
   2. Centria; Series 2000: www.centria.com.
   3. DAMS Incorporated: www.damsinc.com/#sle.
   4. Fry Reglet Corporation; www.fryreglet.com.
   5. Pac-Clad Petersen: www.pac-clad.com.
   6. SAF Metal Fabrication, a division of Southern Aluminum Finishing Company, Inc : www.saf.com/#sle.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FORMED METAL FABRICATIONS - GENERAL

A. Shop Assembly: Preassemble items to greatest extent possible. Minimize field splices and field assembly. Disassemble only as necessary for transportation and handling. Mark items clearly for assembly and installation.
B. Coordination: Match dimensions and attachment of formed metal items to adjacent construction. Produce integrated assemblies. Closely fit joints; align edges and flat surfaces unless indicated otherwise.
C. Forming: Profiles indicated. Maximize lengths. Fold exposed edges to form hem indicated or ease edges to radius indicated with concealed stiffener. Provide flat, flush surfaces without cracking or grain separation at bends.
D. Reinforcement: Increase metal thickness; use concealed stiffeners, backing materials or both. Provide stretcher leveled standard of flatness and stiffness required to maintain flatness and hold adjacent items in flush alignment.
E. Anchors: Straps, plates and anchors as required to support and anchor items to adjacent construction.
F. Supports: Miscellaneous framing, mounting, clips, sleeves, fasteners and accessories required for installation.
G. Welding and Brazing: Weld or braze joints continuously. Grind, fill or dress to produce smooth, flush, exposed surfaces. Do not discolor metal. Grind smooth, polish, and restore damaged finishes to required condition.

2.03 FORMED METAL FABRICATIONS - SHEET METAL

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

2.04 FORMED METAL FABRICATIONS - MCM SHEET

A. MCM Sheet Fabrications, General: Assemble metal panels, fasteners, and anchors in configurations and dimensions shown on drawings.
   1. Provide panel jointing using reveal joints and gaskets but no sealant.
   2. Anchor panels to supporting framing without exposed fasteners.
B. Panels: One inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
   1. Reinforce corners with riveted aluminum angles.

2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
5. Fabricate panels under controlled shop conditions.
6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
   a. Make panel lines, breaks, curves and angles sharp and true.
   b. Keep plane surfaces free from warp or buckle.
   c. Keep panel surfaces free of scratches or marks caused during fabrication.

2.05 FACTORY FABRICATED COLUMN COVERS

A. Factory Fabricated Column Covers: Factory fabricated and factory finished, sheet metal column covers, mechanically fastened to structural support.
   1. Material: Aluminum sheet, ASTM B209 or ASTM B209M alloy 3003 or 5005.
   2. Sheet Thickness: 0.125 inch, minimum.
   3. Column Section Length: 12 feet, maximum, between horizontal joints.
   4. Joint Type: Reveal.
   5. Horizontal Reveals: Manufacturer's standard; at top, bottom, and center.
   6. Fasteners: Self-drilling; ASTM A449 heat treated steel, with manufacturer's standard corrosion resistant coating.
   7. Aluminum Finish: Manufacturer's standard factory applied PVDF coating.
   8. Color: To be selected by Architect from manufacturer's full range.

2.06 MATERIALS

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

B. Aluminum Sheet: ASTM B209 or ASTM B209M, 5005-H32 minimum; alloy and temper recommended by aluminum producer and finisher for use and finish indicated.

C. Metal Composite Material (MCM) Sheet: Two sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials; core material free of voids and spaces; no foamed insulation material content.
   1. Overall Sheet Thickness: 4 mm.
   2. Face Sheet Thickness: 0.19 inches, minimum.
   3. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
   4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
   5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
   6. Flammability: Self-ignition temperature of 650 degrees F or greater, when tested in accordance with ASTM D1929.

D. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15 mil dry film thickness per coat.

2.07 FINISHES

A. Finishes, General: Comply with NAAMM AMP 500-06.

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

B. Aluminum Finishes:
1. High Performance Organic Coatings: AAMA 2604; multiple coats, thermally cured fluoropolymer system.
2. Color: To be selected by Architect from manufacturer's standard range.

C. Steel Finishes:
1. Surface Preparation: Comply with SSPC-SP 1; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust from uncoated steel; comply with SSPC-SP 5.
2. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.
3. Factory Prime: Apply shop primer to prepared surfaces of items where field painting after installation indicated, unless indicated otherwise..
4. Powder-Coat Finish: Manufacturer's standard thermosetting polyester or acrylic urethane powder coating; minimum cured-film thickness of 1.5 mils.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

D. Notify Architect in writing of conditions detrimental to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

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

B. Coat concrete and masonry surfaces that will be in contact with metal surfaces with bituminous coating.

3.03 INSTALLATION - SHEET METAL AND PLATE FABRICATIONS

A. Locate and place decorative formed sheet metal items level and plumb; align with adjacent construction. Cut, drill and fit as required to install.

B. Do not cut or abrade sheet metal finishes that cannot be completely restored in the field. Return such items to manufacturer or fabricator for required alterations and refinishing or provide new items.

C. Use concealed anchorages where possible. Provide washers where needed on bolts or screws to protect metal surfaces and make weathertight connection.

D. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers indicated.

E. Install gaskets, joint fillers, insulation, sealants, and flashings as work progresses.
1. Make exterior decorative formed sheet metal items weatherproof.
2. Make interior decorative formed metal items soundproof or lightproof as required.

F. Corrosion Protection: Apply permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with incompatible substrate materials. Prevent corrosion damage to material and finish.

3.04 INSTALLATION - MCM FABRICATIONS

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.

B. Comply with instructions and recommendations of MCM sheet manufacturer and fabricator, and with approved shop drawings.

C. Install securely allowing for necessary thermal and structural movement; comply with fabricator's instructions for installation of concealed fasteners.

D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.

E. Do not form panels in field unless required by fabricator and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.

F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.

G. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:

1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
2. Deviation of Vertical Member From True Line: 1/8 inch in 25 feet run, maximum.
3. Deviation of Horizontal Member From True Line: 1/8 inch in 25 feet run, maximum.
4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 1/32 inch, maximum.

H. Replace damaged products.

3.05 CLEANING

A. Restore finishes damaged during installation and construction period. Return items that cannot be refinished in the field to manufacturer or fabricator. Refinish entire unit or provide new units.

B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.

C. Remove temporary coverings and protection of adjacent work areas.

D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed products from damage during construction.

END OF SECTION

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Structural dimension lumber framing.
B. Nonstructural dimension lumber framing.
C. Sheathing.
D. Composite nail base insulated roof sheathing.
E. Subflooring.
F. Roofing nailers.
G. Parapet cap framing
H. Preservative treated wood materials.
I. Fire retardant treated wood materials.
J. Miscellaneous framing and sheathing.
K. Communications and electrical room mounting boards.
L. Concealed wood blocking, nailers, and supports.
M. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024.
B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
C. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
D. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2017).
E. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
F. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2018a.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
H. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
I. PS 1 - Structural Plywood; 2023.
J. 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 PARAPET CAP FRAMING

A. As detailed on drawings with wood blocking or Treated LSL engineered parapet cap framing System.
   1. Manufacturer: PreBuck; www.prebuckproducts.com
B. Designed for direct contact with concrete.
   1. Will not cup, twist or warp.
   2. Insect and Fungus resistant.
C. 1.5 inch thick treated with zinc borate LSL engineered lumber
D. Pitched up to 3/8 inch per foot
E. Counter sunk anchor openings

2.04 CONSTRUCTION PANELS

A. Wall Sheathing: Plywood, PS 1, Grade C-C, Exterior Exposure.
   1. Panel Grade: APA Rated; Structural I Sheathing.
   2. Span Rating: 48/24.
   3. Bond Classification: Exterior.
   4. Performance Category: 3/4.
   5. Thickness: 3/4 inch unless otherwise indicated.
   6. Tongue-and-groove edges.
B. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.
   1. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   2. Edges: Square.
   3. Products:
      a. CertainTeed Corp.; GlasRoc Sheathing: www.certainteed.com.
      b. Continental Building Products; Weather Defense Platinum Sheathing: www.continental-bp.com.
      c. Georgia-Pacific Gypsum:DensGlass Sheathing: www.gp.com.
      d. National Gypsum Company; Gold Bond Brand eXP Sheathing: www.nationalgypsum.com.
      e. United States Gypsum Co.; Securock Brand Glass-Mat Sheathing; www.usg.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. 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.
D. 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.

2.05 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.

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

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION - GENERAL

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

3.03 FRAMING INSTALLATION

A. Set structural members level, plumb, and true to line. Discard pieces with defects that would lower required strength or result in unacceptable appearance of exposed members.
B. Make provisions for temporary construction loads, and provide temporary bracing sufficient to maintain structure in true alignment and safe condition until completion of erection and installation of permanent bracing.
C. Install structural members full length without splices.

D. Comply with member sizes, spacing, and configurations indicated, and fastener size and spacing indicated, but not less than required by applicable codes and AWC (WFCM) Wood Frame Construction Manual.
E. Install horizontal spanning members with crown edge up and not less than 3 inches of bearing at each end.
F. Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists; use metal joist hangers unless otherwise detailed.
G. Provide bridging at framing in excess of 8 feet span at mid-span and as detailed. Fit solid blocking at ends of members.
H. Frame wall openings with two or more studs at each jamb; support headers on cripple studs.

3.04 MISCELLANEOUS FRAMING

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

3.05 BLOCKING, NAILERS, AND SUPPORTS

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

3.06 ROOF-RELATED CARPENTRY

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

3.07 PARAPET CAP FRAMING

A. installation to be completed in accordance with manufacturer's specifications.

3.08 INSTALLATION OF CONSTRUCTION PANELS

A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using screws.
B. 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.

3.09 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.

3.10 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.

3.11 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

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SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Standing and running trim.
B. Wood paneling.
C. Cabinets and millwork - specially fabricated.
   1. Plastic-laminate clad cabinets and millwork.
   2. Wood cabinets and millwork.
D. Countertops.- Specified In 12 3600 Countertops
E. Display Case
   1. Glazed Doors and Hardware
   2. Display System
F. Miscellaneous items including:
   1. Window stools
   2. Closet and utility shelving.
   3. L-Bracket Shelving System.
   4. Other items as indicated on Drawings.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
E. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
F. AWPA U1 - Use Category System: User Specification for Treated Wood; 2017.
G. BHMA A156.18 - Materials and Finishes; 2020.
H. BHMA A156.9 - Cabinet Hardware; 2020.
I. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
J. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
K. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
L. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
M. PS 1 - Structural Plywood; 2023.
N. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for the following:
   1. Anchors and fasteners.
   2. Adhesives.
   3. Shop finishing materials.
   4. Fire retardant treatment.
   5. Wood preservative treatment.
C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories. Include the following:
   1. Information required by AWI/AWMAC/WI (AWS).

2. Dimensioned plans, elevations, and sections.
3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.

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

1.05 QUALITY ASSURANCE

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

B. Single Source Responsibility: Provide and install interior architectural woodwork from single fabricator.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements for additional requirements.

B. Mockups: When requested by Architect, build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Comply with AWI/AWMAC/WI (AWS).

B. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas.

C. Store woodwork in installation areas or in areas with the same environmental conditions; temperature and humidity conditions in storage areas shall be at the same levels planned for occupancy.

D. Protect units from moisture damage.

1.08 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 WOOD-BASED COMPONENTS

A. Wood fabricated from old growth timber is not permitted.

B. Particle Board: ANSI A208.1, Grade M-2.

C. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.

D. Hardwood Plywood: HPVA HP-1.

E. Softwood Plywood: PS 1.

F. Fire Retardant Treatment:
   1. Manufacturers:
      a. Lonza Group: www.wolmanizedwood.com.
      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. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread index of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
      a. Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.

G. Preservative Treatment:
   1. Manufacturers:
      a. Lonza Group: www.wolmanizedwood.com.
      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: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
      a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
      b. Treat lumber in contact with masonry or concrete.
      c. Treat lumber in other locations as indicated.
   3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative.
      a. Kiln dry plywood after treatment to maximum moisture content of 19 percent.
      b. Treat plywood in contact with masonry or concrete.
      c. Treat plywood at countertop subtops at sinks or other wet locations.
      d. Treat plywood in other locations as indicated.
   4. Preservative Pressure Treatment of Lumber in Contact with Soil: AWPA U1, Use Category UC4A, Commodity Specification A using waterborne preservative.
   5. Preservative for Field Application to Cut Surfaces: As recommended by manufacturer of factory treatment chemicals for brush-application in the field.

2.02 LAMINATE MATERIALS

A. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as indicated or recommended for specific applications.
   1. Manufacturers:
      a. Formica Corporation: www.formica.com.
      b. Panolam Industries International, Inc. Nevamar: www.nevamar.com.
      c. Panolam Industries International, Inc. Pionite: www.pionitelaminates.com.
      d. Wilsonart: www.wilsonart.com.
      e. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
   2. Colors, Patterns, and Finishes:
      a. PL1 Wilsonart Landmark Wood, 7981K-12, Soft Grain Finish with AEON Scratch Resistance.
      b. PL2A: FormicaStorm Matte Texture, 912-58.
      c. PL2B: Formica Green Slate Matte Texture, 8793-58
      d. PL2C: Formica Gold Braze Matte Finish, 1193-58
      e. PL2D: Formica Earthenware Matte Finish, 8241-58
      f. PL4: Formica Color Core 2, Matte Finish, White, 949C-58

g. PL5: Wilsonart Spruce Velvet, 15518 Ultra Matte Fingerprint Resistant Finish

B. Low Pressure Decorative Laminate (LPDL): Melamine resin, NEMA LD 3, Type VGL (0.20 inch thick) laminate panels; thermally fused.
   1. Manufacturers:
      a. Panolam Industries International, Inc.: www.panolam.com.
      b. Wilsonart: www.wilsonart.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.
   2. Color: White unless otherwise indicated.

C. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness. Match adjacent laminate in color, pattern, and finish.
   1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.
   2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

2.03 SOLID SURFACING

A. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous and non-porous; no surface coating; color and pattern consistent throughout thickness.
   1. Manufacturers:
      a. E. I. du Pont de Nemours and Company (Dupont); Corian: www.corian.com.
      b. Substitutions: See Section 01 6000 - Product Requirements Not permitted.
   2. Colors, Patterns, and Finishes:
      a. SS1Du Pont Corian, Ash Aggregate
      b. SS3Du Pont Corian, Carbon Aggregate.
      c. SS4Du Pont Corian, Everest, with Beveled Rounded Edge.

B. Solid Surfacing Sinks: Undermount oval-shaped sinks integrated at factory with solid-surfacing countertop.
   1. Product:
      a. E. I. du Pont de Nemours and Company (Dupont); Corian Model 810P Lavatory: www.corian.com.
      b. Substitutions: Not permitted.
   2. Colors, Patterns, and Finishes: Glacier White.

2.04 ACCESSORIES

A. Support Faming, Grounds, and Concealed Blocking: Refer to Section 06 1000 - Rough Carpentry.

B. Stain and Finishing Materials: In compliance with AWI/AWMAC/WI (AWS), unless noted otherwise.

C. Adhesives: Type recommended by fabricator to suit application.
   1. Do not use adhesives that contain urea formaldehyde.
   2. VOC Limits for Installation Adhesives and Glues: Use installation adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
      a. Wood Glues: 30 g/L.
      b. Contact Adhesive: 250 g/L.

D. Fasteners: Size and type to suit application.

E. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

F. Concealed Joint Fasteners: Threaded steel.

2.05 HARDWARE

A. Cabinet Hardware, General: BHMA A156.9, types as indicated for quality grade specified.

1. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finish:
    a. Satin Chrome: BHMA 626.
2. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

B. Hinges: Semiconcealed type, 5 knuckle, institutional grade, hospital tip, 2-3/4 inch overlay, 270 opening angle, 3 way adjustment, 0.095 inch gage, steel with satin finish, Grade 1.
1. Manufacturers:
    a. Grass America Inc: www.grassusa.com.
    b. Hafele America Co.: www.hafele.com.
    c. Rockford Hinge; Five Knuckle Overlay Hinge, part no. 374: www.rockfordprocesshingesandhardware.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.
2. Number of Hinges:
    a. Provide two (2) hinges for doors less than 36 inches high.
    b. Provide three (3) hinges for doors 37 inches to 54 inches high.
    c. Provide four (4) hinges for tall cabinet doors 55 inches to 84 inches high.

C. Drawer Slides: Zinc-plated, steel ball-bearing slides.
1. Standard Duty, Grade 1:
    a. Self-closing, side mounted and extending under bottom edge of drawer.
    b. Locations: For drawers not more than 3 inches high and 24 inches wide.
2. Heavy Duty, Grade 1HD-100:
    a. Self-closing, side or bottom mounted; full-extension type.
    b. Locations: For drawers not more than 6 inches high and 24 inches wide.
3. Heavy Duty, Grade 1HD-200:
    a. Self-closing, side or bottom mounted; full-extension type.
    b. Locations: For drawers more than 6 inches high or 24 inches wide.
4. Manufacturers:
    a. Accuride International, Inc: www.accuride.com.
    b. Grass America Inc: www.grassusa.com.
    c. Hafele America Co.: www.hafele.com.
    d. Knape & Vogt Manufacturing Company: www.knapeandvogt.com.
    e. Substitutions: See Section 01 6000 - Product Requirements.

D. Back-Mounted Pulls:
1. Product:
    a. Hafele America Co.; Item No. 117.50.610, Wire Handle, Matt Stainless Steel: www.hafele.com.
        1) 110mm (4 inches nominal) Width.
    b. Substitutions: See Section 01 6000 - Product Requirements.

E. Catches: Magnetic catches, BHMA A156.9, B03141.
1. Available Product:
    a. Hafele America Co.; Model 246.26.702: www.hafele.com.

F. Door and Drawer Silencers: BHMA A156.16, L03011.

G. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated shelf rests, satin chrome finish, for nominal 1 inch spacing adjustments.
1. BHMA A156.9, B04013.

H. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome finish, for nominal 1 inch spacing adjustments.
1. BHMA A156.9, B04102; with shelf brackets, B04112.

I. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with satin finish.
   1. Door Locks: BHMA A156.11, E07121.
   2. Drawer Locks: BHMA A156.11, E07041.
   3. Provide minimum of 2 keys per lock and 4 master keys.
   4. Provide on all drawers and doors, unless otherwise indicated.
   5. Key all cabinets within a room the same, key all rooms differently.

J. Grommets for Cable Passage: 2-1/2 inch OD, solid brass grommets and matching caps with slot for wire passage.
   1. Color: Satin Chrome.
   2. Available Product:
      a. Doug Mockett & Company Inc.; MM6 Series: www.mockett.com.

K. Coat Rod and Brackets:
   1. Rod:
      a. Material: Steel Tubing.
      b. Outside Diameter: 1-5/16 inches.
      c. Wall Thickness: 0.106 inches.
      d. Length: As indicated.
   2. Brackets: Wall flanges; steel.
   3. Finish: Chrome.
   4. Available Product:
      a. Knape & Vogt; KV 770 Series Rod with 764 Wall Flanges: www.knapeandvogt.com.

L. Countertop Support Brackets:
   1. Tee-Shaped Brackets: Fabricated from 6063-T6 extruded aluminum 2 inch by 3 inch by 3/16 inch Tee.
      a. Finish: Black.
      b. Size: 18 inch support unless otherwise indicated.
         1) Manufacturers:
            (a) Rakks Model EH 1818 ; Rangine Corp.: www.rakks.com.
            (b) Or equal by A&M Hardware, Inc.; www.aandmhardware.com.
            (c) Substitutions: See Section 01 6000 - Product Requirements.
      c. Where concealed flush mount is indicated on Drawings, provide the following:
         1) Manufacturers:
            (a) Rakks Model EH1818-FM; Rangine Corp.: www.rakks.com.
            (b) Or equal by A&M Hardware, Inc.; www.aandmhardware.com.
            (c) Substitutions: See Section 01 6000 - Product Requirements.
   2. Face Plate: Fabricated from 6063-T6 extruded aluminum.
      a. Compatible with Flush-Mount Counter Supports.
      b. Adhesive mounts of face of finished gypsum board wall.
      c. Size: 3.25 inch by 3.75 inch with slot for Tee of counter support bracket.
      d. Finish: Clear Anodized.
      e. Manufacturers:
         1) Rakks Model EH-FP-22; Rangine Corp.: www.rakks.com.
         2) Or equal by A&M Hardware, Inc.; www.aandmhardware.com.
         3) Substitutions: See Section 01 6000 - Product Requirements.

M. Z-Clips: 6063-T6 extruded aluminum z clips. Sized as required to support applied loads.
   1. Manufacturers:
      a. Monarch Metal Fabrication: www.monarchmetal.com.
      b. Eagle Mouldings Inc.: www.eagle-aluminum.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

N. Aluminum Channels and Angles: 6061-T6 extruded aluminum channels, with sharp corners, mill finish, size as required or indicated on Drawings.

2.06 FABRICATION

A. General:

1. Fabricate woodwork to dimensions, profiles, and details indicated.
2. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation.
3. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Seal cut edges.
   a. Locate openings accurately and use templates to produce accurately sized and shaped openings.
4. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
5. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
   a. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
   b. Cap exposed plastic laminate finish edges with material of same finish and pattern, unless otherwise indicated.
6. Fire Retardant Wood Materials:
   a. Provide UL (DIR) listed and approved identification on fire retardant treated material.
   b. Deliver fire retardant treated materials cut to required sizes. Minimize field cutting.

B. Cabinets and Millwork:
   1. Assembly: Shop assemble cabinets and millwork for delivery to site in units easily handled and to permit passage through building openings.
   2. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

2.07 STANDING AND RUNNING TRIM

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. For Transparent Finishes:
   1. Wood Species: Select White Maple.
   2. Cut: Plain sawn.
   3. Wood Moisture Content: 5 to 10.
   4. Veneer Grade: AA.

C. For Opaque Finishes:
   1. Wood Species: Any closed-grain hardwood.
   2. Wood Moisture Content: 5 to 10.

D. Wood Profiles: As indicated on Drawings.

2.08 WOOD PANELING

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. For Transparent Finishes:
   1. Wood:
      a. Wood Species: Select White Maple.
      b. Cut: Plain sawn.
      c. Wood Moisture Content: 5 to 10.
      d. Veneer Grade: AA.
   2. Veneer Matching:
   3. Drawing Designation: WV1
      a. Grain Direction: Vertical.
      b. Matching of Veneer Leaves: Slip match.
      c. Veneer Matching within Panel Face: Center-balance match.
      d. Matching Between Adjacent Panels: Running match.

e. Matching Between Vertical Panels: Continuous match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
f. Sequencing within a Room or Space: Blueprint matching.

C. For Opaque Finishes:
1. Wood Species: Any closed-grain hardwood.
2. Wood Moisture Content: 5 to 10.

D. Panel Construction:
1. Design: Flat panel.
2. Corner Profile in Elevation: Square.
3. Panel Thickness: 3/4 inch.
4. Panel Sizes: As indicated on Drawings.
5. Face: Wood veneer.
6. Core: Particle board or medium density fiberboard (MDF); fire-retardant.
7. Panel Edges: Solid hardwood matching wood veneer panel face.
8. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations; water-resistant bond for interior use.
9. Mounting Method: Z-clips; sized as required to support applied loads.

E. Pegboard
1. 0.25 inch tempered hardboard masonite with 9/32 inch diameter holes spaced 1 inch on center each way.
2. Size: 48 inch by 96 inch.
3. Mounting: Provide furring strips as required to mount on Concrete Masonry Unit wall construction.
4. Finish: Natural.

2.09 WOOD CABINETS AND MILLWORK

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Casework Construction Type: Frameless.

C. Door and Drawer Style: Flush Overlay.

D. Exposed Surfaces:
1. Wood Species: Select White Maple.
2. Cut: Plain sawn.
3. Veneer Grade: AA.
4. Grain Direction: Vertically for drawer fronts, doors, and fixed panels.
5. Matching of Veneer Leaves: Book match.
6. Veneer Matching within Panel Face: Running match.
7. Matching Between Adjacent Panels: Well matched for color and grain.

E. Semi-exposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Same species and cut indicated for exposed surface .
2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber, same species indicated for exposed surfaces
3. Drawer Bottoms: Hardwood veneer plywood.

F. Concealed Surfaces:
1. Manufacturer's choice.

G. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Drawer Construction Method: Multiple dovetailed.

H. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

2.10 PLASTIC LAMINATE CABINETS AND MILLWORK

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Casework Construction Type: Frameless.
C. Door and Drawer Style: Flush Overlay.
D. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
E. Exposed Surfaces:
    1. Horizontal Surfaces: Grade HGL (0.039 inch thick).
    2. Vertical Surfaces: Grade VGS (0.028 inch thick).
    3. Door and Drawer Edges:PVC edge banding, 0.118 inch (3mm) thick, matching laminate in color, pattern, and finish .
    4. Other Edges: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish
    5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
F. Semi-exposed Surfaces:
    1. For semiexposed backs of panels with exposed surfaces: Grade VGS (0.028 inch thick).
    2. Surfaces Other Than Drawer Bodies: Low pressure decorative laminate.
        a. Edges of Low Pressure Decorative Laminate Shelves: PVC edge banding, 0.039 inch (1mm) thick, matching laminate in color, pattern, and finish.
    3. Surfaces of Drawer Subfronts, Backs, and Sides: Low pressure decorative laminate.
    4. Cores of Drawer Subfronts, Backs, and Sides: Hardwood veneer plywood.
    5. Drawer Bottoms: Hardwood veneer plywood.
G. Concealed Backs of Panels with Exposed or Semi-exposed Surfaces: Grade BKL (0.020 inch thick).
H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
    1. Drawer Construction Method: Multiple dovetailed or doweled.
I. All cabinets and millwork shall be fabricated with balance construction.
J. Cabinet and millwork sizes, layouts, and configurations: As indicated on Drawings.

2.11 DISPLAY CASE GLASS AND HARDWARE

A. Glazed Doors and Hardware
B. Sliding Glass Display Doors: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (clear), Quality-Q3.
    1. Thickness: 0.25 inch.
    2. Hardware: Basis-of-Design: For each component provide products by C.R. Laurence Co., Inc.: www.crlaurence.com, or approved equal.
        a. Sliding Door Track
            1) Knape and Vogt; Sliding Door Track Roll-Ezy Ball-Bearing Track for Large Sliding Glass Doors: www.knapeandvogt.com.
                (a) Upper T Guide 953.
                (b) Double Channel Upper Track 993.
                (c) Shoe 995.
                (d) Ball-bearing Carrier 997.
                (e) Lower Track 999.
        b. Glass Finger Pulls: Flush finger pull.
            1) Knape and Vogt; Sliding Door Pull SKU 801X NP: www.knapeandvogt.com.
        c. Plunger Lock: Glass mounted type; installs directly onto glass.
            1) C.R. Laurence Co., Inc.; Model KML41GL: www.clrlaurence.com.
        d. Finishes: Polished Nickel.
C. Display System
    1. Wall Track
        a. Gallery System; Track SKU GTR2: www.gallerysystem.com.
        b. Anodized Aluminum
    2. Hangers

a. Gallery System; Hangers, Cable SKU HASC2: www.gallerysystem.com.
b. Steel Cable Hangers, pack of 10 cables.

3. Hooks
   a. Gallery System; Hooks, Pushbutton SKU HOSG: www.gallerysystem.com
   b. Chrome Color
4. End Cap
   a. Gallery System; End Cap SKU EndcapA: www.gallerysystem.com.
   b. Track end cap in Silver color.
5. Hanging Clips
   a. Gallery System; HangRightClips SKU HOHR: www.gallerys
6. Cable Kit
   a. C.R. Laurence Co., Inc.; CRL Floor to Ceiling Cable Kit for 1/4" Glass, Model Y0001CR; www.crlaurence.com
   b. Polished Nickel.

2.12 MISCELLANEOUS ITEMS

A. Quality Standard: Premium Grade, in accordance with AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Solid Surface Window Stools: Solid surfacing sheet or plastic resin casting over continuous substrate.
   1. Flat Sheet Thickness: 1/2 inch, minimum.
   2. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.

C. Power and USB Grommett at Bar-Height Counter
   1. Spherical Grommett Monument with power outlets and USB chargers.
   2. Tamper Resistant power outlets.
   3. USB C style charging only outlets.
   4. Multi-User from all sides.
   5. Surface mount with threaded cyliner and locking ring.
   6. Six feet electrical cord.
   7. UL listed.
   8. Size: 3-13/16 inch outside diameter.
   9. Cutout: 3 inch.
   10. Color: White.

D. Closet and Utility Shelving:
   1. Shelf Material: 3/4 inch thick.
      a. Horizontal Surfaces: Low-Pressure Decorative Laminate, NEMA LD 3, Thermoset decorative faces.
      b. Core: Particle board, medium density fiberboard (MDF), or plywood.
      c. Shelf Edges: PVC or polyester edge banding.
   2. Cleats: 3/4-inch solid lumber.

E. L-Bracket Shelving System
   1. Manufacturer: RAKKS
      a. Pole Supports: Extruded aluminum with channels to accept shelf support brackets.
         1) PC2 Compression Support Pole with screw attachment for L-Brackets.
         2) Height: From floor or raised platform base to soffit. Overall height as indicated on drawings.
         3) Threaded Insert to secure into pole channel.
      b. Pole Mounting Hardware
         1) Threaded mounts: For mounting between floor and ceiling with up to 2 inch overall adjustment.
         2) Mitered Tie Pole: To secure pole supports to walls.
            (a) Provide minimum one tie bracket per pole, located at top of pole.
      c. Provide all accessory components for a complete installation.

1) Including, but not limited to: Spline Connector, Channel Nut Plates, and Channel Covers.

d. L-Bracket with retaining pin: Screw attach to PC2 poles. Retaining pin on each end to securely hold shelves in place.

e. Extruded Aluminum Shelves:
1) 6063-T6 extruded aluminum
2) Length: Factory cut, lengths as indicated on drawings.
3) Thickness: 0.585 inch.
4) Finish: Clear Anodized Aluminum.
5) Deflection: 0.25 inch deflection at 90 pounds.

2.13 SHOP FINISHING

A. Sand work smooth and set exposed nails and screws.

B. Field Applied Opaque Finishes:
1. Apply wood filler in exposed nail and screw indentations and sand smooth.
2. Shop prime with one coat of wood primer as specified in Section 09 9123 - Interior Painting.
3. Refer to Section 099100 - Painting for field painting.

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

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 PREPARATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

B. Condition all interior architectural woodwork to temperature and humidity conditions in installation areas for not less than 72 hours prior to installation.
1. Temperature and humidity conditions shall be same levels planned for occupancy.

3.03 INSTALLATION - GENERAL

A. Install work in accordance with AWI/AWMAC/WI (AWS) requirements for grade indicated.

B. Install architectural woodwork level, plumb, true in line, and without distortion.
1. Shim as required with concealed shims.
2. Install level and plumb to a tolerance of 1/8 inch in 96 inches

C. Scribe and cut architectural woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

3.04 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints.
1. Use full-length pieces to greatest extent possible.

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

3.05 WOOD PANELING INSTALLATION

A. Set and secure panels in place, plumb, level, and in alignment with other panels, using concealed fasteners.

3.06 CABINET AND MILLWORK INSTALLATION

A. Set and secure custom cabinets and millwork in place, assuring that they are rigid, plumb, and level.
B. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned.
   1. Adjust hardware to center doors and drawers in openings and to provide easy and smooth operation.
C. Use fixture attachments in concealed locations for wall mounted components.
   1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips, or No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.
D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
E. Secure cabinets to floor using appropriate angles and anchorages.

3.07 COUNTERTOP INSTALLATION

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

3.08 ADJUSTING

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

3.09 REPAIRING AND CLEANING

A. Repair damaged and defective architectural woodwork, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural woodwork.

B. Clean all architectural woodwork, including, but not limited to, casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 07 0543 - CLADDING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cladding support systems, directly attached to substrates.

1.02 DEFINITIONS

A. Continuous Insulation: As defined by ASHRAE Std 90.1 I-P.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
G. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.
H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate cladding support system manufacturer's requirements with requirements of exterior structural wall assemblies.
B. Preinstallation Meetings:
   1. Agenda: Review exterior structural wall assembly requirements and cladding fastening requirements.
   2. Required Attendees: Contractor, cladding support system subcontractors and cladding subcontractors.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's published descriptive data, including product attributes.
   1. Include data for cladding support system.
C. Shop Drawings: For each cladding support system; signed and sealed by Contractor-provided structural engineer; indicate:
   1. Sections: Include column centers, elevations, and dimensions; indicate locations of system components, component spacings, and wall fasteners.
   2. Details: Connection details between cladding support systems and substrates; indicate fastener size and spacing.
D. Certificate: Certify cladding support systems of this section meet or exceed specified design criteria.
E. Sustainable Design Submittals:
   1. Environmental Product Declaration (EPD).

F. Delegated Design Documents: Submit for information, signed and sealed documents by structural engineer of record responsible for comprehensive design package of cladding system, including wall fasteners and anchors. Submit structural design, rail spacing, and calculations sufficient to comply with structural design criteria of this section.
G. Test Reports: Submit test reports for each type of cladding support system performed by qualified testing agency for manufacturer.
H. Manufacturer's Instructions: Submit manufacturer's written installation instructions.
I. Designer's qualification statement.
J. Manufacturer's qualification statement.
K. Installer's qualification statement.

1.06 QUALITY ASSURANCE

A. Designer Qualifications for Contractor's Design-Related Professional Design Services: Qualified professional structural engineer experienced in design of cladding support systems and licensed in the State in which the Project is located.
B. Designer Qualifications: Qualified professional structural engineer experienced in design of cladding support systems, associated wall fasteners and anchors, and licensed in the State in which the Project is located.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least five years of documented experience.
D. Installer Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience and approved by manufacturer.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Construct exterior wall assembly mock-up, including cladding support systems.
   1. Build integrated mock-up incoroporating back-up wall construction, air barrier assembly, cladding support system, and rainscreen cladding to demonstrate attachments, protection of air barrier assembly, tolerances of rain screen assembly, and workmanship.
C. Locate within same mock-up as masonry components.
D. Mock-up may remain as part of work subject to compliance with requirements if undisturbed at time of Substantial Completion.
E. Approval of mock-up does not constitute approval of deviations from Contract Documents contained in mock-ups unless Architect specifically approves such deviations in writing.

1.08 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
B. Deliver products to project site in wrapped, protected, unbroken packaging with product identification labeling.
C. Handle products without damaging; prevent bending, warping, and twisting to surfaces, edges, or corners.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Manufacturer's Special Warranty: Provide 10-year warranty for cladding support system components, including structural failure due to material defect, commencing on Date of Substantial Completion. Complete forms in Owner's name and register with warrantor.
C. Installer Warranty: Provide 2-year warranty against installation defects commencing on Date of Substantial Completion. Complete forms in Owner's name and register with installer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Manufacturer:
   1. EJOT Fastening Systems, LP; CROSSFIX Substructure System, www.ejot-usa.com.
B. Substitutions: See Section 01 6000 - Product Requirements.
C. Source Limitations: Provide complete cladding support system including wall fasteners and wall anchors from single manufacturer.

2.02 PERFORMANCE CRITERIA

A. Surface Burning Characteristics: Provide cladding support systems with a flame spread index (FSI) of 25 or less, and a smoke developed index (SDI) of 450 or less, when tested in accordance with ASTM E84 or UL 723.
B. Fire Propagation Requirements of Exterior Wall Assemblies: Tested in accordance with, and comply with, the acceptance criteria of NFPA 285.

2.03 DESIGN CRITERIA

A. See Section 01 4000 - Quality Requirements for additional information.
B. Structural Design Services: Provide Contractor's design-related professional services for structural design of cladding support systems based on the following criteria:
   1. Design Loads: Exterior wall design loads as indicated on structural drawings.
   2. Fastener Design Criteria: Minimum safety factor of three for both tension and shear values.
   3. Thermal Movement Design Criteria: Cladding systems allow for thermal movements without overstressing components and evidence of permanent component defects, based on maximum ambient temperature of 120 degrees F.
C. Thermal Performance Design Services: Provide Contractor's design-related professional services for thermal performance design of cladding support systems:
   1. Design Criteria: Provide cladding support systems that, when combined with thermal performance of continuous insulation and other exterior wall assembly components, provide building envelope wall assemblies that meet minimum energy efficiency requirements of ASHRAE Std 90.1 I-P.

2.04 EXTERIOR WALL ASSEMBLIES WITH CLADDING SUPPORT SYSTEMS

A. Cladding: As indicated on drawings.
B. Depth of Air-Gap Cavity: As indicated on drawings.
C. Cladding Support System Applications:
   1. Direct-attached-to-substrate cladding support systems.
D. Exterior Continuous Thermal Insulation:
   1. See Section 07 2100.
   2. Depth of Insulation: As indicated on drawings.
E. Fluid-Applied Membrane Air Barriers: See Section 07 2726

2.05 CLADDING SUPPORT SYSTEMS, DIRECTLY ATTACHED TO SUBSTRATE

A. Subframe Profiles: Cladding support system manufacturer’s standard profiles formed from extruded aluminum.
   1. Panel Attachment::
      a. At Fiber Cement Panels: Exposed fastener.
      b. At Metal Wall Panels: Concealed fastener.
   2. Subframe Profile: L-Profile with Grooves
   3. Subrame Orientation: Manufacturer's recommended configuration meeting performance requirements.
   4. Inward/Outward Adjustability: Minimum 1-1/2 inch.
   5. Finish: Mill finish.

B. Bracket Assembly: Preassembled assembly consisting of stainless steel brackets and plates with manufacturer’s standard polymer thermal isolator.
   1. Bracket Depth: 120 mm to 140 mm minimum to meet cavity depth requirements.
   2. Hanger Rod: Manufacturer's recommended powerkey support as needed to conform with performance requirements.

2.06 MATERIALS

A. Aluminum Framing: ASTM B221 (ASTM B221M), with alloy and temper required to suit structural requirements.
B. Stainless Steel Sheet:
   1. Thickness: Manufacturer's recommended thickness for application.
   2. ASTM A240/A240M; Type 316 and ASTM A666 Type 304.

2.07 FABRICATION

A. Shop fabricate to greatest extent possible.

2.08 ACCESSORIES

A. Miscellaneous Nonstructural Accessories: Provide nonstructural accessories; flashings, sealants, tapes, and shims as recommended by manufacturer, suitable for project-specific applications, and compatible with system components.
B. Fasteners Between Claddings and Cladding Support Systems:
   1. In accordance with Contractor-provided structural design of cladding system.
C. Wall Anchors:
   1. Manufacturer's corrosion-resistant-coated steel wall anchors with recommended washers for anchoring cladding support systems to concrete masonry structural wall assemblies.
      a. Structural Performance: Manufacturer's wall anchors; type, spacing, and embedment in accordance with Contractor-provided structural design of cladding system.
      b. Thermal Performance: Manufacturer's wall anchors with thermally isolated polymer washers.
D. Wall Fasteners:
   1. Manufacturer's corrosion-resistant-coated steel wall fasteners for attaching cladding support systems to steel-framed structural wall assemblies.
      a. Structural Performance: Manufacturer's wall fasteners; type, spacing, and embedment in accordance with Contractor-provided structural design of cladding system.
      b. Thermal Performance: Manufacturer's wall fasteners with thermally isolated polymer washers.
   2. Cold-Formed Steel Substrates: Manufacturer's recommended self-tapping metal screws.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Verify substrates comply with contract documents, including specified tolerances, and are ready to receive work of this section.
   2. Verify air barrier and wall flashing work comply with contract documents.

3.02 PREPARATION

A. Protection of In-Place Conditions: Protect air barrier work from damage.
B. Surface Preparation:
   1. Prepare substrate surfaces using methods in accordance with cladding support system manufacturer's written instructions.

3.03 INSTALLATION

A. Installation of Cladding Support System Substrates.
B. Install cladding support systems in accordance with Contractor-provided structural design.

C. Installation of Wall Anchors in Concrete Masonry Wall Substrates: Install anchors in accordance with Contractor-provided structural design.
D. Installation of Wall Fasteners in Cold-Formed Metal Framing Wall Substrates: Install fasteners in accordance with Contractor-provided structural design.
E. Installation of Secondary System Fasteners to Primary Cladding System Substrates: Install fasteners in accordance with Contractor-provided structural design.

3.04 TOLERANCES

A. Install cladding support systems plumb with noncumulative maximum variation of:
   1. 1/4 inch in 20 feet.
   2. Space individual members no more than plus or minus 1/8 inch from plan location.

3.05 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Manufacturer Services: Provide services of manufacturer's field representative to inspect installation of cladding support systems.

3.06 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

3.07 PROTECTION

A. Protect installed cladding support systems from subsequent construction operations.

END OF SECTION

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SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.
B. Protection boards.

1.02 REFERENCE STANDARDS

A. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
B. ASTM D1227/D1227M - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013, with Editorial Revision (2019).
C. ASTM D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing; 2013.
D. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide properties of primer, bitumen, and mastics.
C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this section with at least 5 years of documented experience.

1.05 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application until dampproofing has cured.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers:
1. BASF Corp., Master Builders Solutions; www.master-builders-solutions.basf.us.
2. Carlisle Coatings and Waterproofing; www.carlisleccw.com.
3. The Euclid Chemical Company; www.euclidchemical.com.
4. Henry Corp.; www.henry.com.
5. Karnak Corp.; www.karnakcorp.com.
6. Lambert Corp.; www.lambertusa.net.
7. W. R. Meadows, Inc.; www.wrmeadows.com.
8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
1. Composition - Vertical Application: ASTM D1227/D1227M Type III or ASTM D1187/D1187M Type I.
2. Composition - Horizontal and Low-Slope Application: ASTM D1227/D1227M Type II or III.
3. VOC Content: Not more than permitted by local, State, and federal regulations.
4. Applied Thickness: 1/16 inch, minimum, wet film.
B. Primers, Mastics, and Related Materials: Type as recommended by dampproofing manufacturer.

2.03 ACCESSORIES

A. Protection Board: 1/8 inch thick bitumen impregnated glass fiberboard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.
B. Verify substrate surfaces are durable, free of matter detrimental to adhesion or application of dampproofing system.
C. Verify that items penetrating surfaces to receive dampproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces not designated to receive dampproofing.
B. Clean and prepare surfaces to receive dampproofing in accordance with manufacturer's instructions.
C. Do not apply dampproofing to surfaces unacceptable to manufacturer.
D. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.

3.03 APPLICATION

A. Perform this work in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
B. Prime surfaces in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
C. Prime surfaces at a rate approved by manufacturer for application indicated, and allow primer to dry thoroughly.
D. Apply bitumen with roller or spray application; apply two coats.
E. Seal items watertight with mastic, that project through dampproofing surface.
F. Place protection board directly over dampproofing, butt joints, and adhere to tacky dampproofing.
G. Scribe and cut boards around projections, penetrations, and interruptions.

END OF SECTION

SECTION 07 1300 - SHEET WATERPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet Waterproofing:
   1. Self-adhered sheet waterproofing membrane.
   2. Drainage panels.

1.02 RELATED REQUIREMENTS

A. Divisions 22 and 32 for piped subdrainage system.

1.03 ABBREVIATIONS

A. HDPE - High-Density Polyethylene.

1.04 REFERENCE STANDARDS

A. ASTM C836/C836M - Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course; 2018 (Reapproved 2022).
B. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
C. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
D. ASTM D882 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting; 2018.
E. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
F. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
G. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2023).
H. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
I. ASTM D5295/D5295M - Standard Guide for Preparation of Concrete Surfaces for Adhered (Bonded) Membrane Waterproofing Systems; 2018.
J. ASTM D5385/D5385M - Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes; 2020.
K. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
L. ASTM E154/E154M - Standard Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover; 2008a (Reapproved 2019).
M. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for membrane, surface conditioner, flexible flashings, joint and crack sealants, drainage panel, and drainage panel collector.
C. Shop Drawings: Indicate special joint or termination conditions and conditions of interface with other materials.
D. Samples: Three samples of each of the following:
   1. Self-adhered sheet waterproofing membrane; approximately 4 inches by 4 inches.
   2. Drainage panel; approximately 8 inches by 8 inches.
   3. Drainage panel collector; 12 inch length.
E. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention, and acceptable installation temperatures.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Membrane Manufacturer Qualifications: Company specializing in manufacturing 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 and with at least 5 years of documented experience.

1.07 MOCK-UP

A. Construct mock-up consisting of 100 sq ft of vertical waterproofed panel; to represent finished work including internal and external corners, seam jointing, and drainage panel.

B. Locate where directed.

C. Mock-up may remain as part of this Work.

1.08 FIELD CONDITIONS

A. Maintain ambient temperatures above 40 degrees F for 24 hours before and during application and until liquid or mastic accessories have cured.

1.09 WARRANTY

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

B. Provide five year manufacturer warranty for waterproofing failing to resist penetration of water.

PART 2 PRODUCTS

2.01 MEMBRANE MATERIALS

A. Self-Adhered Sheet Membrane: 56 mil self-adhesive rubberized asphalt laminated to 4 mil polyethylene or HDPE film.

1. Properties and Performance Requirements:
   a. Tensile Strength:
      1) Film: 5,000 psi, minimum, measured in accordance with ASTM D882 and at grip-separation rate of 2 inches per minute.
      2) Membrane: 325 psi, minimum, measured in accordance with ASTM D412 Method A, using die C and at spindle-separation rate of 2 inches per minute.
   b. Elongation at Break: 300 percent, minimum, measured in accordance with ASTM D412.
   c. Water Vapor Permeance: 0.05 perm, maximum, measured in accordance with ASTM E96/E96M.
   d. Low Temperature Flexibility: Unaffected when tested in accordance with ASTM D1970/D1970M at minus 20 degrees F, 180 degree bend on 1 inch mandrel.
   e. Crack Cycling: Unaffected when tested according to ASTM C836/C836M at minus 25 degrees F.
   f. Peel Strength: 9 pounds per inch, minimum, when tested according to ASTM D903.
   g. Lap Adhesion Strength: 5 lb per inch, minimum, when tested in accordance with ASTM D1876.
   h. Puncture Resistance: 48 pounds, minimum, measured in accordance with ASTM E154/E154M.
   i. Water Absorption: 0.1 percent increase in weight, maximum, measured in accordance with ASTM D570, 24 hour immersion.
   j. Hydrostatic Resistance: Resists the weight of 230 feet when tested according to ASTM D5385/D5385M.
2. Products:
   a. Carlisle Coatings & Waterproofing Inc; MiraDRI 860/861: www.carlisleccw.com.
   b. CETCO; Envirosheet: www.cetco.com.
   c. GCP Applied Technologies; Bituthene System 4000: www.gcpat.com.
   d. Polyguard Products, Inc.; 650 Membrane: www.polyguardproducts.com.
   e. W. R. Meadows, Inc.; MEL-ROL: www.wrmeadows.com.

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

2.02 ACCESSORIES

A. Provide all related auxiliary materials as recommended by waterproofing sheet membrane manufacturer for complete installation; materials shall be compatible with sheet waterproofing and substrates. Includes, but is not limited to, the following:
   1. Surface conditioners and primers.
   2. Crack fillers and sealants; comply with requirements of Section 07 9200 - Joint Sealants.
   3. Seaming materials.
   4. Liquid membranes and flexible flashings.
   5. Cants.

B. Drainage Panel: Drainage layer with geotextile filter fabric on earth side.
   1. Composition: Dimpled polystyrene, polyethylene, or polypropylene core; polypropylene filter fabric.
   2. Properties and Performance Requirements:
      a. Thickness: 0.40 inches.
      b. Roll Size: 48 inches wide by 50 feet.
      c. Compressive Strength: 15,000 psi, minimum, per ASTM D1621.
      d. Water Flow Rate: 20 gpm per ft, minimum
   3. Products:
      a. Carlisle Coatings & Waterproofing Inc; MiraDRIAN 6200: www.carlisleccw.com.
      b. CETCO; Aquadrain 15X: www.cetco.com.
      c. GCP Applied Technologies; Bituthene System 4000: www.gcpat.com.
      d. Polyguard Products, Inc.; Polyflow 15: www.polyguardproducts.com.
      e. W. R. Meadows, Inc.; MEL-DRAIN 7955: www.wrmeadows.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. Drainage Panel Collector: Subsurface drainage panel collector wrapped with geotextile filter fabric.
   1. Collects water from darainage panels and directs water flow to piped subdrainage system provided by others.
   2. Provide all associated components to connect drainage panel collector to piped subdrainage system.
   3. Properties and Performance Requirements:
      a. High Profile Thickness: 1 inch.
      b. Low Profile Thickness: 0.40 inches.
      c. Roll Size: 24 inches wide by 50 feet.
      d. Compressive Strength: 9,000 psi, minimum, per ASTM D1621.
      e. Water Flow Rate:
         1) High Profile: 100 gpm per ft., minimum.
         2) Low Profile: 21 gpm per ft., minimum.
   4. Products:
      a. Carlisle Coatings & Waterproofing Inc; Side/Endout Drain Connector: www.carlisleccw.com.
      b. CETCO; Aquadrain 100DB: www.cetco.com.
      c. GCP Applied Technologies; Hydroduct: www.gcpat.com.
      d. Polyguard Products, Inc.; Totalflow: www.polyguardproducts.com.
      e. W. R. Meadows, Inc.; MEL-DRAIN TOTAL-DRAIN: www.wrmeadows.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions are acceptable prior to starting this work.

B. Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.

C. Verify items that penetrate surfaces to receive waterproofing are securely installed.

3.02 PREPARATION

A. Protect adjacent surfaces from damage not designated to receive waterproofing.
B. Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's instructions; vacuum substrate clean.
C. Do not apply waterproofing to surfaces unacceptable to membrane manufacturer.
D. Fill non-moving joints and cracks with a filler compatible with waterproofing materials.
E. Seal moving cracks with sealant and non-rigid filler, using procedures recommended by sealant and waterproofing manufacturers.
F. Prepare building expansion joints at locations as indicated on drawings.
G. Surfaces for Adhesive Bonding: Apply surface conditioner at a rate recommended by manufacturer, and protect conditioner from rain or frost until dry.
H. Concrete Surfaces for Adhesive Bonding: Prepare concrete substrate according to ASTM D5295/D5295M.
    1. Remove substances that inhibit adhesion including form release agents, curing compounds admixtures, laitance, moisture, dust, dirt, grease and oil.
    2. Repair surface defects including honeycombs, fins, tie holes, bug holes, sharp offsets, rutted cracks, ragged corners, deviations in surface plane, spalling and delaminations, as described in the reference standard.
    3. Remove and replace areas of defective concrete as specified in Section 03 3000.
    4. Prepare concrete for adhesive bonded waterproofing using mechanical or chemical methods described in the referenced standard.
    5. Test concrete surfaces as described in the referenced standards. Verify surfaces are ready to receive adhesive bonded waterproofing membrane system.

3.03 INSTALLATION - MEMBRANE

A. Install membrane waterproofing in accordance with manufacturer's instructions and NRCA (WM) applicable requirements.
B. Roll out membrane, and minimize wrinkles and bubbles.
C. Self-Adhering Membrane: Remove release paper layer, and roll out onto substrate with a mechanical roller to provide full contact bond.
D. Overlap edges and ends, minimum 3 inches, seal permanently waterproof by method recommended by manufacturer.
E. Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
F. Weather lap joints on sloped substrate in direction of drainage, and seal joints and seams.
G. Install building expansion joints at locations as indicated on drawings.
H. Flexible Flashings: Seal items watertight that penetrate through waterproofing membrane with flexible flashings.
I. Seal membrane and flashings to adjoining surfaces.

3.04 INSTALLATION - DRAINAGE PANEL

A. Install drainage panels and drainage panel collectors in accordance with manufacturer's instructions
B. Place drainage panel directly against membrane, lap joints, place to encourage drainage downward. Scribe and cut boards around projections, penetrations, and interruptions.
C. Tie-in drainage panel collector to bottom edges of drainage panels.
    1. Connect drainage panel collector to piped subdrainage system provide by others.
        a. Refer to Divisions 22 and 32 for piped subdrainage system

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.

B. Waterproofing will be considered defective if it does not pass tests and inspections.

1. Correct deficiencies in or remove and replace waterproofing that does not comply with requirements.

3.06 PROTECTION

A. Protect waterproofing from damage and wear during construction period.

B. Repair or remove and replace damaged waterproofing that does not comply with requirements.

END OF SECTION

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SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation.
B. Batt insulation.
C. Board insulation and integral vapor retarder at cavity wall construction, perimeter foundation wall, underside of floor slabs, over roof deck, over roof sheathing, exterior wall behind _____ wall finish, and interior wall with facer providing exposed finish.

1.02 RELATED REQUIREMENTS

A. Section 04 2000 - Unit Masonry: Cavity wall insulation specified as part of the masonry.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
E. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
G. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016a.
H. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
C. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 BOARD INSULATION MATERIALS

A. Extruded Polystyrene Board Insulation - High Load: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:

1. Type: Type VII.
2. Compressive Strength: 60 psi; ASTM D1621.
3. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
4. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
5. R-Value (RSI-value); 1 inch of material at 75 degrees F: 5 (0.88), minimum.
6. Insulation shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria, of NFPA 285.
7. Board Edges: Square.
8. Water Absorption, Maximum: 0.3 percent, by volume.
9. Products:
   a. DiversiFoam Products: CertiFoam 60; www.diversifoam.com.
   b. Dow Building Solutions, Dow Chemical Company; Styrofoam Highload 60: www.dow.com.
   c. Kingspan Insulation LLC; GreenGuard Type VII XPS: www.trustgreenguard.com.
   d. Owens Corning; Foamular 600: www.owenscorning.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.

B. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
3. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.
4. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
5. Board Edges: Square.
6. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
7. Products:
   a. DuPont de Nemours, Inc; Styrofoam Brand Cavitymate Plus : building.dupont.com/#sle.
   b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.
   c. Owens Corning Corporation; FOAMULAR Type CW25 Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com/#sle.
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIBERBOARD INSULATION MATERIALS

A. Where fiberboard insulation is indicated, either rock, slag, or glass mineral fiberboard insulation may be used, at Contractor's option.

B. Mineral Fiberboard Insulation: Rigid mineral fiber, in accordance with ASTM C612.
1. Facing: Black non-woven mat.
2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
4. Board Size: 48 by 48 inches.
5. Board Thickness: 1 inch.
6. Board Edges: Square.
7. Thermal Conductivity (k-factor): BTU inch/hr sq ft degrees F of 0.26 per inch, minimum, at 75 degrees F when tested in accordance with ASTM C518.
8. Maximum Density: 8 pcf, nominal.
9. Products:
   a. Johns Manville; CladStone Water & Fire Block: www.jm.com/#sle.

b. Owens Corning Corporation; Thermafiber RainBarrier Dark : www.ocbuildingspec.com/#sle.
c. ROCKWOOL (ROXUL, Inc); COMFORTBOARD 80: www.rockwool.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 BATT INSULATION MATERIALS

A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
2. Smoke Developed Index: 50 or less, when tested in accordance with ASTM E84.
3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
4. Formaldehyde Content: Zero.
5. Thermal Resistance: R-value of 15 unless otherwise indicated.
6. Thickness: 3-1/2 inch, unless otherwise indicated.
7. Facing: Unfaced, Type 1.
8. Products:
a. CertainTeed Corporation; CertaPro AcoustaTherm Batts: www.certainteed.com.
b. Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
c. Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
d. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.owenscorning.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

B. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced.
1. Flame Spread Index: 0 (zero) when tested in accordance with ASTM E84.
2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
3. Facing: Unfaced, Type 1.
4. At Metal Studs and Miscellaneous Locations:
a. Density: 2.5 pcf, minimum..
b. Thermal Resistance: R-value of 3.7 per inch.
c. Thickness: 3-1/2 inches, unless otherwise indicated.
d. Products:
1) Johns Manville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com..
2) Rockwool; Comfortbatt: www.rockwool.com.
3) Thermafiber Inc., an Owens Corning Company; UltraBatt: www.owenscorning.com.
4) Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORIES

A. Insulation Fasteners: Impaling clip of unfinished steel with self-locking washer retainer, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.
1. Manufacturers:
a. Gemco: www.gemcoinsulation.com.
b. AGM Industries, Inc.
c. Substitutions: See Section 01 6000 - Product Requirements.

B. Wire Mesh: Galvanized steel, hexagonal wire mesh.

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

D. Formed-in-Place Foam Sealant: Two-component polyurethane sealant.
1. Gun-applied and straw-applied products.
2. Thermal Resistance (R) Value: 6.5 per inch.

3. Maximum gap width: 3 inches.
4. Manufacturer:
   a. Dow Building Solutions, Dow Chemical Company; Froth-Pak Foam Sealant: www.dow.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.
C. Verify board insulation materials are dry, clean, and ready to receive foam-in-place sealants.

3.02 INSTALLATION - GENERAL

A. Install according to insulation manufacturers instructions.
B. Use sizes, thickness, and types as indicated on Drawings.
C. Fit insulation snugly against abutting insulation and building construction without gaps.
D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT FOUNDATION PERIMETER

A. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
B. Install boards vertically on foundation perimeter, unless otherwise indicated.
   1. Extend boards 24 inches, minimum, below finished floor, unless otherwise indicated.
   2. Place boards to maximize adhesive contact.
   3. Install in running bond pattern.
   4. Butt edges and ends tightly to adjacent boards and to protrusions.
C. Extend boards over expansion joints, unbonded to foundation on one side of joint.
D. Formed-in-Place Foam Sealant
   1. Apply formed-in-place foam sealant in accordance with manufacturer's instructions at the following locations:
      a. Between all board joints.
         1) Insert dispensing nozzle between boards and fill with foam sealant until bead of foam is visible at the board surface and continuous along all board joints.
      b. Between insulation board and abutting adjacent construction.
      c. Between boards and all penetrating items.
      d. Foam sealant shall be installed continuously without breaks or gaps.
   2. When complete, insulation board installation shall be continuous without air gaps, holes, or open joints and penetrations.
   3. Formed-in-place foam sealant is not required at boad insulation where foundation perimeter does not have a habitable basement, tunnels, or other open air spaces on the interior side of the foundation perimeter.

3.04 BOARD INSTALLATION AT WALLS

A. Apply adhesive to back of boards:
   1. Three continuous beads per board length.
B. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.
C. Extend boards over expansion joints, unbonded to wall on one side of joint.
D. Apply formed-in-place foam sealant in accordance with manufacturer's instructions at the following locations:
   1. Between all board joints.

a. Insert dispensing nozzle between boards and fill with foam sealant until bead of foam is visible at the board surface and continuous along all board joints.
2. Between insulation board and abutting adjacent construction.
3. Between boards and all penetrating items.
4. Foam sealant shall be installed continuously without breaks or gaps.

E. When complete, insulation board installation shall be continuous without air gaps, holes, or open joints and penetrations.

F. Soffits and overhead insulation installation is similar.

3.05 BOARD INSTALLATION UNDER CONCRETE SLABS

A. Place insulation under slabs on grade after base for slab has been compacted.

B. Butt edges and ends tightly to adjacent boards; taping and foam-in-place sealant is not required.

C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

D. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.06 BATT INSTALLATION

A. Install insulation in accordance with manufacturer's instructions.

B. Install in wall, roof, and ceiling spaces without gaps or voids. Do not compress insulation.

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

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

E. Where extra support is needed, retain insulation batts in place with wire mesh secured to framing members or adjacent construction.

3.07 INSULATION AT MISCELLANEOUS VOIDS

A. Install one or more of the following:
1. Glass fiber batt insulation.
2. Mineral fiber batt insulation.
3. Formed-in-place foam sealant.

B. Install insulation to neatly fit spaces; fill voids completely without compressing insulation.

3.08 PROTECTION

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

END OF SECTION

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SECTION 07 2423 - DIRECT-APPLIED FINISH SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Direct-Applied Finish System (DAFS) for exterior and interior soffits and ceilings.

1.02 ABBREVIATIONS

A. DAFS: Direct-Applied Finish Systems.

1.03 REFERENCE STANDARDS

A. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
B. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
C. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
D. ASTM D968 - Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive; 2017.
E. ASTM D2247 - Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity; 2015.
F. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
H. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
I. ASTM G153 - Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.
J. ASTM G155 - Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Nonmetallic Materials; 2013.
K. ICC-ES AC219 - Acceptance Criteria for Exterior Insulation and Finish Systems; 2009, with Editorial Revision (2022).
L. ICC-ES AC235 - Acceptance Criteria for EIFS Clad Drainage Wall Assemblies; 2015, with Editorial Revision (2022).

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on system materials, product characteristics, performance criteria, and system limitations.
C. Shop Drawings: Indicate plans, details, joint patterns, joint details, and molding profiles.
D. Verification Samples: Submit three actual samples of selected coating on specified substrate, minimum 12 inches square, illustrating project colors and textures.
E. Manufacturer's Installation Instructions: Indicate preparation required, installation techniques, and jointing requirements.

1.05 QUALITY ASSURANCE

A. Maintain copy of specified installation standard and manufacturer's installation instructions at project site during installation.
B. Manufacturer Qualifications: Provide DAFS products from manufacturer with qualifications as follows:
   1. Member in good standing of EIMA (EIFS Industry Members Association).
   2. Manufacturer of DAFS products for not less than 5 years.

C. Installer Qualifications: Company specializing in the type of work specified and with at least 5 years of documented experience and approved by manufacturer.

1.06 MOCK-UP

A. Construct mock-up of typical DAFS application on specified substrate, size as required to include examples of all key conditions, and including flashings, joints, and edge conditions.
B. Locate mock-up where directed.
C. Mock-up 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. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.
   2. Protect Portland cement based materials from moisture and humidity. Store under cover off the ground in a dry location.

1.08 FIELD CONDITIONS

A. Do not prepare or install materials in conditions other than those described in the manufacturer's written instructions.
B. Do not prepare or apply materials during inclement weather unless areas of installation are protected. Protect installed direct-applied finish system areas from inclement weather until dry.
C. Do not install coatings or sealants when ambient temperature is below 40 degrees F.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer's standard material warranty, covering a period of not less than 5 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products:
   1. BASF Corp.; Synergy Direct Finish Systems for Soffits and Ceilings: www.basf.com.
   2. Dryvit Systems, Inc.; Direct Applied TAFs: www.dryvit.com.
   3. Parex USA, Inc.; ACF Soffit: www.parex.com.
   4. Sto Corp.; Or Equal: www.stocorp.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DIRECT-APPLIED FINISH SYSTEM

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, when tested in accordance with ASTM E84.
B. Adhesion of Water-Resistive Coating to Substrate: For each combination of coating and substrate, minimum ensile bond strength of 15 psi, when tested in accordance with ASTM E2134 .
C. Water Penetration Resistance: No water penetration beyond the plane of the base coat after 15 minutes, when tested in accordance with ASTM E331 at 6.24 psf differential pressure.
D. Salt Spray Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 300 hours exposure in accordance with ASTM B117, using at least three samples matching intended assembly, at least 4 by 6 inches in size.
E. Freeze-Thaw Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 10 cycles, when tested in accordance with {\rs\#1} or 16 CFR 1201.

F. Weathering Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when viewed under 5x magnification after 2000 hours of accelerated weathering conducted in accordance with ASTM G153 Cycle 1 or ASTM G155 Cycles 1, 5, or 9.
G. Water Degradation Resistance: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating after 14 days exposure, when tested in accordance with ASTM D2247.
H. Mildew Resistance: No growth supported on finish coating during 28 day exposure period, when tested in accordance with ASTM D3273.
I. Abrasion Resistance Of Finish: No cracking, checking or loss of film integrity when tested in accordance with ASTM D968 with 113.5 gallons of sand.

2.03 MATERIALS

A. Finish Coating Top Coat: Water-based, air curing, acrylic or polymer-based finish with integral color and texture.
   1. Texture: Sand/Fine.
   2. Color: As selected by Architect from manufacturer's full range.
B. Base Coat: Acrylic- or polymer-modified, fiber reinforced Portland cement coating; compatible with substrate board and reinforcing mesh.
   1. Portland Cement: ASTM C150/C150M, Type I or II.
C. Reinforcing Mesh: Balanced, open weave glass fiber fabric, treated for compatibility and improved bond with coating; weight, strength, and number of layers as required by base coat manufacturer.
D. Substrate Board: Refer to Section 06 1000 - Rough Carpentry.

2.04 ACCESSORY MATERIALS

A. Primer: Primer as recommended by DAFS manufacturer for substrate and project conditions.
B. Trim: DAFS manufacturer's standard PVC trim accessories, as required for a complete project.
C. Sealant Materials: Compatible with DAFS materials and as recommended by DAFS manufacturer.
D. Exterior Soffit Vents: One piece, perforated, ASTM B221 AA DAF-45 6063 alloy, T5 temper, aluminum, with edge suitable for direct application to gypsum board and manufactured especially for soffit application. Provide continuous vent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is sound and free of oil, dirt, other surface contaminants, efflorescence, loose materials, or protrusions that could interfere with DAFS installation and is of a type and construction that is acceptable to DAFS manufacturer. Do not begin work until substrate and adjacent materials are complete and thoroughly dry.
B. Verify that substrate surface is flat, with no deviation greater than 1/4 in when tested with a 10 ft straightedge.

3.02 PREPARATION

A. Apply primer to substrate as recommended by DAFS manufacturer for project conditions.

3.03 INSTALLATION

A. Install in accordance with DAFS manufacturer's instructions.
B. Substrate Boards: Refer to Section 06 1000 - Rough Carpentry.
C. Base Coat: Apply in thickness as necessary to fully embed reinforcing mesh, wrinkle free, including back-wrap at terminations of DAFS. Install reinforcing fabric as recommended by DAFS manufacturer.

1. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
2. Allow base coat to dry a minimum of 24 hours before next coating application.

D. Apply finish coat after base coat has dried not less than 24 hours and finish to a uniform texture and color.

E. Finish Coat Thickness: As recommended by manufacturer.

F. Seal control and expansion joints within the field of exterior finish and insulation system, using procedures recommended by sealant and finish system manufacturers.

3.04 CLEANING

A. Clean DAFS surfaces and work areas of foreign materials resulting from DAFS operations.

3.05 PROTECTION

A. Protect completed work from damage and soiling by subsequent work.

END OF SECTION

SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vapor-permeable, fluid-applied air barriers.

1.02 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces. Note: For the purposes of this specification, vapor impermeable air barriers are classified as vapor retarders.

C. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.
   a. Vapor Barrier: Has water vapor permeance of 0.1 perms maximum.
   b. Vapor Permeable: Has water vapor permeance of 1 perms or greater.

D. Water-Resistive Barrier: Water-shedding barrier made of material that is moisture resistant, to the degree specified, intended to be installed to shed water without sealed seams.

1.03 REFERENCE STANDARDS

A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023.

B. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.

C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).

D. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).

E. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers; 2022.

F. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems; 2017.

G. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

H. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2018.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.

K. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work of this section.

B. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.05 SUBMITTALS

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

B. Product Data: Provide product description and data on material characteristics, performance criteria, and limitations.

C. Shop Drawings: For air barrier assemblies.

1. Show locations and extent of air barrier materials, accessories, and assemblies specific to Project conditions.
2. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
3. Include details of interfaces with other materials that form part of air barrier.

D. Product Certificates: From air barrier manufacturer, certifying compatibility of air barriers and accessory materials with Project materials that connect to or that come in contact with the barrier.

E. Qualifications: For manufacturer and applicator.

F. Field Quality Control: Submit field inspection reports.

G. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 5 years of documented experience.

B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum 5 years of documented experience and as follows:

1. Applicator shall be approved or certified by the air barrier manufacturer.
2. Applicator shall be an accredited installer under the Air Barrier Association of America's (ABAA) Quality Assurance Program.

1.07 MOCK-UP

A. Construct mock-up, 4 feet long by 8 feet wide; include wall construction and typical transition and flashing details at openings such as windows and doors.

1. Include junction with roofing membrane, building corner condition, and foundation wall intersection.

B. Locate where directed.

C. Mock-up may remain as part of the Work.

1.08 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

B. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 PRODUCTS

2.01 MATERIALS

A. Source Limitations: Obtain primary air barrier materials and air barrier accessories from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Air Barrier Performance: Air barrier assembly and seals with adjacent construction shall be capable of performing as a continuous air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

2.03 AIR BARRIER MATERIALS - VAPOR PERMEABLE AIR BARRIER

A. Vapor Permeable Air Barrier Sheet, Fluid-Applied: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of 35 mils (0.9 mm) or thicker.
   1. Physical and Performance Properties:
      a. Dry Film Thickness: As recommended by weather barrier manufacturer.
      b. Water Vapor Permeance: 15 perms, maximum; ASTM E96/E96M, Method B.
      c. Air Permeance: 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. (0.02 L/sec per sq m, maximum, at 75 Pa); ASTM E2178.
      d. Air Leakage - Assembly: Pass, less than 1 percent; ASTM E2357.
      e. Elongation: 250 percent, minimum; ASTM D412.
      f. Tensile Strength: 100 psi, minimum; ASTM D412.
      g. Flame Spread Index: Less than 25, Class A; ASTM E84.
      h. Smoke Developed Index: Less than 450, Class A; ASTM E84.
      i. Nail Sealability: Pass, no leakage; ASTM D1970/D1970M.
      j. VOC Content: 100 g/L, maximum.
      k. Air barrier shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria of NFPA 285.
   2. Products:
      a. BASF; MasterSeal AWB 660: www.master-builders-solutions.basf.us
      b. Carlisle Coatings & Waterproofing; Fire Resist Barritech VP: www.carlisleccw.com.
      c. GCP Applied Technologies; Perm-a-Barrier VPL: www.gcpat.com.
      d. Henry Company; Air-Bloc 17MR: www.henry.com.
      e. Prosoco Inc.; R-Guard Spray Wrap MVP: www.prosoco.com.
      f. Sto Corp.; StoGuard AirSeal: www.stocorp.com.
      g. Tremco Inc.; EXOAIR 230: www.tremcosealants.com.
      h. W.R. Meadows; Air-Shield LMP: www.wrmeadows.com.
      i. Substitutions: See Section 01 6000 - Product Requirements.

2.04 ACCESSORY MATERIALS

A. Primers: As recommended for substrate by air barrier material manufacturer and accessory manufacturers.

B. Transitions and Flashings:
   1. General:
      a. Products shall be compatible with air barrier and approved by the air barrier manufacturer.
      b. Maintain the continuity of the air and water barrier as it transitions to adjacent materials.
      c. Materials shall be compatible with adjacent materials.
      d. Transisitions and flashings shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria of NFPA 285.
   2. Silicone Sheet Transitions:
      a. Pre-cured silicone rubber sheets and pre-molded corners.

b. Install using liquid-applied flashings and sealants as an adhesive.
c. Available products include, but are not limited to, the following:
1) The Dow Chemical Company; Dowsil Silicone Transition Strip: www.dow,com.
2) Momentive Performance Materials, Inc./GE; UltraSpan UST/USM Pre-Cured Silicone Transition Sheet and Molded Corners: www.siliconeforbuilding.com.
3) Prosoco Inc.; R-Guard SureSpan EX: www.prosoco.com.
4) Tremco, Inc.; ProGlaze ETA and Spectrem Simple Seal: www.tremcosealants.com.

3. Flexible Fabric Flashing - Self-Adhering: Self-adhering stainless steel/polymer fabric flashing. ASTM A240/A240M stainless steel sheet bonded with rubber-based adhesive to one sheet of polymer fabric. Flashing shall be self-adhering using a pressure-sensitive adhesive.
a. Type 304 stainless steel.
1) Thickness: 2 mils, miniumum.
b. Available products include, but are not limited to, the following:
1) York Manufacturing, Inc.; York 304: www.yorkmfg.com.
2) Momentive Performance Materials, Inc./GE; GE Elemax SS Flashing: www.siliconeforbuilding.com.

C. Sealants: Provide non-sag, single component, silicone sealants compatible with air barrier and approved by the air barrier manufacturer.
D. Miscellaneous Accessories:
1. As recommended by air barrier manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and conditions are ready to accept the work of this section.
1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that substrates have cured and aged for minimum time recommended in writing by air barrier manufacturer.
3. Verify that substrates are visibly dry and free of moisture. Test concrete substrates for capillary moisture by plastic sheet method according to ASTM D4263.
4. Verify that masonry joints are flush and completely filled with mortar.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
B. Mask and protect adjacent surfaces from over spray or dusting.
C. Prepare static gaps and joints as recommended by air barrier manufacturer and as indicated on Drawings.
D. Install transitions and flashings around corners of openings, around penetrations, and elsewhere as recommended by air barrier manufacturer and as indicated on Drawings.
1. Use silicone sheet transitions and pre-molded corners adhered with liquid-applied flashings and sealants except where flexible fabric flashings or metal flashings are indicated on Drawings or recommended by air barrier manufacturer.
E. Coordinate detailing of transitions to other materials in order to maintain a continuous air and water barrier.
1. Ensure that transition materials are compatible with adjacent materials and substrates.
F. When recommended by air barrier manufacturer, apply primer in accordance with manufacturer's instructions.
G. Notify Architect of any issues prior to installing air barrier materials. Do not proceed with air barrier installation until issues have been resolved and approved by Architect.

3.03 INSTALLATION

A. Apply primer to substrates as recommended by air barrier manufacturer.
B. Ensure that all transitions, bridging of gaps and joints, corners, flashings, penetrations, and terminations are completed in accordance with the recommendations of the air barrier manufacturer and as indicated on Drawings
C. Apply air barrier material according to air barrier manufacturer's written instructions and details.
    1. Apply continuous unbroken air barrier material to substrates.
    2. Apply air barrier material in full contact around protrusions such as masonry ties.
D. Do not cover air barrier until it has been tested and inspected by testing agency.
E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.
F. Remove masking materials after installation.

3.04 FIELD QUALITY CONTROL

A. Field inspections and tests will be performed by an independent testing agency under provisions of Section 01 4000 - Quality Requirements.
    1. Owner will engage a qualified testing agency to perform tests and inspections.
B. Inspections: Air barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:
    1. Verification of substrate preparations. Do not cover until inspections are complete.
    2. Verification that transitions and flashing details are installed properly. Do not cover until inspections are complete.
    3. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
    4. Air barrier dry film thickness.
    5. Site conditions for application temperature and dryness of substrates have been maintained.
    6. Maximum exposure time of materials to UV deterioration has not been exceeded.
    7. Compatible materials have been used.
    8. All penetrations have been sealed.
C. Tests: As determined by testing agency from among the following tests:
    1. Air-Leakage-Location Testing: Air barrier assemblies will be tested for evidence of air leakage according to ASTM E1186, chamber pressurization or depressurization with smoke tracers.
    2. Adhesion Testing: Air barrier assemblies will be tested for required adhesion to substrate according to ASTM D4541 for each 600 sq. ft. (56 sq. m) of installed air barrier or part thereof.
D. Air barriers will be considered defective if they do not pass tests and inspections.
    1. Deficiencies shall be corrected by the Contractor at no additional cost to the Owner.
E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.
F. Prepare test and inspection reports.

3.05 PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
    1. Protect air barrier from exposure to UV light and harmful weather exposure as recommended by manufacturer.
    2. If exposed to these conditions for longer than recommended, remove and replace overexposed air barrier materials according to air barrier manufacturer's instructions.
B. If damage occurs, patch damaged areas in accordance with air barrier manufacturer's instructions.

END OF SECTION

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SECTION 07 4213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.

1.02 ABBREVIATIONS

A. MCM: Metal composite material.
B. ACM: Aluminum composite material.

1.03 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2023.
C. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2023.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
G. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
H. ASTM D1781 - Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2021).
I. ASTM D1929 - Standard Test Method for Determining Ignition Temperature of Plastics; 2023.
J. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2016.
K. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
N. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Wall Assemblies Containing Combustible Components; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meeting: Convene one week before starting work of this section to verify project requirements, coordinate with installers of other work, establish condition and completeness of building substrate, and review manufacturers' installation instructions and warranty requirements.
   1. Require attendance by the installer and relevant sub-contractors.
   2. Include MCM sheet manufacturer’s representative and wall system manufacturer’s representative to review storage and handling procedures.
   3. Review procedures for protection of work and other construction.
B. Product Coordination and Limitations: Provide products that when combined with materials and components of other sections, form exterior wall assemblies as detailed on Drawings, that comply with NFPA 285 testing and acceptance criteria.

1.05 SUBMITTALS

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

B. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
   1. Finish manufacturer's data sheet showing physical and performance characteristics.
   2. Storage and handling requirements and recommendations.
   3. Fabrication instructions and recommendations.
   4. Specimen warranty for finish, as specified herein.
C. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.
   4. Specimen warranty for wall system, as specified herein.
D. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
   1. Differentiate between shop and field fabrication.
   2. Indicate substrates and adjacent work with which the wall system must be coordinated.
   3. Include large-scale details of anchorages and connecting elements.
   4. Include flashing and trim details.
   5. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
E. Verification Samples: For each finish product specified, submit at least three samples, minimum size 6 inch square, and representing actual product in color and texture.
F. Design Data: Submit structural calculations stamped by design engineer, for Architect's information and project record.
G. Test Report: Submit report of full-size mock-up tests for air infiltration, water penetration, and wind performance.
H. NFPA 285 Documentation: For each product, submit documentation listing compatible materials and components that when used together in wall assemblies as detailed on Drawings, comply with NFPA 285 testing and acceptance criteria.
I. Manufacturer's Field Reports: Provide within 48 hours of field review. State what was observed and what changes, if any, were requested or required.
J. Manufacturer's qualification statement.
K. Installer's qualification statement.
L. Testing agency's qualification statement.
M. Maintenance Data: Care of finishes and warranty requirements.
N. Executed Warranty: Submit warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
B. Design Engineer's Qualifications: Design structural supports and anchorages under direct supervision of a Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
C. Manufacturer Qualifications: Company specializing in manufacturing wall panel systems specified in this section.
   1. With not less than five years of documented experience.
D. Installer Qualifications: Company specializing in performing work of the type specified in this section.
   1. With minimum five years of documented experience.

2. Approved by wall panel system manufacturer.

E. Testing Agency Qualifications: Independent agency experienced in testing assemblies of the type required for this project and having the necessary facilities for full-size mock-up testing of the type specified.

F. Construct mock-up, 10 feet long by 10 feet wide; include panel system, attachments to building frame, associated air/water barrier materials, weep drainage system, sealants and seals in mock-up.

1.07 DELIVERY, STORAGE, AND HANDLING

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

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

1.08 WARRANTY

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

B. Wall System Warranty: Provide joint written warranty by manufacturer and installer, agreeing to correct defects in manufacturing or installation within a two year period after Date of Substantial Completion.

C. MCM Sheet Manufacturer’s Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 20 years:
   1. Chalking: No more than that represented by a No. 8 rating based on ASTM D4214.
   2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
   3. Gloss Retention: Minimum of 30 percent gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Composite Material (MCM) Sheet Manufacturers - Products:
   1. Arconic Architectural Products LLC; Reynobond FR: www.arconic.com.
   2. Mitsubishi Chemical Composites America, Inc.; APOLIC/fr: www.alpolic-americas.com.
   3. ALUCOBOND USA; ALUCOBOND PLUS: www.alucobondusa.com/#sle.
   4. Alfrex, LLC; Alfrex fr: www.alfrexusa.com/#sle.
   5. Citadel Architectural Products, Inc; Envelope 2000: www.citadelap.com/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall Panel System Manufacturers - Products:
   1. Citadel Architectural Products, Inc.; Envelope 2000 RS: www.citadelap.com.
   2. Riverside Group; R4-300 System: www.riversidegroup.net.
   3. Royalton Architectural Fabrication, Inc.; Royaltech 3000 Panel System: www.rafpanels.com.
   4. Sobotec Ltd.; SL-2000 PER System: www.sobotec.com.

5. Wolverine Enclosure; AAP DS-9500 Presure Equalized MCM Rainscreen System: www.panels.com .
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WALL PANEL SYSTEM

A. Wall Panel System: Metal panels, framing, flashings and trim, fasteners, and anchors designed to be supported by substrate provided by others; provide installed panel system capable of maintaining specified performance without defects, damage or failure.
   1. Wall panel system shall be a rainscreen system designed to allow air movement behind the panels with weeps and channels to allow water and moisture entering the system to escape.
   2. Provide structural design by or under direct supervision of a Structural Engineer licensed in the State in which the Project is located.
   3. Provide panel jointing and weatherseal using reveal joints and gaskets but no sealant.
   4. Anchor panels to supporting framing without exposed fasteners.
   5. Overall System Depth (panel plus framing system): 2 inches, nominal.

B. Performance Requirements
   1. Thermal Movement: Provide for free and noiseless vertical and horizontal thermal movement due to expansion and contraction under material temperature range of minus 20 degrees F to 180 degrees F without buckling, opening of joints, undue stress on fasteners, or other detrimental effects; allow for ambient temperature at time of fabrication, assembly, and erection procedures.
   2. Wind Performance: Provide system tested in accordance with ASTM E330/E330M without permanent deformation or failures of structural members under the following conditions:
      a. Design Wind Pressure: As indicated on Drawings.
      b. Maximum deflection of perimeter framing member of L/175 normal to plane of the wall; maximum deflection of individual panels of L/60.
      c. Maximum anchor deflection in any direction of 1/16 inch at connection points of framing members to anchors.
   3. Wall panel system shall be an approved component of an NFPA 285 tested exterior wall assembly as detailed on Drawings; tested in accordance with, and complying with the acceptance criteria, of NFPA 285.
   4. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.

C. Panels: 1 inch deep pans formed of metal composite material sheet by routing back edges of sheet, removing corners, and folding edges.
   1. Reinforce corners with riveted aluminum angles.
   2. Provide concealed attachment to supporting structure by adhering attachment members to back of panel; attachment members may also function as stiffeners.
   3. Maintain maximum panel bow of 0.8 percent of panel dimension in width and length; provide stiffeners of sufficient size and strength to maintain panel flatness without showing local stresses or read-through on panel face.
   4. Secure members to back face of panels using structural silicone sealant approved by MCM sheet manufacturer.
   5. Fabricate panels under controlled shop conditions.
   6. Where final dimensions cannot be established by field measurement before commencement of manufacturing, make allowance for field adjustments without requiring field fabrication of panels.
   7. Fabricate as indicated on drawings and as recommended by MCM sheet manufacturer.
      a. Make panel lines, breaks, curves, and angles sharp and true.
      b. Keep plane surfaces free from warp or buckle.
      c. Keep panel surfaces free of scratches or marks caused during fabrication.

8. Provide joint details providing a watertight and structurally sound wall panel system that allows no uncontrolled water penetration on inside face of panel system.

D. Metal Framing System: Manufacturer's standard extruded aluminum framing system.
1. Provide material strength, dimensions, configuration as required to meet the applied loads applied and in compliance with applicable building code.
2. Include base and sill angles, perimeter terminations, horizontal and vertical framing members, and flashings required for complete installation.
3. Fabricate in pieces of longest practical lengths.

2.03 MATERIALS

A. Aluminum Composite Material (ACM) Sheet: Two sheets of aluminum sandwiching a core of extruded thermoplastic material; no foamed insulation material content.
1. Overall Sheet Thickness: 0.157 inch (4mm), minimum.
2. Face Sheet Thickness: 0.02 inches, minimum.
3. Core: Fire retardant.
4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound/inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70 degrees F.
5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
6. Flammability: Self-ignition temperature of 700 degrees F or greater, when tested in accordance with ASTM D1929.
7. Fluoropolymer Coating System: Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, including minimum 70 percent PVDF color topcoat and minimum total dry film thickness (DFT) of 0.9 mil. Comply with AAMA 2605.
   a. Color(s): To match Architect's samples.
      1) ACM1: Design Intent: Alpolic Mica MFS Grey.

B. Aluminum: Extruded components; ASTM B221.

2.04 ACCESSORIES

A. Flashing: Sheet aluminum; 0.032 inch thick, minimum; finish and color to match ACM sheet; refer to Section 07 6200 for additional requirements.

B. Anchors, Clips and Accessories:
1. Stainless steel complying with ASTM A276/A276M, ASTM A480/A480M, or ASTM A666.

C. Fasteners:
1. Stainless steel; exposed fasteners permitted only where absolutely unavoidable, subject to prior approval of the Architect.
2. Fasteners for Flashing and Trim: Blind fasteners of high-strength aluminum or stainless steel.

D. Bituminous Coating: Cold-applied asphalt mastic, noncorrosive compound free of asbestos, sulfur, and other deleterious impurities; 15-mil dry film thickness per coat.

E. Joint Sealer: Provide color to match wall panels; silicone sealant of type approved by ACM sheet manufacturer, and in compliance with ASTM C920.
1. See Section 07 9200 for additional requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine dimensions, tolerances, and interfaces with other work.
1. Verify that weather barrier system is properly installed, refer to Section 07 2726 - Fluid-Applied Membrane Air Barriers for requirements.

B. Examine substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturer's written instructions.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
D. Notify Architect in writing of conditions detrimental to proper and timely completion of work, and do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 PREPARATION

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

3.03 INSTALLATION

A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer.
C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
E. Do not form panels in field unless required by wall system manufacturer and approved by the Architect; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
G. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
    1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
    2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
    3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.
    4. Offset From True Alignment Between Two Adjacent Members Abutting End To End, In Line: 0.03 inch, maximum.
H. Replace damaged products.
    1. Exception: Field repairs of minor damage to finishes are permitted only when approved in writing by Architect, panel manufacturer, and fabricator.
    2. Field Repairs to Finishes: Using materials and methods sufficient that repairs are not discernible when viewed at distance of 10 feet under all typical light conditions experienced at the project.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Wall System Manufacturer's Field Services: Provide field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with instructions.

3.05 CLEANING

A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
C. Remove temporary coverings and protection of adjacent work areas.
D. Clean installed products in accordance with manufacturer's instructions.

3.06 PROTECTION

A. Protect installed panel system from damage until Date of Substantial Completion.

END OF SECTION

SECTION 07 4213 - METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for walls and soffits, with related flashings and accessory components.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
C. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage.
D. Samples: Submit three samples of wall panel and soffit panel, 12 inch by 12 inch in size illustrating finish color, sheen, and texture.

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 installing products of the type specified in this section with minimum 5 years of documented experience and approved by manufacturer.

1.05 MOCK-UP

A. Construct mock-up, 10 feet long by 10 feet wide; include panel and soffit system, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.
B. Locate where directed by Architect.
C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
B. Store prefinished material off the ground and protected from weather; prevent twisting, bending, or abrasion; provide ventilation; slope metal sheets to ensure proper drainage.
C. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Correct defective work within a twenty year period after Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.
C. Correct defective work within a five year period after Date of Substantial Completion, including defects in water tightness and integrity of seals for metal wall panels.

PART 2 PRODUCTS

2.01 MANUFACTURED METAL PANELS - GENERAL

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.

1. Provide exterior panels and soffit panels.
2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch returns.

2.02 WALL PANELS - EXPOSED FASTENERS

A. MWP2 - Corrugated Panels at Screenwalls:
1. Profile: Corrugated.
2. Panel Coverage (Width): 36 inches, minimum.
3. Panel Depth: 1-1/2 inches.
4. Corrugation Pattern Repeat: 7.2 inches, on center.
5. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.
6. G90 Galvanized.
7. Side Laps: Overlapping.
8. End Laps: Overlapping.
9. Fasteners: Exposed.
10. Panel Surface: Smooth.
11. Color: As selected by Architect from manufacturer's standard line.
    a. Exterior facing side: Fluoropolymer Three-Coat Metallic System. Design Intent: Centria Pewter 9967 XL.
    b. Interior facing side at ground level screen walls: Fluoropolymer Two-Coat System. Design Intent: Centria Fluorofinish.
12. Basis-of-Design: Centria; Style-Rib: www.centria.com. Provide either the named product or a comparable product by one of the following:
    a. AEP Span; Reversed HR-36: www.aepspan.com.
    b. ATAS International, Inc.; Belvedere 7.2" Rib: www.atas.com.
    c. Berridge Manufacturing Company; "M" Panel: www.berridge.com.
    d. Fabral; Hefti-Rib: www.fabral.com.
    e. MBCI, an NCI Building Systems company; 7.2 Panel: www.mbci.com.
    f. Metl-Span, an NCI Building Systems company; Style-Rib: www.metlspan.com.
    g. Petersen Aluminum Corporation; 7.2 Panel: www.pac-clad.com.
    h. Substitutions: See Section 01 6000 - Product Requirements.

2.03 WALL PANELS - CONCEALED FASTENERS

A. MWP1- Ribbed Panels:
1. Profile: Asymmetrical Ribs.
2. Panel Coverage (Width): 16 inches, minimum.
3. Panel Depth: 7/8 inches.
4. Panel Reveal: None.
5. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.
6. Side Laps: Interlocking.
7. End Laps: As standard with manufacturer.
8. Fasteners: Concealed.
9. Panel Surface: Smooth.
10. Color: As selected by Architect from manufacturer's standard line.
    a. Design Intent: Centria Pewter 9967 XL.

11. Basis-of-Design: Centria; CS-660: www.centria.com. Provide either the named product or a comparable product by one of the following:
    a. AEP Span; Perception Collection www.aepspan.com.
    b. ATAS International, Inc; Rigid Wall II: www.atas.com.
    c. Berridge Manufacturing Company; HR-16: www.berridge.com.
    d. Fabral; Silohouette HCF: www.fabral.com.
    e. Metal Sales Manufacturing Corp.; CN88-1653: www.metalsales.us.com.
    f. Petersen Aluminum Corporation; HWP: www.pac-clad.com.
    g. Substitutions: See Section 01 6000 - Product Requirements.

2.04 SOFFIT PANELS

A. FAC1 - Soffit Panels:
1. Profile: Flat Panels.
2. Panel Coverage (Width): 4 inches.
3. Panel Depth: 1/2 inch.
4. Ventilation: None; solid panel.
5. Material: Precoated aluminum sheet, 20 gauge, 0.032 inch minimum thickness.
6. Side Joints: Interlocking.
7. Fasteners: Concealed.
8. Panel Surface: Smooth.
9. Color: To match Architect's sample. Design Intent: Light Cherry.
10. Basis-of-Design: FastPlank Systems, Inc.; Siding and Soffit: www.fastplank.com. Provide either the named product or a comparable product by one of the following:
    a. ATAS International, Inc.; Opaline OPF: www.atas.com.
    b. Elevate; UC-500 Flush Panel Systems: www.holcimelevate.com
    c. Longboard Architectural Products; Tongue & Groove Planks: www.longboardproducts.com.
    d. Petersen Aluminum Corporation; Flush Solid Soffit: www.pac-clad.com.
    e. Substitutions: See Section 01 6000 - Product Requirements.

2.05 MISCELLANEOUS

A. Internal and External Corners: Same material, thickness, and finish as wall panels and soffit panels; profile to suit system;shop cut and factory mitered to required angles.
B. Expansion Joints: Same material, thickness and finish as wall panels and soffit panels; manufacturer's standard type, of profile to suit system.
C. Trim, Closure Pieces, Caps, and Flashings: Same material, thickness and finish as wall panels and soffit panels; brake formed to required profiles.
D. Anchors: Galvanized steel or Stainless steel.

2.06 MATERIALS

A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.
B. Precoated Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper, smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.07 FINISHES

A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch.

2.08 ACCESSORIES

A. Concealed Sealants: Non-curing butyl sealant or tape sealant.

B. Exposed Sealants: Refer to Section 07 9200 - Joint Sealants.
C. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Exposed fasteners same finish as panel system.
D. Field Touch-up Paint: As recommended by panel manufacturer.
E. Bituminous Paint: Asphalt base.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that cladding support system framing members are ready to receive panels.
B. Verify that weather barrier has been installed over substrate completely and correctly.

3.02 INSTALLATION

A. Install panels on walls and soffits in accordance with manufacturer's instructions.
B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
C. Fasten panels to structural supports; aligned, level, and plumb.
D. Lap panel ends minimum 2 inches.
E. Provide expansion and control joints where indicated.

3.03 TOLERANCES

A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
B. Maximum Variation from Plane or Location Indicated on Drawings: 1/8 inch.

3.04 CLEANING

A. Remove site cuttings from finish surfaces.
B. Remove protective material from wall panel surfaces.
C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 4646 - FIBER-CEMENT SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiber-cement siding.

1.02 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
B. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets; 2022.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
   1. Manufacturer's requirements for related materials to be installed by others.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods, including nail patterns.
C. Shop Drawings: Indicate dimensions, layout, joints, construction details, support clips, and methods of anchorage.
D. Verification Samples: For each finished product specified, two samples, minimum size 4 inch by 4 inch, representing actual product, color, and patterns.
E. Manufacturer's qualification statement.
F. Installer's qualification statement.
G. Maintenance Instructions: Periodic inspection recommendations and maintenance procedures.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 7419 - Construction Waste Management and Disposal for packaging waste requirements.
B. Deliver and store materials in manufacturer's unopened packaging, with labels intact, until ready for installation.
C. Store materials under dry and waterproof cover, well ventilated, and elevated above grade on a flat surface.
D. Protect materials from harmful environmental elements, construction dust, and other potentially detrimental conditions.

1.06 FIELD CONDITIONS

A. Do not install panels when air temperature or relative humidity are outside manufacturer's limits.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide manufacturer warranty for 10 year period commenting on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 FIBER-CEMENT SIDING

A. FCWP: Through Color High Density Fiber Cement Panels: High-density through colored fiber cement panel with no coating. Complying with ASTM C1186, and ASTM C518. Panel is water repellent by means of hydrophobation.
   1. Application: Exterior and Interior.
   2. Nominal Thickness: 5/16 inch (8mm).
   3. Attachment Method: Exposed screw fasteners.
   4. Texture: As scheduled.
   5. Size: As Indicated on Drawings.
   6. Colors:
      a. FWCP01: Tectiva TE20.
      b. FWCP02: Linea LT20.
      c. FWCP03: Tectiva TE40.
      d. FWCP04: Tectiva TE30.
      e. FWCP05: Natura N411.
   7. Physical Characteristics:
      a. Strength Classification: Grade IV.
      b. Mean density (dry): 101 pounds per cubic foot.
      c. Mean bending strength perpendicular (dry): 4475 pounds per square inch.
      d. Mean bending strength perpendicular (wet): 3886 pounds per square inch.
      e. Moisture content: 5.9 percent.
      f. Water absorption: 19 percent.
      g. Moisture movement: 0.02 percent.
      h. Thermal conductivity: 0.226 BTU/h ft Farenheit.
   8. Fire Performance:
      a. ASTM E84 Flame spread index: 0
      b. ASTM E84 Smoke development index: 5
   9. Products:
      a. ETEX Group; Equitone Fiber Cement Facade Materials: www.equitone.com/en-us/.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.02 ACCESSORIES

A. Support for Cladding: See Section 07 0543 Cladding Support Systems.
B. Trim: Same material and texture as siding.
C. Metal Trim: Extruded aluminum alloy 6063-T5 temper.
   1. Finish: Powder coating.
   2. Color: As selected by Architect.
   3. Outside Corner Trim:
      a. Type: As selected by Architect from manufacturer's standard line.
D. Aluminum Joint Closures: Manufacturer's standard products as detailed. Maximum thickness of non structural finishing profile to be 21 gauge.
E. Fasteners: Galvanized or corrosion resistant; length as required to penetrate, 1-1/4 inches, minimum.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate, clean and repair as required to eliminate conditions that would be detrimental to proper installation.
B. Do not begin until unacceptable conditions have been corrected.
C. If substrate preparation is responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Protect surrounding areas and adjacent surfaces during execution of this work.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and recommendations.
   1. Read warranty and comply with terms necessary to maintain warranty coverage.
   2. Use trim details as indicated on drawings.
   3. Touch up field cut edges before installing.
   4. Pre-drill nail holes if necessary to prevent breakage.

B. Do not install siding less than 24 inches from ground surface and other surfaces where water may collect.

C. After installation, seal joints except lap joints of lap siding; seal around penetrations, and paint exposed cut edges.

3.04 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.

B. Clean faced panels in accordance with manufacturer’s maintenance instructions, using cleaning materials and methods acceptable to manufacturer.

3.05 PROTECTION

A. Protect installed products until Date of Substantial Completion.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 07 5300 - ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Elastomeric roofing membrane application.
B. Insulation, flat and tapered.
C. Vapor retarder.
D. Deck sheathing.
E. Cover boards.
F. Roofing walkway pads.

1.02 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
B. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
D. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
E. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2023).
F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
G. ASTM D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method; 1983 (Reapproved 2018).
H. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015, with Editorial Revision (2022).
I. ASTM D5602/D5602M - Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens; 2018 (Reapproved 2022).
J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
K. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
L. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
M. FM (AG) - FM Approval Guide; Current Edition.
N. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction; 2022.
O. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2024).
P. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
Q. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of associated counterflashings installed under other sections.
B. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, fasteners, deck sheathing, cover board, and adhesives.
C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, walkway pad locations, and sacrificial membrane locations.
D. Samples for Verification: Submit three samples 4 by 4 inches in size illustrating roofing membrane, cover board, insulation, vapor retarder, deck sheathing, and walkway pads.
E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
F. Manufacturer's Installation Instructions: Indicate membrane seaming precautions, special procedures, and perimeter conditions requiring special attention.
G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.
J. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 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.

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

A. Do not apply roofing membrane during unsuitable weather and as defined by roofing membrane manufacturer.
B. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
D. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Manufacturer Warranty: Provide Twenty (20) year manufacturer's system warranty where manufacturer shall repair or replace roofing system components that fail in materials or workmanship; includes failure to prevent penetration of water to include roof edge metals.
C. Installer Warranty: Provide installation warranty where installer agrees to correct defective Work within a Two (2) year period after Date of Substantial Completion; includes failure to prevent penetration of water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. EPDM Membrane Materials:
   1. Carlisle SynTec Systems: www.carlisle-syntec.com/#sle.
   2. Elevate: www.holcimelevate.com/#sle.
   3. Johns Manville: www.jm.com/#sle.
   4. Substitutions: See Section 01 6000 - Product Requirements.

B. Source Limitations: Obtain roof membrane from one of the named Roof Assembly manufacturers and provide related roofing assembly components from either the roof membrane manufacturer or one of the listed product manufacturers; subject to approval of roof membrane manufacturer.

2.02 ROOFING

A. EPDM single-ply roof membrane; fully adhered.
   1. EPDM single-ply roof membrane; fully adhered.
   2. Cover board; fully adhered.
   3. Insulation, including tapered insulation; first layer mechanically fastened, all subsequent layers fully adhered.
   4. Deck sheathing; mechanically fastened.
   5. Walkway Pads.

B. Performance Requirements:
   1. Comply with Factory Mutual (FM) Global and FM Approvals' RoofNav Listing requirements as follows:
      a. Roof membrane, base flashings, and component materials shall comply with requirements in FM Approvals FM 4450 or FM Approvals FM 4470 as part of a roofing system, and shall be listed in FM Approvals' RoofNav for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals Certification markings.
         1) Fire/Windstorm Classification: Class 1A-90.
         2) Hail-Resistance Rating: SH.
      b. Comply with the following Property Loss Prevention Data Sheets:
         1) Data Sheet FM DS 1-28: Wind Design.
         2) Data Sheet FM DS 1-29: Roof Deck Securement and Above-Deck Roof Components.
         3) Data Sheet FM DS 1-49: Perimeter Flashing.
   2. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials as demonstrated by roof membrane manufacturer based on testing and field experience.

C. Acceptable Insulation Types - Constant Thickness Application: Any of types specified.
   1. Minimum 2 layers of polyisocyanurate board.
   2. Minimum R-value: 30.

D. Acceptable Insulation Types - Tapered Application:
   1. Uniform thickness polyisocyanurate board covered with tapered polyisocyanurate board.

2.03 ROOFING MEMBRANE AND ASSOCIATED MATERIALS

A. Membrane: Ethylene-propylene-diene-monomer (EPDM); internally reinforced with fabric or scrim; complying with minimum properties of ASTM D4637/D4637M.
   1. Thickness: 60 mil, 0.060 inch, minimum.
   2. Color: Black.

B. Seaming Materials: As recommended by membrane manufacturer.

C. Flexible Flashing Material: Same material as membrane.
   1. Thickness: Same as roofing membrane unless otherwise recommended by roof membrane manufacturer.
   2. Uncured, unless otherwise recommended by roof membrane manufacturer.

D. Factory Fabricated Flashings: Same material as roofing membrane
   1. Provide manufacturer's standard preformed flashings including, but not limited to, cone and vent sheet flashings, molded pipe boot flashings, and pourable sealer penetration pockets.

2.04 DECK SHEATHING

A. Deck Sheathing: Glass mat faced gypsum panels, ASTM C1177/C1177M, glass-mat, water resistant gypsum board.
   1. Thickness: 1/2 inch.
   2. Size: 4 by 4 or 4 by 8 feet.
   3. Products:
      a. Georgia-Pacific; DensDeck Prime Roof Board: www.densdeck.com/#sle.
      b. National Gypsum Company, DEXcell Brand FA Glass Mat Roof Board: www.nationalgypsum.com
      c. USG Corporation; Securock Ultralight Coated Glass-Mat Roof Board: www.usg.com/#sle.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Deck Sheathing: Fiber-reinforced gypsum roofing boards, ASTM C1278/C1278M, mold-resistant, 1/2 inch thick.
   1. Products:
      a. USG Corporation; Securock Gypsum-Fiber Roof Board: www.usg.com/#sle.

2.05 COVER BOARDS

A. Cover Boards: Faced and with high compressive strength polyisocyanurate (ISO) insulation complying with ASTM C1289.
   1. Classifications:
      a. Type II - Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 4 - Faced with coated or uncoated glass fiber mat facers on both major surfaces of the core foam. This product is used at a maximum thickness of 1/2 inch (12.7 mm).
            (a) Compressive Strength: Grade 1, 80 psi, minimum.
   2. Board Size: 48 by 48 inches or 48 by 96 inches.
   3. Board Thickness: 1/2 inch.
   4. Thermal Resistance at 1/2 inch Thick, R-value: 2.5, nominal.
   5. Products:
      a. Substitutions: See Section 01 6000 - Product Requirements.

2.06 INSULATION

A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
         1) Class 2 - Faced with coated glass fiber mat facers on both major surfaces of the core foam.
   2. Board Size: 48 by 48 inches or 48 by 96 inches.
   3. Board Thickness: 2.0 inch.
   4. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
   5. Board Edges: Square.
   6. Products:
      a. Carlile SynTec Systems: SecurShield: www.carlislesyntec.com
      b. Elevate; Resista: www.holcimelevate.com
      c. Johns Manville; Enrgy3 CGF: www.jm.com
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.07 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive; cold applied, with slip-resisting surface and release paper backing.
   1. Properties:
      a. Thickness: 30 mil total thickness, minimum; ASTM D1970/D1970M.
      b. Tensile Strength: 50 lbf/in MD, 70 lbf/in XMD; ASTM D5147.
      c. Elongation: 50 percent MD, 20 percent XMD; ASTM D5147; 73 degress F.
      d. Low Temperature Flexibility: Minus 30 degress F; ASTM D5147.
      e. Static Puncture: 90 lbf; ASTM D5602/D5602M.
      f. Tear Strength: 80 lbf/in MD, 90 lbf/in XMD; ASTM D5601; at 73 degress F.
      g. Lap Adhesion: 6 lbf/in; ASTM D1876; at 73 degress F
      h. Peel Resistance: 5 lbf/in; ASTM D903.
      i. Water Absorption: Less than 0.1 percent; ASTM D5147.
      j. Water Vapor Permeability: Maximum permeance rating of 0.1 perm; ASTM E96/E96M, Procedure B.
      k. Air Permeability: Maximum permeance of 0.0002 cu ft/min-sq ft; ASTM E2178.
   2. Products:
      a. Carlisle SynTec Systems; VapAir Seal 725TR: www.carlislesyntec.com.
      b. Holcim Elevate; V-Force: www.holcimelevate.com.
      c. Johns Manville; JM Vapor Barrier SA: www.jm.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.08 WALKWAY PADS

A. Flexible Walkway Pads: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads.
   1. Size: 30 by 30 inches.
   2. Thickness: 0.30 inch, minimum.
   3. Color: Black.
   4. Products:
      a. Carlisle SynTec Systems; Sure-Seal EPDM Pressure-Sensitive Molded Walkway Pads: www.carlislesyntec.com.
      b. Elevate; QuickSeam Walkway Pad: www.holcimelevate.com.
      c. Johns Manville; JM EPDM Peel & Stick Walkpads: www.jm.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.09 ACCESSORIES

A. Auxiliary Materials: Provide all materials recommended by roofing assembly manufacturer for a complete and weathertight assembly.
B. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel bars, approximately 1 by 1/8 inch thick; with anchors.
C. Seaming Materials: Manufacturer's standard splice tape with release film.
D. Insulation Adhesive: As recommended by insulation manufacturer and as follows:
   1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals FM 4470, designed for fastening components to substrate, and acceptable to roofing system manufacturer
F. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
G. Vapor Barrier Primer: As recommended by vapor barrier manufacturer.
H. Sheathing Joint Tape: Paper type, wide, self adhering.
I. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.
J. Insulation Fasteners: Appropriate for purpose intended and approved by Factory Mutual and roofing manufacturer.

K. Membrane and Flashing Adhesive: As recommended by membrane manufacturer.
L. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
M. Insulation Adhesive: As recommended by insulation manufacturer.
N. Sealants and Pou: As recommended by membrane manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.
B. Verify deck is supported and secure.
C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
D. Verify deck surfaces are dry and free of snow or ice.
E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and nailing strips are in place.

3.02 PREPARATION - CONCRETE DECK

A. Fill surface honeycomb and variations with latex filler.
B. Do not begin work until elevated concrete substrate has cured at least 28 days and moisture content is five percent or less.
    1. Test as Follows:
        a. Concrete Moisture Content: No beading water under plastic after 16 hours when tested in accordance with ASTM D4263.
        b. Relative Humidity in Concrete: Not greater than 75 percent when tested in accordance with ASTM F2170.

3.03 PREPARATION - METAL DECK

A. Install deck sheathing on metal deck.
    1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
    2. Cut sheathing cleanly and accurately at roof breaks and protrusions to provide smooth surface.
    3. Tape joints.
B. Mechanically fasten sheathing to roof deck, in accordance with Factory Mutual recommendations and roofing manufacturer's instructions.
    1. Over entire roof area, fasten sheathing using six fasteners with washers per sheathing board.

3.04 INSTALLATION - VAPOR RETARDER AND INSULATION, UNDER MEMBRANE

A. Self-Adhering-Sheet Vapor Retarder: Install according to vapor barrier manufacturer's instructions. Prime substrate if required by manufacturer. Lap self-adhering-sheet vapor barrier sides and ends a minimum of 3 and 6 inches, respectively.
B. Extend vertically up parapet walls and projections to a minimum height equal to height of insulation and cover board.
C. Completely seal vapor barrier at terminations, obstructions, and penetrations to prevent air movement into roofing system.
D. Ensure vapor retarder is clean and dry, continuous, and ready for application of insulation.
E. Attachment of Insulation:
    1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and FM (AG) Factory Mutual requirements.
    2. Embed second layer of insulation into full bed of adhesive in accordance with roofing and insulation manufacturers' instructions.
F. Cover Boards:
    1. Adhere cover board to insulation using adhesive according to roof assembly manufacturer's instructions and FM (AG) Factory Mutual requirements.

G. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
H. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
I. On metal deck, place boards perpendicular to flutes with insulation board ends bearing on deck flutes.
J. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
   1. Gaps between boards and adjacent materials shall note exceed 1/4 inch.
K. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
L. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.
M. Do not apply more insulation than can be covered with membrane in same day.

3.05 INSTALLATION - MEMBRANE

A. Install elastomeric membrane roofing system in accordance with manufacturer's recommendations and NRCA (WM) applicable requirements.
B. Roll out membrane, free from wrinkles or tears. Place sheet into place without stretching.
C. Shingle joints on sloped substrate in direction of drainage.
D. Overlap edges and ends and seal seams by splice tape, minimum 3 inches. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
E. At intersections with vertical surfaces:
   1. Extend membrane over cant strips and up a minimum of 4 inches onto vertical surfaces.
   2. Fully adhere flexible flashing over membrane and up to nailing strips.
   3. Secure flashing to nailing strips at 4 inches on center.
   4. Insert flashing into reglets and secure.
F. At gravel stops, extend membrane under gravel stop and to the outside face of the wall.
G. At copings, unless otherwise indicated, extend membrane under coping and down face of wall behind front of coping. Secure with fasteners to nailing strips.
H. Around roof penetrations, seal flanges and flashings with flexible flashing.
I. Install roofing expansion joints where indicated. Make joints watertight.
   1. Install prefabricated joint components in accordance with manufacturer's instructions.
J. Coordinate installation of roof drains and sumps and related flashings.
K. Coordinate installation of associated counterflashings installed under other sections.

3.06 SACRIFICIAL MEMBRANE INSTALLATION

A. At roof exhausts which expel vegetable oils, animal fats, and other kitchen wastes, or expel other chemicals detrimental to the roof membrane, install a sacrificial membrane over the roof membrane in an 8 foot radius, minimum, around the roof exhaust.
   1. Sacrificial membrane shall be the same material and thickness as the roof membrane.

3.07 WALKWAY PAD INSTALLATION

A. Walkway Pads: Install walkway products according to manufacturer's instructions.
B. Install walkway pads at the following locations:
   1. Perimeter of each rooftop unit.
   2. Between each rooftop unit location, creating a continuous path connecting rooftop unit locations.
   3. Between each roof hatch and each rooftop unit location or path connecting rooftop unit locations.
   4. Top and bottom of each roof access ladder.
   5. Between each roof access ladder and each rooftop unit location or path connecting rooftop unit locations.

6. At downspout discharges onto roof assembly.
7. Other locations as indicated on Drawings.
8. As required by roof membrane manufacturer's warranty requirements.

C. Provide 6 inch clearance between adjoining pads.
D. Adhere walkway products to substrate with compatible adhesive according to walkway pad manufacturer's instructions.

3.08 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Provide daily on-site attendance of roofing and insulation manufacturer's representative during installation of this work.
C. Final Roof Inspection: Arrange for roof assembly manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.
D. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.
E. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements

3.09 CLEANING

A. See Section 01 7000 - Execution and Closeout Requirements for additional requirements.
B. Clean all dirt, footprints, overspray, spillage, debris, and other construction waste materials from the roof assembly.
C. Remove bituminous markings from finished surfaces.
D. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
E. Repair or replace defaced or damaged finishes caused by work of this section.

3.10 PROTECTION

A. Protect installed roofing and flashings from construction operations.
B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Formed sheet metal items, including, but not limited to, the following:
   1. Flashings.
   2. Counterflashings.
   3. Other items as indicated on Drawings.
B. Manufactured reglets.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
C. ASTM B32 - Standard Specification for Solder Metal; 2020.
D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
F. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
G. FM DS 1-49 - FM Global Property Loss Prevention Data Sheet - Perimeter Flashing; 2016.
H. NRCA (RM) - The NRCA Roofing Manual; 2019.
I. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
C. Samples:
   1. For each material and finish, submit three samples 4 by 4 inch in size illustrating metal finish color.
   2. Reglets: Submit three samples, 4 inches long, full size, of each type and finish.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) requirements, except as otherwise indicated.
B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.06 MOCK-UP

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockup of typical wall flashing with counterflashing, approximately 10 feet long, including supporting construction cleats, seams, attachments and accessories.
   2. Locate where directed.
   3. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Perform work in accordance with SMACNA (ASMM) and NRCA (RM) requirements, unless more stringent requirements are indicated.

B. Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction.

C. Sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

D. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standards, and by Data Sheet FM DS 1-49: Perimeter Flashing, for application, but not less than thickness of metal being secured.

E. Coordination:

1. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
2. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

2.02 SHEET MATERIALS

A. Pre-Finished Aluminum: ASTM B209 (ASTM B209M); 20 gage, (0.032 inch) thick, minimum; plain finish shop pre-coated with fluoropolymer coating.

1. Fluoropolymer Coating: High Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
2. Color: Two or three-coat custom color to match Architect's sample.

B. Stainless Steel: ASTM A666, Type 304 alloy, soft temper, 24 gage, 0.025 inch thick, minimum; smooth 2D (dull, cold rolled) finish.

2.03 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes.

C. Fabricate cleats of same material as sheet, interlocking with sheet.

D. Form pieces in longest possible lengths.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

G. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

H. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

2.04 ACCESSORIES

A. General: Provide all related materials, fasteners, hardware and accessories for a complete installation.

B. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

1. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
2. Exposed Fasteners: Heads matching color of sheet metal using factory-applied coating.

C. Protective Backing Paint: Zinc molybdate alkyd.

D. Concealed Sealants: Non-curing butyl sealant.

E. Exposed Sealants: ASTM C920; elastomeric silicone sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.

F. Solder: ASTM B32; Sn96 type for stainless steel.

2.05 DRIP EDGES

A. Material: Pre-finished aluminum.

B. Provide L-shaped drip edges; extend horizontal leg 4 inches onto roof with vertical leg terminated with a 45 degree bent drip edge.

C. At Contractor's option, provide manufactured drip edges of type and profile required.

2.06 REGLETS

A. Manufactured Reglets: Units of type and profile required, formed to securely interlock with separate counterflashing pieces. Provide factory-mitered and welded corners and junctions.

1. Material: Same material and finish as counterflashing metal.
2. Surface Mounted Type: Provide slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
3. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
4. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.
5. Accessories:
   a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge
6. Manufacturers:
   a. Cheney Flashing Company: www.cheneyflashing.com.
   b. Fry Reglet Corporation: www.fryreglet.com.
   c. Heckmann Building Products, Inc.: www.heckmannbuildingprods.com.
   d. Hohmann & Barnard, Inc.: www.h-b.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. To prevent galvanic action or corrosion, back paint concealed metal surfaces with protective backing paint, minimum dry film thickness of 3 mil, where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates.

3.03 INSTALLATION - GENERAL

A. Install flashings and trim in accordance with SMACNA (ASMM) and NRCA (RM) requirements, unless more stringent methods are indicated.

B. Unless otherwise indicated, provide pre-finished aluminum flashings and trim in areas exposed to public view; at all other areas provide stainless steel flashings.

C. Insert flashings into reglets to form tight fit; secure in place with plastic wedges; seal flashings into reglets with sealant.

1. Counterflashings shall lap base flashing 4 inches, minimum.

D. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted.

E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

F. Seal metal joints watertight.

G. For stainless steel, solder metal joints for full metal surface contact, and after soldering wash metal clean with neutralizing solution and rinse with water.
   1. Do not solder aluminum.

3.04 REGLETS

A. Surface Mounted Type: Install according to manufacturer's instructions.
B. Refer to Section 03 3000 - Cast-in-Place Concrete, for casting reglets in concrete.
C. Refer to Section 04 2000 - Unit Masonry, for embedding reglets in masonry.

3.05 TOLERANCES

A. Sheet Metal Flashing and Trim Tolerances:
   1. Install to tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings.
   2. Install with 1/8 inch maximum offset of adjoining faces and of alignment of matching profiles.

3.06 CLEANING

A. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal manufacturer. Maintain sheet metal flashing and trim in clean condition.
B. Replace sheet metal flashing and trim damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 7100 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including:
   1. Fascia/gravel stops.
   2. Roof expansion joint cover assemblies.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
C. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
D. NRCA (RM) - The NRCA Roofing Manual; 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on shape of components, materials and finishes, anchor types and locations.
C. Shop Drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work.
D. Samples:
   1. For each material and finish, submit three samples 4 by 4 inch inch in size illustrating metal finish color.
   2. Provide a full size sample, 12 inches long, for each of the following:
      a. Roof expansion joint cover assemblies.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 COMPONENTS

A. Fascia/Gravel Stop: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia, cant, and edge securement for roof membrane.
   2. Accessories:
      a. Fascia extenders with continuous hold-down cleats.
         1) Depth: As indicated on Drawings.
   3. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
   4. Material: Formed aluminum sheet, 0.050 inch thick, minimum.
   5. Finish: PVDF coating; 70 percent polyvinylidene fluoride.
   6. Color: Two or three coat custom color to match Architect's sample.
   7. Products:
      a. Architectural Products Co.; AP Snap-On Fascia: www.archprod.com.
      b. ATAS International, Inc.; Edge-Lok 2: www.atas.com.
      c. Carlisle SynTec Systems; SecureEdge 200 Fascia: www.carlislesyntec.com.
      d. Holcim Elevate; Elevate EdgeGard - Snap-On: www.holcimelevate.com/us-en.
      e. Johns Manville; Presto-Tite Edge One Fascia System: www.jm.com.
      f. Metal-Era; Perma-Tite System 200 Fascia: www.metalera.com.

g. OMG Roofing Products; EconoSnap Fascia System: www.omgroofing.com.
h. Petersen Aluminum Corp.; PAC Snap Edge Fascia: www.pac-clad.com.
i. Sika Sarnafil; Edge Grip Fascia: usa.sarnafil.sika.com.
j. Substitutions: See Section 01 6000 - Product Requirements.

B. Expansion Joint Covers - Bellows: Composite construction of flexible EPDM or neoprene flashing of black color with closed cell urethane foam backing, each edge seamed to stainless steel sheet metal flanges, designed for nominal joint width of 2 inch. Include special formed corners, tees, intersections, and wall flashings, each sealed watertight.
1. Type: Roof-to-roof and roof-to-wall; cant based.
2. Accessories: Include the following:
a. Manufacturer's standard moisture barrier.
3. Products:
a. Balco, Inc.; BRB-WC Series: www.balcousa.com.
b. Construction Specialties, Inc.; BRJW-CF Series: www.c-sgroup.com.
c. Johns Manville; Expand-O-Flash CF/EJ Series: www.jm.com.
d. MM Systems Corp.; ERFL Series: www.mmsystemscorp.com.
e. Inpro Corporation; 674-G02 Series: www.inprocorp.com.
f. Nystrom; ECFw Series: www.nystrom.com.
g. Watson Bowman Acme Corp.; Wabo Flash EEJ/C Series: www.wbacorp.com.
h. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FINISHES

A. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system. Two or three-coat system, unless otherwise indicated.

2.03 ACCESSORIES

A. Sealant for Joints in Linear Components: As recommended by component manufacturer.
B. Adhesive for Anchoring to Roof Membrane: Compatible with roof membrane and approved by roof membrane manufacturer.
C. Roof Cement: ASTM D4586/D4586M, Type I.
D. Protective Backing Paint: Zinc molybdate alkyd.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck, curbs, roof membrane, base flashing, and other items affecting work of this Section are in place and positioned correctly.

3.02 PREPARATION

A. To prevent galvanic action or corrosion, back paint concealed metal surfaces with protective backing paint, minimum dry film thickness of 3 mil, or provide other permanent separation as recommended by unit manufacturer, where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates.

3.03 INSTALLATION - GENERAL

A. Install components in accordance with manufacturer's instructions and NRCA (RM) applicable requirements.
B. Seal joints within components when required by component manufacturer.
C. Anchor components securely.
D. Coordinate installation of components of this section with installation of roofing membrane and base flashings.

3.04 CLEANING

A. On completion of manufactured roof specialties installations, remove unused materials and clean finished surfaces as recommended by roof specialties manufacturers. Maintain finishes in clean condition.

B. Replace manufactured roof specialties damaged or deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 07 7200 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof curbs.
B. Roof hatches.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.
C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
D. Samples:
   1. For each material and finish, submit three samples 4 by 4 inch in size illustrating metal finish color.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF CURBS

A. Manufacturers:
   1. The Pate Company: www.patecurbs.com.
   2. LMCurbs: www.lmcurbs.com.
   3. Roof Products & Systems (RPS), Hart & Cooley Inc.: www.rpscurbs.com.
   4. Thybar Corporation: www.thybar.com.
   5. Vent Products Company, Inc.: www.ventproducts.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.
B. Roof Curbs: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Roof Curb Mounting Substrate: Curb substrate consists of corrugated metal roof deck with insulation.
   2. Sheet Metal Material:
      a. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G90 coating designation; 18 gage, 0.048 inch thick, minimum.
         1) Finish: Factory primed.
   3. Nailer: Provide preservative treated wood nailers along top of rails.
   4. Insulation: Factory insulated with 1-1/2 inch thick glass-fiber board insulation; 3 lb density.
   5. Liner: Same material as curb, of manufacturer's standard thickness and finish.
   6. Height Above Finished Roof Surface: 12 inches, minimum.
   7. Provide layouts and configurations indicated on drawings.

2.02 EQUIPMENT RAILS

A. Manufacturers:

1. The Pate Company: www.patecurbs.com.
2. LMCurbs: www.lmcurbs.com.
3. Roof Products & Systems (RPS), Hart & Cooley Inc.: www.rpscurbs.com.
4. Thybar Corporation: www.thybar.com.
5. Vent Products Company, Inc.: www.ventproducts.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. Equipment Rails: Factory fabricated hollow sheet metal construction, internally reinforced, and capable of supporting superimposed live and dead loads and designated equipment load with fully mitered and sealed corner joints welded or mechanically fastened, and integral counterflashing with top and edges formed to shed water.
   1. Equipment Rail Mounting Substrate: Rail substrate consists of corrugated metal roof deck with insulation.
   2. Provide straight curbs on each side of equipment, with top of curbs parallel with metal roofing system and each other for equipment mounting.
   3. Sheet Metal Material:
      a. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G90 coating designation; 18 gage, 0.048 inch thick, minimum.
         1) Finish: Factory primed.
   4. Nailer: Provide preservative treated wood nailers along top of rails.
   5. Height Above Finished Roof Surface: 12 inches, minimum.
   6. Provide layouts and configurations indicated on drawings.

2.03 ROOF HATCHES

A. Roof Hatch Manufacturers:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
   2. Acudor Products Inc: www.acudor.com.
   3. Babcock-Davis: www.babcockdavis.com.
   4. Bilco Company: www.bilco.com.
   5. Milcor, Inc., Hart & Cooley Inc.: www.milcorinc.com.
   6. Nystrom, Inc: www.nystrom.com.
   7. The Pate Company; www.patecurbs.com
   8. Substitutions: See Section 01 6000 - Product Requirements.

B. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, straight sides, and integrally formed deck-mounting flange at perimeter bottom.
   1. Type: Single-leaf lid.
   2. Size: As indicated on drawings.
   3. Roof Hatch Mounting Substrate: Substrate consists of corrugated metal roof deck with insulation.
   4. Performance Requirements:
      a. Loads:
         1) External Live Load: 40 psf, minimum.
         2) Wind Uplift: 20 psf.
      b. Lid operation shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
         1) Operation shall not be affected by temperature.
      c. Entire hatch assembly shall be weather tight.
   5. Sheet Metal Material: For lid and curb.
      a. Galvanized Steel: Hot-dip zinc coated steel sheet complying with ASTM A653/A653M, SS Grade 33; G90 coating designation; 14 gage, 0.0747 inch thick, minimum.
         1) Finish: Powder coat.

2) Color: As selected by Architect from manufacturer's standard line of colors.

6. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
7. Liners for Lid and Curb: Same material as curb, of manufacturer's standard thickness and finish.
8. Curb Height: 12 inches from surface of roof deck, minimum.
9. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   a. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   b. Hinges: Heavy duty pintle type.
   c. Hold open arm with vinyl-coated handle for manual release.
   d. Latch: Upon closing, engage latch automatically and reset manual release.
   e. Manual Release: Pull handle on interior and exterior.
   f. Locking: Padlock hasp on interior.
10. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
    a. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
    b. Height: 42 inches above finished roof deck.
    c. Material: Steel tube.
    d. Finish: Manufacturer's standard baked enamel or powder coat.
    e. Color: Yellow.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.
B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
C. Verify dimensions of roof openings for roof accessories.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.
B. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
C. Roof-Hatch Installation:
   1. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
   2. Attach ladder-assist post according to manufacturer's instructions.

3.04 CLEANING

A. Clean installed work to like-new condition.

3.05 PROTECTION

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

END OF SECTION

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SECTION 07 8400 - FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.
   1. Firestopping of joints and penetraftions 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 9100 - PREFORMED JOINT SEALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Precompressed foam seals.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's technical data sheets for each product, including chemical composition, movement capability, color availability, limitations on application, and installation instructions.
C. Color Cards: For color selection.
D. Samples: Submit three samples 6 inches long illustrating each color selected.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.

1.03 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 in this section with at least 5 years of documented experience and approved by manufacturer.

1.04 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Correct defective work within a 5 year period after Date of Substantial Completion.
C. Warranty: Include coverage for installed sealers that fail to achieve watertight seal or exhibit loss of adhesion or cohesion.

PART 2 PRODUCTS

2.01 PRECOMPRESSED FOAM SEALS

A. Precompressed Foam Seal: Silicone-faced, urethane foam impregnated with water-repellent; chemical-resistant.
    1. Color: As selected by Architect from manufacturer's standard colors.
    2. Size as required to provide water-tight seal when installed.
    3. Provide factory fabricated corners, changes in direction, transitions, and terminations.
    4. Performance Requirements:
        a. Provide a weathertight, airtight, UV-stable, insulated joint seal.
        b. Nominal Joint Width: 2 inches.
        c. Minimum Joint Width: 1 inch.
        d. Maximum Joint Width: 3 inches.
        e. Adapts to fit tightly against irregularities of adjacent substrates.
        f. R-Value: 2 per inch; ASTM C518.
    5. Products:
        a. Balco, Inc.; BCSW Wall Compression Seals: www.balcousa.com.
        b. Construction Specialties, Inc.; VF Series: www.c-sgroup.com.
        c. Emseal Joint Systems, Ltd.; Seismic Colorseal: www.emseal.com.
        d. Inpro Corporation; 1200 Series Foam Seals: www.inprocorp.com.
        e. Watson Bowman Acme Corp./BASF Corp.; SWS Series: www.wbacorp.com.
        f. Willseal LLC; Willseal Color Coreseal V: www.willseal.com.
        g. Substitutions: See Section 01 6000 - Product Requirements

2.02 ACCESSORIES

A. Adhesive: As recommended by seal manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive this work.

B. Measure joint dimensions and verify that seal products are of the correct size to properly seal the joints.

3.02 PREPARATION

A. Properly prepare construction components adjacent to the work of this section to prevent damage and disfigurement due to this work.

3.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions.

B. Precompressed Foam Seals:

1. Install only when ambient temperature is within recommended application temperature range of adhesive. Consult manufacturer when installing outside this temperature range.
2. Prepare joints and install seals in accordance with manufacturer's written recommendations.
3. Remove loose materials and foreign matter that could impair adhesion of sealant.
4. Do not stretch precompressed seal; avoid joints except at corners, ends, and intersections; install with face 1/8 to 1/4 inch below adjoining surface.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect joints from damage until adhesives have properly cured.

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.

1.02 RELATED REQUIREMENTS

A. Section 07 8400 - Firestopping: Firestopping sealants.
B. Section 07 9100 - Preformed Joint Seals: Precompressed foam, gaskets, and strip seals.
C. Section 08 8000 - Glazing: Glazing sealants and accessories.
D. Section 09 2116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.

1.03 REFERENCE STANDARDS

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; 2023.
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).

1.04 SUBMITTALS

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

1. Provide 1/2 inch wide joint sealant samples formed between two 4 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

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.

1.05 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing the work of this section and with at least 5 years of documented experience.

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

1. Adhesion Testing: In accordance with ASTM C794.
2. Compatibility Testing: In accordance with ASTM C1087.
3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
4. Allow sufficient time for testing to avoid delaying the work.
5. Deliver to manufacturer sufficient samples for testing.
6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

D. Owner may employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.

1. Contractor shall cooperate with testing agency and repair failures discovered.
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.

1.06 WARRANTY

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

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Openings below ledge angles in masonry.
   e. Other joints as indicated.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
   a. Joints between door, window, and other frames and adjacent construction.
   b. Joints between dissimilar finished materials.
   c. 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 07 9513 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies for wall and ceiling surfaces.
   1. Interior expansion joint cover assemblies.
   2. Exterior expansion joint cover assemblies.

1.02 RELATED REQUIREMENTS

A. Section 07 9100 - Preformed Joint Seals: Sealing expansion and control joints using preformed joint seals.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
B. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
C. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
D. ASTM B308/B308M - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles; 2020.
E. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
F. ITS (DIR) - Directory of Listed Products; Current Edition.
G. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish, and fire ratings.
C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and fire ratings.
   1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work.
   2. Include transition and termination details.
D. Expansion Joint Cover Assembly Schedule: Include the following information in tabular form:
   1. Manufacturer and model number for each expansion joint cover assembly.
   2. Expansion joint cover assembly location cross-referenced to Drawings.
   3. Nominal, minimum, and maximum joint width.
   4. Movement direction.
   5. Materials, colors, and finishes.
   6. Product options.
   7. Fire-resistance ratings.
E. Samples: For each expansion joint cover assembly, submit three samples 6 inch long, illustrating profile, dimension, color, and finish selected.
F. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.
G. Field Quality Control: Submit field inspection reports.

1.06 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in installing products of the type specified in this section with minimum 5 years of documented experience and approved by manufacturer.

1.07 MOCK-UP

A. Mock-ups: Build mock-ups to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Build mockup of each type of expansion joint cover assembly.
   2. Locate where directed by Architect.
   3. Mock-up may remain as part of the Work.

PART 2 PRODUCTS

2.01 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS - EXTERIORS

A. Wall Joint Cover - Elastomeric Seal: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap.
   1. Application: Wall to wall and wall to corner.
   2. Exposed Metal: Aluminum.
   3. Seal: Preformed elastomeric membranes or extrusions.
   4. Nominal Joint Width: 2 inches.
   5. Minimum Joint Width: 1-1/2 inch.
   6. Maximum Joint Width: 3 inches.
   7. Fire Resistance Rating: Not less than that of adjacent construction.
   8. Secondary Moisture Barrier: Manufacturer's standard elastomeric moisture barrier.
   9. Finishes:
      a. Aluminum: Mill.
      b. Elastomeric Seal: As selected by Architect from manufacturer's standard colors.
   10. Products:
      a. Balco, Inc.; FC Series: www.balcousa.com.
      b. Construction Specialties, Inc; SF Series: www.c-sgroup.com.
      c. Inpro Corp; 611 Series: www.inprocorp.com.
      d. MM Systems Corp.; VSS Series: www.mmsystemcorp.com.
      e. Nystrom; EWN Series: www.nystrom.com.
      f. Watson Bowman Acme Corp./BASF Corp; WSW Series: www.wbacorp.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS - INTERIORS

A. Wall Joint Cover - Surface Mounted, Metal Plate: Metal cover plate fixed on one side of joint gap and free to slide on other.
   1. Application: Wall to wall and wall to corner.
   2. Installation: Surface mounted.
   3. Exposed Metal: Aluminum.
   4. Nominal Joint Width: 2 inches.
   5. Minimum Joint Width: 1/2 inch.
   6. Maximum Joint Width: 3 inches.
   7. Fire Resistance Rating: Not less than that of adjacent construction.
   8. Finishes:
      a. Aluminum: Clear anodized.
   9. Products:
      a. Balco, Inc.; WD/WDC Series: www.balcousa.com.
      b. Construction Specialties, Inc; ASM/ASMC Series: www.c-sgroup.com.
      c. Inpro Corp; 811 Series: www.inprocorp.com.
      d. MM Systems Corp.; XM Series: www.mmsystemcorp.com.
      e. Nystrom; WJ Series: www.nystrom.com.
      f. Watson Bowman Acme Corp./BASF Corp; EWH Series: www.wbacorp.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

B. Wall Joint Cover - Flush Mounted, Metal Glide Plate: Assembly consisting of center metal plate that slides in and out of recessed metal frames fixed to sides of joint gap; recessed frames flush with face of wall, designed for gypsum board.
   1. Application: Wall to wall and wall to corner.
   2. Installation: Recess mounted.
   3. Exposed Metal: Aluminum.
   4. Nominal Joint Width: 2 inches.
   5. Minimum Joint Width: 1/2 inch.
   6. Maximum Joint Width: 3 inches.
   7. Fire Resistance Rating: Not less than that of adjacent construction.
   8. Finishes:
      a. Aluminum: Clear anodized.
   9. Products:
      a. Balco, Inc.; 6000 Series: www.balcousa.com.
      b. Construction Specialties, Inc; AFW/AFWC Series: www.c-sgroup.com.
      c. Inpro Corp; 300 Series: www.inprocorp.com.
      d. MM Systems Corp.; FX-K Series: www.mmsystemcorp.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

C. Ceiling Joint Cover - Elastomeric Seal: Assembly consisting of elastomeric seal anchored to frames fixed to sides of joint gap, includes drywall bead for mudding to gypsum board.
   1. Application: Ceiling to ceiling and ceiling to wall.
   2. Installation: Flush mounted.
   3. Exposed Metal: Aluminum.
   4. Seal: Preformed elastomeric membranes or extrusions
   5. Nominal Joint Width: 2 inches.
   6. Minimum Joint Width: 1 inches.
   7. Maximum Joint Width: 3-1/2 inches.
   8. Fire Resistance Rating: Not less than that of adjacent construction.
   9. Finishes:
      a. Aluminum: Mill.
      b. Elastomeric Seal: As selected by Architect from manufacturer's standard colors.
   10. Products:
      a. Balco, Inc.; GCWW/GCWC Series: www.balcousa.com.
      b. Construction Specialties, Inc; FWS/FWSC Series: www.c-sgroup.com.
      c. Inpro Corp; 114 Series: www.inprocorp.com.
      d. MM Systems Corp.; VSW Series: www.mmsystemcorp.com.
      e. Nystrom; LCD Series: www.nystrom.com.
      f. Watson Bowman Acme Corp./BASF Corp; CWWS Series: www.wbacorp.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

D. Acoustical Ceiling Joint Cover - Elastomeric Seal: Elastomeric-seal assembly designed for use in suspended acoustical ceilings.
   1. Application: Ceiling to ceiling and ceiling to wall.
   2. Installation: Flush mounted.
   3. Exposed Metal: Aluminum.
   4. Seal: Preformed elastomeric membranes or extrusions
   5. Nominal Joint Width: 2 inches.
   6. Minimum Joint Width: 1 inches.
   7. Maximum Joint Width: 3-1/2 inches.
   8. Finishes:
      a. Aluminum: Mill.
      b. Elastomeric Seal: As selected by Architect from manufacturer's standard colors.
   9. Products:
      a. Balco, Inc.; ACWW/ACWC Series: www.balcousa.com.

b. Construction Specialties, Inc; FCS/FCSC Series: www.c-sgroup.com.
c. Inpro Corp; 115 Series: www.inprocorp.com.
d. MM Systems Corp.; VSG Series: www.mmsystemcorp.com.
e. Nystrom; LCE Series: www.nystrom.com.
f. Watson Bowman Acme Corp./BASF Corp; CEB Series: www.wbacorp.com.
g. Substitutions: See Section 01 6000 - Product Requirements.

2.03 EXPANSION JOINT COVER ASSEMBLIES - GENERAL

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   2. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
B. Provide factory fabricated corners, changes in direction, transitions, and terminations.
C. Floor Joint Covers: Coordinate with indicated floor coverings.
D. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.
E. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.
F. Covers In Fire Rated Assemblies: Provide cover assembly having fire rating equivalent to that of assembly into which it is installed.
   1. Acceptable Evaluation Agencies: UL (DIR) and ITS (DIR).

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
B. Elastomeric Seals: Manufacturer's standard preformed elastomeric membranes or extrusions to be installed in metal frames.
C. Fire Barriers: Any material or material combination, when fire tested after cycling, designated to resist the passage of flame and hot gases through a movement joint and to comply with performance criteria for required fire-resistance rating.
D. Secondary Moisture Barriers: Manufacturer's standard, continuous, moisture and vapor barrier membrane; within joint and attached to substrate on sides of joint.
E. Anchors and Fasteners: As recommended by cover manufacturer.
F. Ferrous Metal Anchors: Galvanized where embedded in concrete or in contact with cementitious materials.
G. 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.
H. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.05 FINISHES

A. Aluminum Finishes:
   1. Mill finish.
   2. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level.
C. Rigidly anchor to substrate to prevent misalignment.
    1. At recessed floor joint assemblies, grout annular spaces between concrete slab and floor joint framing solid with nonshrink, nonmetallic grout; make flush with concrete floor slab.
D. Fire Barriers: Install fire barriers to provide continuous, uninterrupted fire resistance throughout length of joint, including transitions and field splices.
    1. Ensure that fire-resistance rated expansion joint assemblies comply with performance requirements of tested assemblies.
E. Secondary Moisture Barrier: Install continuous, uninterrupted barrier throughout length of joint, including transitions and field splices.
F. Do not install final covers of expansion joint assemblies until internal components inspected by manufacturer's representative.

3.03 FIELD QUALITY CONTROL

A. Provide manufacturer's representative to inspect installation of expansion joint cover assemblies, including internal fire barriers, secondary moisture barriers, transitions and terminations, and overall installation.
    1. Provide inspection reports.

3.04 PROTECTION

A. Touch-up, repair, or replace damaged expansion joint assemblies before Date of Substantial Completion
B. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION

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SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 ABBREVIATIONS AND ACRONYMS

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

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames.; 2003.
C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.
D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2020.
H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
I. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
J. ASTM C476 - Standard Specification for Grout for Masonry; 2023.
K. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
L. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
M. BHMA A156.115 - Hardware Preparation In Steel Doors And Steel Frames; 2016.
N. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
O. ITS (DIR) - Directory of Listed Products; Current Edition.
P. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
Q. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
R. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
S. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
T. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
U. UL (DIR) - Online Certifications Directory; Current Edition.

V. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
W. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.
   3. Door Edge Profile: Beveled, both sides.
   4. Typical Door Face Sheets: Flush.

5. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
6. Hardware Preparations, Selections and Locations: Comply with BHMA A156.115 and ANSI A250.8 (SDI-100) in accordance with specified requirements and as follows:
   a. Minimum Hardware reinforcing thicknesses:
      1) Mortise Butt Hinges: 0.123 inches (10 gage),
      2) Pivot Hinges: 0.167 inches (7 gage)
      3) Continuous Hinges: 0.067 inches (14 gage).
      4) Exit Devices: 0.067 inches (14 gage)
      5) Mortise Locksets and Deadbolts: 0.067 inches (14 gage).
      6) Bored Locksets and Deadbolts: 0.067 inches (14 gage).
      7) Flush and Surface Bolts: 0.067 inches (14 gage).
      8) Closers and Hold Open Arms: 0.067 inches (14 gage).
      9) Pull Plates and Push/Pull Bars: 0.067 inches (14 gage).
      10) Protection Plates and Push Plates: No reinforcing required.
7. Zinc Coating: Where indicated, provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvannealed) by the hot-dip process in accordance with ASTM A653/A653M.
   a. Minimum A60/ZF180 (galvannealed) coating unless otherwise indicated.

B. Hollow Metal In-Fill Panels: Same construction, performance, and finish as doors.

C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire Rated:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.

C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 2 - Heavy-duty.
   b. Physical Performance Level B, 500,000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
3. Temperature-Rise Rating (TRR) Across Door Thickness: 450 degrees F.
   a. Provide where indicated on Drawings and at vertical exit enclosures and exit passageways.
4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
   a. Attach fire rating label to each fire rated unit.
5. Smoke and Draft Control Doors: Install in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
   a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.

b. Gasketing: Refer to Section 08 7100.
c. Label: Include the "S" label on fire-rating label of door.

6. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
7. For Exterior Fire-Rated Doors provide the following:
   a. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
   b. Core Material: Mineral board.
   c. Weatherstripping: Refer to Section 08 7100.

2.04 HOLLOW METAL FRAMES

A. Hollow metal frames based on SDI Standards: ANSI A250.8 (SDI-100).
   1. Joints between faces of abutting frame members shall appear seamless; joints shall be securely welded, filled, and and finished smooth without visible seams.
B. Frame Finish: Factory primed and field finished.
C. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   2. Includes frames for wood doors.
D. Door Frames, Fire-Rated: Full profile/continuously welded type.
   1. Fire Rating: Same as door, labeled.
   2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   3. Includes frames for wood doors.
   4. For Exterior Fire-Rated Doors provide the following:
      a. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
E. Borrowed Light Frames: Full profile/continuously welded type.
   1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
   2. Face dimensions to match door frames.
F. Mullions for Pairs of Doors: Where indicated provide fixed mullions with profile similar to jambs.
   1. Refer to Section 08 7100 - Door Hardware for removable mullions.
G. Transom Bars: Fixed, of profile same as jamb and head.
H. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
I. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
J. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
K. Frame Anchors:
   1. Provide anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
   2. Floor Anchors: Base anchors welded to bottom of frames, designed to attach frame to floor.
   3. Masonry Anchors: Masonry anchors shall be T-strap type, corrugated or perforated.
   4. Stud Anchors: Z-type, welded to back of frames.
   5. In-Place Concrete or Masonry Wall Anchors: Minimum 3/8 inch diameter bolts with expansion shields or inserts, with manufacturer's standard spacer.
      a. For existing walls or new openings cut into existing walls

2.05 FINISHES

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

2.06 ACCESSORIES

A. Glazing: As specified in Section 08 8000.

B. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
   1. At Contractor's option, instead of glass stops provided by door manufacturer, provide fire rated glass manufacturer's standard vision lite kits for installing fire-rated glass in doors.
      a. Refer to Section 08 8000 - Glazing.
C. Astragals for Double Doors: Sp ecif
D. Grout for Frames: Mortar grout complying with ASTM C476 with maximum slump of 4 inches as measured in accordance with ASTM C143/C143M for hand troweling in place; plaster grout and thinner pumpable grout are prohibited.
   1. Comply with requirements of Section 04 2000 - Unit Masonry.
E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
F. Filler: Two-component, non-shrinking resin, autobody filler.
   1. Available Products:
      a. 3M/Bondo; Professional Gold Body Filler: www.bondo.com.
G. Mineral Fiber Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread and smoke developed indexes of 0 (zero) when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Back-Coating of Non-Rated Frames: Field-apply corrosion resistant back-coatings to frames that are to be grouted solid.
   1. Do not back-coat fire-rated frames.

3.03 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
B. Install fire rated units in accordance with NFPA 80.
C. Install smoke control units in accordance with NFPA 105.
D. Set frames accurately in position, aligned, plumb, and square.
E. Fill head and jamb members with mineral fiber insulation prior to installation.
   1. Exception: Do not fill frames that are to be grouted solid.
F. Grout frames solid in masonry and concrete construction, using hand trowel methods; brace frames so that pressure of grout before setting will not deform frames.
   1. Install silencers prior to grouting frames.
   2. Do not grout fire-rated frames; instead fill head and jamb members with mineral fiber insulation.
G. Frame Anchors:
   1. Coordinate frame anchor placement with wall construction.
   2. Minimum number of anchors:
      a. Provide 3 jamb anchors per jamb up to 90 inches in height; evenly spaced.
      b. Provide 4 jamb anchors per jamb from 90 to 144 inches in height; evenly spaced.
      c. Provide 1 additional anchor per jamb for each 24 inches or fraction thereof more than 144 inches in height.
      d. Provide 1 floor anchor at the bottom of each jamb or mullion; where a floor anchor is not possible provide one additional jamb anchor.

3. In-Place Concrete or Masonry Wall Anchor: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

H. Install doors plumb with uniform clearance at jambs and head; doors shall open and close without binding

I. Install glass in accordance with Section 08 8000 - Glazing.

J. Install door hardware as specified in Section 08 7100.

K. Coordinate installation of electrical connections to electrical hardware items.

3.04 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 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. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
C. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
D. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
E. 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.

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. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. 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. Wood veneer facing with factory transparent finish.

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. 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 sollid 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

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SECTION 08 1610 - FRP-FACED ALUMINUM DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 ABBREVIATIONS

A. FRP: Fiberglass reinforced plastic.

1.03 REFERENCE STANDARDS

A. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
B. AAMA 701/702 - Performance Specification for Pile Weatherstrips (AAMA 701) and Polymer Weatherseals (AAMA 702); 2023.
C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
D. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
J. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
K. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
L. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
M. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010 (Reapproved 2018).
N. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007 (Reapproved 2015).
O. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
P. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
Q. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
R. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
T. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's descriptive literature for each type of door and frame; include information on fabrication methods, hardware preparation, accessories, installation, and maintenance instructions.
C. Shop Drawings: Include elevations of each opening type and details at each wall type.
   1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
D. Selection Samples: Complete set of color and finish options, using actual materials, for Architect's selection.
E. Verification Samples: Three actual pieces of products in each finish specified, not less than 4 inches square or 6 inches long for linear components.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 DELIVERY, STORAGE, AND HANDLING

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

1.07 FIELD CONDITIONS

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

1.08 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide ten year manufacturer warranty for defects in workmanship and materials.
C. Provide 25 year warranty on fiberglass reinforced plastic (FRP) face sheets covering delamination, bubbling, and panel corrosion.
D. Provide 20 year warranty on aluminum finishes in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:

1. Special-Lite, Inc.; SL-17 Door: www.special-lite.com.
2. Substitutions: See Section 01 6000 - Product Requirements.

B. Aluminum Insert Framing:
1. Special-Lite, Inc.; 10-30 Series Inset Framing: www.special-lite.com.
2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 DESIGN CRITERIA

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

2.03 MATERIALS

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

D. Foam Insulation Fill Material:
1. Manufacturer's standard polystyrene or polyurethane foam.
a. Compressive Strength:
1) Polyurethane: 60 psi; ASTM D1621.
b. Thermal Resistance:
1) Polyurethane: R-value 6.8 per inch, minimum; ASTM C518.

2.04 DOORS

A. Flush Aluminum Doors with Fiberglass Reinforced Plastic (FRP) Face Sheets:
1. Overall Door Thickness: 1-3/4 inches.
2. Internal Framing: Extruded aluminum tubing, 1/8 inch minimum thickness, with heavy-duty plated steel through bolts in rails.
a. Top and Bottom Rails: 6 inches wide.
b. Side Stiles: 2-1/2 inches wide.
3. Provide manufacturer's standard aluminum and steel reinforcements for door hardware; 1/8 inch minimum thickness.
4. Facing: Seamless laminated FRP sheet.
a. Sheet Thickness: 0.12 inch, minimum.
b. Texture - FRP: Pebble grain.
c. Color: As selected by Architect from manufacturer's standard line.
1) Design Intent: Dark Bronze
5. Perimeter Edges: Extruded aluminum caps or returns that capture and secure edges of FRP face sheets.
a. Door Edge Profile: Hinged edge square, and lock edge beveled.
6. Core: Foam insulation fill material.

7. Vision Lites: Extruded aluminum framed, gasket glazed.
   a. Glazing: As specified in Section 08 8000 - Glazing.
8. Aluminum Finish: Superior performing organic coating.
   a. Color: As selected by Architect from manufacturer's standard line.
   b. Design Intent: Match Adjacent Storefront or Curtainwall Framing.
9. Hardware:
   a. Weatherstripping: Replaceable pile type; at jambs and head of exterior doors.
   b. Bottom Sweep: Manufacturer's concealed adjustable bottom brush.
   c. Door Pulls: Provide recessed flush door pulls, unless otherwise indicated.
      1) Products:
         (a) Special-Lite, Inc.; SL-82: www.special-lite.com.
         (b) Substitutions: See Section 01 6000 - Product Requirements.
   d. Balance of Hardware: Refer to Section 08 7100 - Door Hardware.

2.05 INSERT FRAMING

A. Insert Framing: Extruded aluminum door framing designed for installation within existing door framing.
   1. Extruded aluminum shapes, not less than 0.125 inch thick.
   2. Includes integral door stop.
   3. Weatherstripping: Replaceable pile type.
   4. Corner Joints: Mitered.
   5. Finish: Same as doors.

2.06 FINISHES FOR ALUMINUM

A. Superior Performing Organic Coatings: Multiple coats, thermally cured polyvinylidene fluoride (PVDF) system; AAMA 2605.
   1. Polyvinylidene fluoride (PVDF) multi-coat thermoplastic fluoropolymer coating system, with minimum 70 percent PVDF color topcoat and minimum dry film thickness 0.9 mil; color and gloss as indicated on drawings.
B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 ACCESSORIES

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

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.

B. Replace components with damage to exposed finishes.
C. Separate dissimilar metals to prevent electrolytic action between metals.

3.03 INSTALLATION

A. Install doors in accordance with manufacturer's instructions.
B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.
C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.
E. Install door hardware as specified in Section 08 7100.
F. Comply with glazing installation requirements of Section 08 8000.
G. Coordinate installation of electrical connections to electrical hardware items.

3.04 FIELD QUALITY CONTROL

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

3.05 TOLERANCES

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

3.06 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.07 CLEANING

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

3.08 PROTECTION

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

END OF SECTION

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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; 2023.

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

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SECTION 08 3223 - FOLDING GLASS STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Factory fabricated sliding/folding glazed door/wall with frames and operating hardware.
   1. Aluminum panel frame system.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. ASTM D1187/D1187M - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal; 1997 (Reapproved 2018).
C. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
D. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
E. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
F. ASTM E413 - Classification for Rating Sound Insulation; 2022.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide information on dimensions, frame and sill construction, glazing, and hardware.
C. Samples: Submit two samples, 12 by 12 inch in size illustrating typical frame corner construction, accessories, and finishes.
D. Manufacturer's Installation Instructions: Include complete preparation, installation, and cleaning requirements.
E. Installer's Qualification Statement.
F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than three years of documented experience.
   1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
B. Installer Qualifications: Company specializing in installation of products of type specified, with not less than three years of documented experience and approved by manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site and store in manufacturer's protective cartons until openings are ready for installation.
B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.06 FIELD CONDITIONS

A. Field Measurement: Contractor to field verify dimensions of rough openings (R.O.) and threshold depressions to receive sill. Mark field measurements on product drawing submittal.

1.07 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. Provide ten year manufacturer warranty against failure of glass seal, including interpane dusting or misting, and rollers. Include provision for replacement of failed units.
D. Provide ten year manufacturer warranty against failure of all Other Components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aluminum Framed Folding/Paired Panel Glazed System:
   1. Basis of Design: NanaWall Systems, Inc; SL45 Aluminum Framed Folding Panel System: www.nanawall.com/#sle.
   2. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. ADA Compliant Flush Sill – Inward and Outward Opening:
   1. Air Infiltration ASTM E283/E283M-: 0.25 cfm/ft^2 (1.28 L/s/m^2) at a static air pressure difference of 1.6 psf (75 Pa).
B. Structural Loading ASTM E330/E330M :
   1. Load Structure: At 1.5 times design wind pressure with no glass breakage or permanent damage to fasteners or storefront components.
   2. Design Pressure: Positive and Negative at 35 psf (1675 Pa).
C. Swing Panel - Operation / Cycling Performance (AAMA 920): 500,000 cycles
D. Acoustical Performance: Provide glass partitions and door assemblies tested by qualified testing agency, calculated in accordance with ASTM E413, tested in accordance with ASTM E90, and rated for not less than Sound Transmission Class (STC) indicated.
   1. Partition STC Rating: 35, minimum, for framed partition.

2.03 SLIDING/FOLDING GLAZED DOORS/WALLS

A. Aluminum Sliding/Folding Glazed Doors/Walls: Extruded aluminum sliding/folding and operable panel frames, factory fabricated; complete with sill, flashings, support and anchorage devices, hardware, and glazing.
   1. Support System: Top hung.
   2. Panel Type: Hinged.
   3. Panel Configuration: Straight.
   4. Standard Sill: Flush type, with sealant, shims and fasteners at necessary locations.
   5. Stack Storage Configuration: Inswing and Outswing.
   6. Panel and Frame:
      a. Panel: Single Lite.
      b. Panel Size:
         1) Panel Rail Depth: 1-3/4 inch.
         2) Panel Top Rail Height: 2-1/8 inch, square edge.
         3) Panel Bottom Rail Height: 2-1/8 inch, square edge.
      c. Frame Size:
         1) Top Track Width: 2-1/2 inch.
         2) Top Track and Side Jamb Depth: 1-3/4 inch.
         3) Sill Type: ADA Compliant Flush sill.
         4) Sill Finish: Aluminum with clear anodized finish.
   7. Aluminum Frames: Factory finished; manufacturer's standard corner construction; non-thermally broken.
      a. Aluminum Extrusion: AlMgSi 0.5 alloy, 6063-T5.
      b. Thickness: 0.078 inch, nominal.
   8. Drainage: Provide drainage to exterior for moisture entering joints and glazing spaces and for condensation occurring within frame construction.

9. Glass Stops: Same material and color as frame.
10. Aluminum Frame Finish: PVDF coating in accordance with AAMA 2605.
    a. Exterior Color: Match Architect's Sample. Design Intent: Kawneer Sea Wolf.
    b. Interior Color: Match Architect's Sample. Design Intent: Kawneer Sea Wolf.

2.04 FACTORY ASSEMBLY

A. Factory assemble sliding/folding operable panel frames as single unit, including head, jambs, and bottom sections; provide concealed fasteners.
   1. Sizes: Allow for tolerances of rough framed openings, clearances, and shims at perimeter of assemblies.
   2. Joints and Corners: Flush, hairline and waterproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   3. Glazing: Factory installed.

2.05 ACCESSORIES

A. Glazing: Single glazed, clear, STC 35 laminated, with glass thickness 1/4 inch to achieve unit STC of 33.
B. Folding Hardware: Provide manufacturer's standard hardware including carriages with sealed ball bearing rollers, and top or bottom tracks.
   1. Main Entry Panel(s) for Models with a Swing Panel:
      a. Lever Handles: On inside and outside.
      b. A lockset with a lockable latch.
      c. Multi-point locking with a dead bolt and rods at the top and bottom on primary panel only.
      d. Rods to be concealed and not edge mounted.
      e. Operation: After turn of key or thumb-turn, depression of handles withdraws latch. Lifting handles engages rods and key or thumb turn engages deadbolts and operates lock.
   2. Secondary Panels and Pairs of Folding Panels: Provide manufacturer’s Standard secondary handles and concealed two-point locking hardware operated by 180º turn of handle between each pair. Face applied flush bolt locking NOT acceptable.
C. Weatherstripping: Brush seals, continuous and replaceable; provide between doors, panels, frame and track.
D. Exposed Hardware Finish: Brushed satin.
   1. Handle Height: 41-3/8 inch (105 cm) centered from bottom of panel.
E. Hinges: Die-cast zinc.
F. Locking Mechanisms: Minimum two-point deadbolt locking of each panel; manufacturer's standard type.
G. Aluminum locking rods with standard fiberglass reinforced polyamide end caps at the top and bottom. Rods to have a stroke of 15/16 inch (24 mm).
H. Adjustment: Provide folding-sliding hardware capable of compensation and adjustments without needing to remove panels from tracks, in width, 1/16 inch (1.5 mm) per hinge and in height, 5/64 inch (2 mm) up and down.
I. Anchors: Hot-dipped galvanized or stainless steel in accordance with project and manufacturer's installation requirements.
J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive work and opening dimensions and clearances are as indicated on approved shop drawings.

3.02 PREPARATION

A. Prepare opening to permit correct installation of door unit in coordination with air and vapor seal.

3.03 INSTALLATION

A. Install door/wall unit assembly in accordance with manufacturer's instructions.
B. Attach frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
C. Use anchorage devices to securely fasten assembly to adjacent construction without distortion or imposed stresses.

3.04 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 from 10 feet straight edge.

3.05 ADJUSTING

A. Adjust hardware for smooth operation.
B. Verify the Folding Glass Storefront system operates and functions properly. Adjust hardware for proper operation.
C. Non-Conforming Work: Repair or replace non-conforming work as directed by the Architect; see General and Supplementary Conditions, and Division 01, General Requirements.

3.06 CLEANING

A. Remove protective material from factory finished surfaces.
B. Remove labels and visible markings.
C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.

3.07 PROTECTION

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

END OF SECTION

SECTION 08 3323 - OVERHEAD COILING DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Exterior coiling doors.
B. Interior non-fire-rated coiling doors.
C. Fire-rated coiling doors.
D. Electric operators and control stations.

1.02 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
C. ITS (DIR) - Directory of Listed Products; Current Edition.
D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2008 (Reaffirmed 2020).
F. NEMA MG 1 - Motors and Generators; 2017.
G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
H. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
I. UL (DIR) - Online Certifications Directory; Current Edition.
J. 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. Exterior Coiling Doors: Galvanized steel slat curtain.
   1. Basis of Design Product: Overhead Door Corp.; Model 625; www.overheaddoor.com.
   2. Capable of withstanding positive and negative wind loads of 20 psf without undue deflection or damage to components.
   3. 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.
   4. Sandwich slat construction with insulated core of foamed-in-place polyurethane insulation; minimum R-value of 7.5. Galvanized steel.
   5. Nominal Slat Size: 2-1/2 inches wide x required length.
   6. Finish: Manufacturer's standard powder coat finish; standard color as selected by Architect. Design Intent: Overhead Door Corporation Gray.
      a. Includes slats, hood enclosure, bottom bar, and guides.
   7. Guide, Angles: Galvanized steel.
   8. Bottom Bar or Angles: Galvanized steel.
   9. Hood Enclosure: Manufacturer's standard; galvanized steel.
   10. Electric operation.
   11. Mounting: Surface mounted unless otherwise indicated on Drawings.

B. Non-Fire-Rated Interior Coiling Doors: Stainless steel slat curtain.
   1. Basis of Design Product: Overhead Door Corp.; Model 610; www.overheaddoor.com.
   2. Capable of withstanding positive and negative wind loads of 20 psf, without undue deflection or damage to components.
   3. 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.
   4. Single Thickness Slats: Manufacturer's standard.
   5. Nominal Slat Size: 2-1/2 inches wide x required length.
   6. Finish: No. 4 - Brushed.
      a. Includes slats and hood enclosure.
   7. Finish: Manufacturer's standard powder coat finish; color to match Architect's sample.
      a. Includes bottom bar and guides.
   8. Guides, Angles: Primed steel.
   9. Bottom Bar or Angles: Primed steel.
   10. Hood Enclosure: Manufacturer's standard; stainless steel.
   11. Electric operation.

12. Mounting: Surface mounted, unless otherwise indicated on Drawings.

C. Fire-Rated Coiling Doors with Integral Egress Door: Steel slat curtain; conform to NFPA 80.
1. Basis of Design Product: McKeon; Model Safescape T2000-PC; www.mckeondoor.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: 3 inches wide by required length.
8. Swinging Egress Door: Incorporated within the curtain shall be a swinging type steel door designed and built as an integral part of the fire door's assembly.
   a. Door Frame: Shall be an all-steel unit type ASTM A366 hot rolled steel, 14 gauge with the same labeled fire resistance rating as specified for door.
   b. Door Assembly: Complete with door, hinge, and locking channel mechanism. 20 gauge stretcher leveled, electro galvanized and bonderized steel faces.
   c. Hardware:
      1) Fire Exit Device: Flush mounted integral type fire exit device on one face and with pull handle on opposite face of the swinging door.
      2) Closer: Shall be surface mounted 90 degree pocketed application.
      3) Electro Magnetic Door Holder: Shall be surface mounted with proper projection to hold swinging door in the fully open position.
9. ~~**Finish: No. 4 - Brushed.**~~ ****ADD2****
   a. ~~**Includes slats and hood enclosure.**~~
10. Finish: Manufacturer's standard powder coat finish; color to match Architect's sample.
    a. Includes bottom bar and guides.
11. Guides, Angles: Primed steel.
    a. Provide internal, fully concealed UL Classified smoke seals located within each guide assembly. Externally mounted smoke seals shall not be acceptable.
12. Bottom Bar or Angles: Primed steel.
13. Hood Enclosure: Manufacturer's standard; stainless steel.
14. Fire Alarm Release Mechanism: Electric-motor operated from fire alarm system and local heat or smoke detectors.
15. Electric operation.
16. Mounting: As indicated.

D. Fire-Rated Coiling Doors: Steel slat curtain; conform to NFPA 80. (Indicated as SMOKE rated on door schedule)
1. Basis of Design Product: Overhead Door Corp.; Model 630; www.overheaddoor.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. 1/3 hour fire rating.
4. Single thickness slats.
5. Nominal Slat Size: 3 inches wide by required length.
6. Swinging Egress Door: Incorporated within the curtain shall be a swinging type steel door designed and built as an integral part of the fire door's assembly
7. ~~**Finish: No. 4 - Brushed.**~~ ****ADD2****
   a. ~~**Includes slats and hood enclosure.**~~
8. Finish: Manufacturer's standard powder coat finish; color to match Architect's sample.

a. Includes bottom bar and guides.
9. Guides, Angles: Primed steel.
10. Bottom Bar or Angles: Primed 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: As indicated.

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. 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

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SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront.
B. Aluminum doors and frames.

1.02 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
F. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
J. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
K. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
L. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
M. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
N. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
O. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
   1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
D. Samples:
   1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
   2. Submit three samples of infill panels for each color and finish, not less than 6 inches square.
E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
F. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
   1. Include storefront manufacturer's field representative's field observation reports.
G. Designer's qualification statement.
H. Manufacturer's qualification statement.
I. Installer's qualification statement.

1.05 QUALITY ASSURANCE

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

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-ups.
B. Provide minimum 4 by 8 feet mock-up including each component being used on the project. Assemble to illustrate component assembly including glazing materials, weep drainage system, attachments, anchors, and perimeter sealant.
C. Locate on-site where directed by Architect; mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 FIELD CONDITIONS

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

1.09 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. SF-01: Thermally Broken Storefront Products - Deep Profile:
   1. Basis of Design: Kawneer North American, an Arconic company; 601T Framing System: www.kawneer.com.

2. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products:
   a. CMI Architectural: CTS Series: www.cmiarch.com.
   b. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 960: www.efcocorp.com.
   c. Manko Window Systems, Inc.; 2600xpt Series: www.mankowindowsystems.com.
   d. Tubelite Inc, an Apogee Enterprises, Inc. company; T24650 Series: www.tubeliteinc.com.
   e. YKK AP America, Inc.; YES 600: www.ykkap.com.
   f. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. SF-02: Non-Thermally Broken Storefront Products:
   1. Basis of Design: Kawneer North American, an Arconic company; Trifab VG 450 Framing System: www.kawneer.com.
   2. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      a. CMI Architectural; Series 450FG: www.cmiarch.com.
      b. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 401: www.efcocorp.com.
      c. Manko Window Systems, Inc.; 450 Series: www.mankowindowsystems.com.
      d. Tubelite Inc, an Apogee Enterprises, Inc. company; 4500 Series: www.tubeliteinc.com.
      e. U. S. Aluminum, part of the C. R. Laurence Family of Companies; Series 450: www.crl-arch.com.
      f. YKK AP America, Inc.; YES 40 FS: www.ykkap.com.
      g. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Swing Door Manufacturers:
   1. Any of the manufacturers specified for storefront products.

D. Source Limitations: Obtain storefront systems, including swing doors, from one manufacturer.
   1. Storefront systems shall be same manufacturer as that of curtain wall specified in Section 08 4413 - Glazed Aluminum Curtain Walls.

2.02 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Thermal Breaks: Manufacturer's standard pour and debridge system.
   2. Glazing Rabbet: For 1 inch insulating glazing, unless otherwise indicated.
   3. Glazing Position: Centered (front to back).
   4. Framing Face Width: 2 inches.
   5. Framing Depth:
      a. Thermally Broken: 6 inches.
      b. Non-Thermally Broken: 4 to 4-1/2 inches.
   6. Finish: Superior performing organic coatings.
      a. Factory finish all surfaces that will be exposed in completed assemblies.
      b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   7. Finish Color: As selected by Architect from manufacturer's standard line.
      a. SF-01 Design Intent: Kawneer Charcoal.
      b. SF-02 Design Intent: Kawneer Sea Wolf.
   8. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
   9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.

10. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
11. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
12. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
13. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
   a. Design Wind Loads: Comply with requirements of ASCE 7 and as indicated on Drawings; not less than 25 lbf/ sq ft.
   b. Member Deflection: Limit member deflection to 1/175 in any direction, with full recovery of glazing materials.
2. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
3. Condensation Resistance Factor of Framing: 60, minimum, measured in accordance with AAMA 1503.
4. Overall U-value Including Glazing: 0.42 Btu/(hr sq ft deg F), maximum.
5. Design door frames to resist unauthorized entry when a 200 pound opening load acting upon the exterior door handle is applied to the locked door.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.
3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
   a. Provide as required to comply with performance requirements.

B. Glazing: See Section 08 8000.

C. Swing Doors: Glazed aluminum.
1. Style: Wide style.
2. Thickness: 1-3/4 inches.
3. Top Rail: 5 inches wide.
4. Vertical Stiles: 5 inches wide.
5. Bottom Rail: 12 inches wide.
6. Glazing Stops: Square.
7. Finish: Same as storefront.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

C. Fasteners: Stainless steel.

D. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.

E. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.

F. Glass and Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 HARDWARE

A. For each door, include weatherstripping and sill sweep strip.

B. Other Door Hardware: See Section 08 7100.

C. Weatherstripping: Wool pile, continuous and replaceable; provide on all doors.

D. Sill Sweep Strips: Resilient seal type, of neoprene; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

I. Install glass in accordance with Section 08 8000 - Glazing.

J. Install door hardware as specified in Section 08 7100 - Door Hardware.

K. Coordinate installation of electrical connections to electrical hardware items.

L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

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

B. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.

C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.

1. Perform a minimum of three tests in each designated area as directed by Architect.

2. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.

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

E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

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

END OF SECTION

SECTION 08 4413 - GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed curtain wall.
B. Aluminum doors and frames.

1.02 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
F. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
M. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
N. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
O. ASTM E783 - Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors; 2002 (Reapproved 2018).
P. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, internal drainage details, glazing, and infill.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
   1. Include details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
D. Samples:
   1. Submit three samples for each finish specified, not less than 6 inches square or 6 inches long for linear components.
   2. Submit three samples of infill panels for each color and finish, not less than 6 inches square.
E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
F. Structural Sealant Glazing (SSG): Submit product data and calculations showing compliance with performance requirements.
G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
   1. Include curtain wall manufacturer's field representative's observation reports.
H. Designer's Qualification Statement.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design curtain wall and its structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed at the State in which the Project is located.
B. Verify that each component is appropriate for use in structural sealant glazing (SSG) application in regards to at least the following properties; size, shape, dimensions, material, self-life, storage conditions, and color.
C. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with not less than 5 years of documented experience.
D. Installer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience and approved by manufacturer.

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

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

1.08 FIELD CONDITIONS

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

1.09 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Glazed Aluminum Curtain Walls - Captured Glazing:
   1. Basis of Design: Kawneer North American, an Arconic company; 1600 Wall System 1 Curtain Wall: www.kawneer.com.
   2. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products :
      a. CMI Architectural; 6600 Wall: www.cmiarch.com.
      b. EFCO Corporation, an Apogee Enterprises, Inc. company; System 5900: www.efcocorp.com.
      c. Manko Window Systems, Inc; 250: www.mankowindows.com.
      d. Tubelite Inc, an Apogee Enterprises, Inc. company; 400 Series: www.tubeliteinc.com.
      e. U. S. Aluminum, part of the C. R. Laurence Family of Companies; Series 2200: www.crl-arch.com.
      f. YKK AP America, Inc.; YUW 700: www.ykkap.com.
      g. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. Glazed Aluminum Curtain Walls - Captured Glazing - High Perfromance:
   1. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      a. EFCO Corporation, an Apogee Enterprises, Inc. company; System 5500X: www.efcocorp.com.
      b. Manko Window Systems, Inc; 250: www.mankowindows.com.
      c. Tubelite Inc, an Apogee Enterprises, Inc. company; 400TU Series: www.tubeliteinc.com.
      d. U. S. Aluminum, part of the C. R. Laurence Family of Companies; Series 3252: www.crl-arch.com.
      e. YKK AP America, Inc.; YCW 750 XT: www.ykkap.com.
      f. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Swing Door Manufacturers:
   1. Any of the manufacturers specified for curtain wall products.

D. Operable Vent/Sash Products:
   1. Basis of Design: Kawneer North American, an Arconic company; GLASSvent: www.kawneer.com.
   2. Other Manufacturers: Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      a. CMI Architectural; 278 SSG Zero Sight-line Vents: www.cmiarch.com.
      b. EFCO Corporation, an Apogee Enterprises, Inc. company; WV410 SSG Vent: www.efcocorp.com.
      c. Tubelite Inc, an Apogee Enterprises, Inc. company; CVW 3700 Concealed Vent Window: www.tubeliteinc.com.
      d. U. S. Aluminum, part of the C. R. Laurence Family of Companies; Series 7500 Concealed Vent: www.crl-arch.com.
      e. YKK AP America, Inc.; YES SSG Vent Zero Sightline: www.ykkap.com.
      f. Substitutions: Refer to Section 01 6000 - Product Requirements.

E. Source Limitations: Obtain curtain wall systems, including swing doors and operable sashes, from one manufacturer.
   1. Curtain wall systems shall be same manufacturer as that of storefront systems specified in Section 08 4313 - Aluminum-Framed Storefronts.

2.02 CURTAIN WALL

A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
   1. Thermal Breaks: Manufacturer's standard pour and debridge system.

2. Outside glazed, with pressure plate and mullion cover.
   a. Pressure Plate: Metal plate.
   b. Mullion Cover: Manufacturer's standard.
3. Fabrication Method: Either shop/factory or field fabricated system.
4. Vertical Mullion Face Width: 2-1/2 inches.
5. CW-01: Vertical Mullion Depth From Face of Glazing or Standard Mullion Cover to Back of Frame: 8 to 10.5 inches, unless otherwise indicated.
6. CW-02: Vertical Mullion Depth From Face of Glazing or Standard Mullion Cover to Back of Frame: 6 inches, unless otherwise indicated.
7. Finish: Superior performing organic coatings.
   a. Factory finish surfaces that will be exposed in completed assemblies.
   b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
   c. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
8. Provide flush joints and corners, weathersealed, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
9. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
10. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
11. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

2.03 PERFORMANCE REQUIREMENTS

A. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
   1. Design Wind Loads: Comply with the requirements of ASCE 7 and as indicated on Drawings; but not less than 25 lbf/ sq ft.
      a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
      b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
   2. Seismic Loads: Design and size components to withstand seismic loads and sway displacement in accordance with requirements of ASCE 7.
   3. Movement: Accommodate the following movement without damage to components or deterioration of seals:
      a. Expansion and contraction caused by 180 degrees F surface temperature.
      b. Expansion and contraction caused by cycling temperature range of 170 degrees F over a 12 hour period.
      c. Movement of curtain wall relative to perimeter framing.
      d. Deflection of structural support framing, under permanent and dynamic loads.
      e. Design door frames to resist unauthorized entry when a 200 pound opening load acting upon the exterior door handle is applied to the locked door.
B. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on indoor face when tested as follows:
   1. Test Pressure Differential: 12 psf.
   2. Test Method: ASTM E331.
C. Air Leakage: 0.06 cfm/sq ft maximum leakage of wall area when tested in accordance with ASTM E283/E283M at 6.27 psf pressure difference across assembly.

D. Thermal Performance Requirements:
   1. Condensation Resistance Factor of Framing: 65, minimum, measured in accordance with AAMA 1503.
   2. Overall U-value Including Glazing: 0.42 Btu/(hr sq ft deg F), maximum.

2.04 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
   1. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.

B. Glazing: See Section 08 8000.

C. Infill Panels: Insulated, aluminum sheet face and back, with edges formed to fit glazing channel and sealed.
   1. Overall Thickness: 1 inch.
   2. Face Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
   3. Core: Rigid polystyrene (EPS) insulation core with R-value of 4.
   4. Back Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
   5. Finish: Same as curtain wall.
   6. Products:
      a. Citadel Architectural Products; GlazeGuard 1000 WR+; www.citadelap.com.
      b. Laminators, Inc.; Thermolite; www.laminatorsinc.com.
      c. Mapes Panels LLC; Corelite: www.mapespanels.com.
      d. Substitutions: Refer to Section 01 6000 - Product Requirements.

D. Swing Doors: Glazed aluminum.
   1. Style: Wide style.
   2. Thickness: 1-3/4 inches.
   3. Top Rail: 5 inches wide.
   4. Vertical Stiles: 5 inches wide.
   5. Bottom Rail: 12 inches wide.
   6. Glazing Stops: Square.
   7. Finish: Same as curtain wall.

E. Operable Sash: Aluminum casement; finished to match curtain wall; turn handle latch with manufacturer's standard insect screen.
   1. Operable sashes shall be a zero sightline, concealed, design type.

2.05 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209/B209M.

C. Structural Steel Sections: ASTM A36/A36M; galvanized in accordance with requirements of ASTM A123/A123M.

D. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

E. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.

F. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.

G. Firestopping: See Section 07 8400.

H. Structural Sealant Glazing (SSG) Adhesive: As specified in Section 08 8000 - Glazing, subject to approval of curtainwall manufacturer.

I. Weatherseal Sealant: Silicone, with adhesion in compliance with ASTM C794; type recommended by structural sealant glazing (SSG) adhesive manufacturer.

2.06 FINISHES

A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
   1. Color and Gloss: As selected from manufacturer's standard line.
      a. Design Intent: Kawneer Charcoal.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 HARDWARE

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

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other related work.
B. Verify that curtain wall openings and adjoining water-resistive and air barrier seal materials are ready to receive work of this section.
C. Verify that anchorage devices have been properly installed and located.

3.02 INSTALLATION

A. Install curtain wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
C. Provide alignment attachments and shims to permanently fasten system to building structure.
D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
E. Provide thermal isolation where components penetrate or disrupt building insulation.
F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
G. Refer to Section 07 8400 - Firestopping for installation of firestopping at each floor slab edge.
H. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
I. Install operating sash.
J. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 08 8000.
K. Structural Sealant Glazing (SSG) Adhesive: Install structural sealant glazing adhesive and weatherseal sealant in accordance with manufacturer's instructions and Section 08 8000 - Glazing.
L. Install door hardware as specified in Section 08 7100 - Door Hardware.
M. Coordinate installation of electrical connections to electrical hardware items.
N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inches every 3 ft non-cumulative or 0.5 inches per 100 ft, whichever is less.
B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
C. Sealant Space Between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.04 FIELD QUALITY CONTROL

A. Provide services of curtain wall manufacturer's field representative to observe for proper installation of system and submit report.

B. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.

C. Water-Spray Test: Provide water spray quality test of installed curtain wall components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.

1. Perform a minimum of three tests in each designated area as indicated on drawings.
2. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.

D. Owner may engage an independent inspection agency to perform additional tests and inspections as follows:

1. Provide field testing of installed curtain wall system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
   a. Perform a minimum of three tests in each designated area as indicated on drawings.
   b. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.
   c. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 12 psf.
      1) Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
   d. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.20 psf.
      1) Maximum allowable rate of air leakage is 0.09 cfm/sq ft.

E. Repair or replace curtain wall components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, take care to remove dirt from corners, and wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

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

END OF SECTION

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SECTION 08 6223 - TUBULAR SKYLIGHTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tubular skylights, consisting of skylight dome, reflective tube, and diffuser assembly.

1.02 REFERENCE STANDARDS

A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights; 2022.
B. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
C. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
D. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2020a.
E. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
F. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
G. UL 790 - Standard for Standard Test Methods for Fire Tests of Roof Coverings; Current Edition, Including All Revisions.
H. Coordination: Coordinate installation with affected trades.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Shop Drawings: Indicate configurations, dimensions, locations, fastening methods, and installation details.
D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
   1. Evidence of AAMA Certification.
   2. Evidence of WDMA Certification.
   3. Evidence of CSA Certification.
   4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
E. Test Reports: Prior to submitting shop drawings or starting fabrication, submit test report(s) by independent testing agency showing compliance with performance requirements in excess of those prescribed by specified grade.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.07 WARRANTY

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

B. Skylights: Manufacturer's standard warranty for 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Solatube International, Inc; SolarMaster 750-DS-O, Open Ceiling with OptiView diffuser : www.solatube.com/#sle.

B. Velux America, Inc; VELUX TCC - Curb Mounted SUN TUNNEL Skylight: www.veluxusa.com/#sle.

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

2.02 TUBULAR SKYLIGHTS

A. Tubular Skylights: Transparent roof-mounted skylight dome and curb, reflective tube, and diffuser assembly, transferring sunlight to interior spaces.
   1. Fabrication and assembly of components is by single manufacturer.
   2. Non-Metal Parts: Flammability less than the following.
      a. Roof-Top Components: Class B when tested in accordance with ASTM E108 or UL 790.
      b. Combustibility - Light Transmitting Parts: Minimum 2.5 inches/min (ICC Class CC-2), when tested in accordance with ASTM D635.

B. Roof Assemblies: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
   1. Glazing: Acrylic plastic, 1/8 inch minimum thickness.
   2. Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
   3. Base Height: 11 inches.
   4. Curb cap insulation:
      a. Type CCI, Nominal 1 inch thick thermal insulation pad. Rated R-6 min.
   5. Dome Ring: Attached to top of base section; 0.090 inch nominal thickness injection molded high impact ABS; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing; weather seal of medium density pile weather stripping.

C. Reflective Tube: ASTM B209/B209M aluminum sheet, thickness between 0.015 inch and 0.020 inch.
   1. Interior Finish: Exposed interior surfaces of high reflectance specular finish; specular reflectance of 92, total reflectance 95 percent.
   2. Tube Diameter: 21 inches.
   3. Tube Configuration and Length: Straight run, approximately 48 inches..

D. Diffuser Assemblies: Supporting light transmitting surface at bottom termination of tube, with compression seal to minimize condensation and bug or dirt infiltration.
   1. Ceiling Ring: Edge trim for ceiling opening; injection molded high impact ABS.
   2. Diffuser Trim: Edge and attachment trim for diffuser lens; injection molded high impact ABS.
   3. Lens: Prismatic lens design to maximize light output and diffusion.
   4. Lens Material: Acrylic plastic.
   5. Lens Thickness: 0.022 inch, minimum.
   6. Visible Light Transmission (VLT): 90 percent, minimum.
   7. Seal: Closed cell EPDM foam rubber.

2.03 PERFORMANCE REQUIREMENTS

A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific tubular skylight:
   1. Product Type: Tubular Daylighting Device, Open Ceiling (TDDOC).
B. Design Pressure (DP): In accordance with applicable codes.
C. No permanent deflection in excess of 0.2 percent of span.
D. Air Leakage: 0.30 cfm/sq ft maximum leakage for tubular skylight unit when tested at 1.57 psf pressure difference in accordance with ASTM E283/E283M.
E. Water Resistance: No uncontrolled water leakage at 6.27 psf pressure differential with water rate of 5 gallons/h/sf, when tested in accordance with ASTM E331; design to ensure that water will not accumulate inside assembly.

2.04 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.
B. Sealant: Elastomeric, silicone or polyurethane; compatible with materials being sealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's written instructions.
B. Set roof assembly flashing in continuous bead of sealant.
C. Seal joints exposed to weather in accordance with sealant manufacturer's written instructions.
D. Conduct field test for water tightness; conduct water test in presence of Architect. Correct defective work and re-test until satisfactory.

3.04 PROTECTION

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

END OF SECTION

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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.

D. 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.

E. 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.

F. 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
   2. 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.
   3. Review sequence of operation for each opening with electrified hardware to ensure that every opening functions properly for the Owner’s use.
   4. Discuss the types of electrified door hardware, inspection, and electrical roughing-in and other preparatory work performed by other trades.
   5. 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.
   6. 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.

H. Keying Meeting
   1. 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:
      a. Function of the building, flow of traffic, individual area’s purpose, and degree of security.
      b. Lock functions and operation.
      c. Preliminary key system schematic diagram.
      d. Verify existing keyway(s), and/or proposed keyway(s)
      e. Visual key and cylinder identification
      f. Quantity of keys required including master level keys, change keys, and keys per lock.
      g. Review the key control system.
      h. Determine the recipient and contact information for the delivery of keys and accessories.

I. Pre-installation Meeting
   1. 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.
   2. Inspect and discuss preparatory work performed by other trades.
   3. Include in-conference decisions regarding proper installation methods and procedures for receiving and handling hardware.

4. Review all system, elevation, and point-to-point drawings to ensure that all necessary components are provided and detailed.
5. Review and finalize construction schedule and verify availability of materials, installer's personnel, equipment, and facilities needed to make progress and avoid delays.
6. Review required testing, inspecting, and certifying procedures.

J. 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.
2. 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 ladings. 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. Shelve 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.

5. Acceptable Manufacturers:
a. Hager
b. Stanley
c. 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.
4. Acceptable Manufacturers:
   a. Hager
   b. National Guard Products
   c. 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:

	2 Conductors	10 Conductors
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:

	Manual Flush Bolt	Auto Flush Bolt	Dust Proof Strike
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:

	Coordinator	Bracket	Bracket for stops greater than 2-1/4."
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:

	Keyed Fire-Rated	Keyed Non-Fire-Rated
Hager	4900TF	4900T
Von Duprin	KR9954	KR4954

E. Acceptable manufacturers for removable mullions:

	Fire-Rated	Non-Fire-Rated
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.

D. Exit device to mount flush with door.

E. Latch bolts:
1. Rim device – 3/4" throw, Pullman type with automatic dead-latching, stainless steel

2. 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.
3. Fasteners: Wood screws, machine screws, and thru bolts.

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

G. Acceptable Manufactures:

	Wide Stile	Narrow Stile
Hager	4500 Series	4600 Series
Von Duprin	99 Series	33 Series

H. 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.

1. 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.
2. Stamp large bow key blanks with visual key control (keyset symbol) and "Do Not Duplicate".
3. 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	BF157
Trimco	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:

	Wall Convex	Wall Concave	Floor Mounted
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:

	Heavy Duty Surface	Heavy Duty Concealed	Slim Line Concealed
Hager	7000 SRF Series	7000 CON Series	
Glynn Johnson	90 SRF Series	100 Series	
ABH	1000 Series	9000 Series	1020 SL Series
Rixon	1 Series	9 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:

	Stop Applied	Stop Applied	Adhesive Applied
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:

	Hollow Metal Frame	Wood Frame
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.

C. 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 provide these results to the Owner and correct immediately.

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
AB	ABH Manufacturing Inc.
ARRW	Arrow Lock & Door Hardware
BYOT	By Others
HA	Hager
SC	Schlage
SECT	Securitech Group
SPCL	Special-Lite
VO	Von Duprin

3 HARDWARE SETS

Set #01.00

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Exit Device	4501 RIM LD FEC	US32D	HA
1	Closer(s)	5100	ALM	HA
1	Drop Plate	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

NOTE: Top jamb mount the door closer.

Set #01.01

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Exit Device	4501 RIM LD FEC	US32D	HA
1	Offset Door Pul(s)	12J	US32D	HA
1	Closer(s)	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

NOTE: Top jamb mount the door closer.

Set #01.02

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Offset Door Pul(s)	12J	US32D	HA
1	Automatic Operator	8418 PUSH	ALM	HA
2	Actuator(s)	2-659-0175/2-659-0175 (as req'd)	US32D	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

NOTE: Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latch and activates the outside actuator.
Depressing the actuator cycles the automatic operator.
Free egress by depressing the exit device rail retracts the latch or by depressing the actuator retracts the latch and cycles the automatic operator.

Set #01.03

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Offset Door Pul(s)	12J	US32D	HA
1	Closer(s)	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Access Control Reader	By Security Provider		BYOT
1	Power Supply	2909		HA

NOTE: Top jamb mount the door closer.

Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latch for entry.
Free egress at all time.

Set #01.04

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Offset Door Pul(s)	12J	US32D	HA
1	Closer(s)	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA

NOTE: Top jamb mount the door closer.

Operation:
Doors normally closed and locked.
Time schedule from the access control system retracts the latch for entry.
Free egress at all time.

Set #02.00

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Offset Door Pul(s)	12J	US32D	HA
1	Automatic Operator	8418 PUSH	ALM	HA
2	Actuator(s)	2-659-0175/2-659-0175 (as req'd)	US32D	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

NOTE: Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latch and activates the outside actuator.
Depressing the actuator cycles the automatic operator.
Free egress by depressing the exit device rail retracts the latch or by depressing the actuator retracts the latch and cycles the automatic operator.

Set #02.01

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Offset Door Pul(s)	12J	US32D	HA
1	Closer(s)	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA

NOTE: Top jamb mount the door closer.

Operation:
Doors normally closed and locked.
Time schedule from the access control system retracts the latch for entry.
Free egress at all time.

Set #02.02

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Exit Device	98L-2SI x 996L-R&V	US26D	VO
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumbturn Cylinder	XB11-979	626	SC
1	Closer(s)	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

NOTE: Top jamb mount the door closer.

Set #02.03

1	Continuous Hinge(s)	780-112HD 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	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #02.04

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Rachie Elec. Lock	RLA-G10-DR	630	SECT
2	Mortise Cylinder(s)	3902 SFIC x LAR	US26D	HA
2	Permanent Core	By Owner		BYOT
2	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100	ALM	HA
1	Drop Plate(s)	5110	ALM	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Power Supply	2908		HA
1	Access Control Reader	By Security Provider		BYOT

NOTE: Top jamb mount the door closer.

Operation:
Lobby B110 side of door is Fail Secure.
During operational hours Lobby B110 side of door is unlocked by an access control time schedule.
After operational hours Lobby B110 side of door is locked.
A valid credential at the reader unlocks the lever for entry.

Welcome Center B102 side of door is Fail Safe.
Door is closed and locked at all time with a fail safe lock.
A valid credential at the reader on the Welcome Center B102 side of the opening unlocks the lever for egress.
Must be tied to an approved fire alarm system.
Activation of the fire alarm or signal from fire command shunts power to the electrified lockset.

Set #03.00

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Exit Device	4501 RIM LD FEC	US32D	HA
1	Closer(s)	5100 HDCS	ALM	HA
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #03.01

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Exit Device	4501 RIM LD FEC	US32D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Door Pull(s)	SL-86 (By the Door Mfr.)	CL	SPCL
1	Closer(s)	5100 HDCS	ALM	HA
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #03.02

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Door Pull(s)	SL-86 (By the Door Mfr.)	CL	SPCL
1	Closer(s)	5100 HDCS	ALM	HA
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

NOTE: Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latch for entry.
Free egress at all time.

Set #03.03

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Door Pull(s)	SL-86 (By the Door Mfr.)	CL	SPCL
1	Closer(s)	5100 HDCS	ALM	HA
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

NOTE: Operation:
Doors normally closed and locked.
Time schedule from the access control system retracts the latch for entry.
Free egress at all time.

Set #03.04

1	Continuous Hinge(s)	780-112HD x LAR EPT Prep	CLR	HA
1	Power Transfer(s)	2-679-0623	ALM	HA
1	Exit Device	4501 RIM MLR FEC	US32D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Door Pull(s)	SL-86 (By the Door Mfr.)	CL	SPCL
1	Automatic Operator	8418 PUSH	ALM	HA
2	Actuator(s)	2-659-0175/2-659-0175 (as req'd)	US32D	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT
1	Power Supply	2909		HA
1	Access Control Reader	By Security Provider		BYOT

NOTE: Operation:
Door normally closed and locked.
A valid credential at the reader retracts the latch and activates the outside actuator.
Depressing the actuator cycles the automatic operator.
Free egress by depressing the exit device rail retracts the latch or by depressing the actuator retracts the latch and cycles the automatic operator.

Set #03.05

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100 HDCS	ALM	HA
1	Threshold	520S N x LAR	MIL	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Note: Install lockset with the keyed cylinder on the stairwell side of the opening.

Set #04.00

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Dummy Push Pad	4501 D x LAR FEC	US32D	HA
1	Door Pull(s)	SL-86 (By the Door Mfr.)	CL	SPCL
1	Closer(s)	5100 HDCS	ALM	HA
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #04.01

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Dummy Push Pad	4501 D x LAR FEC	US32D	HA
1	Door Pull(s)	SL-86 (By the Door Mfr.)	CL	SPCL
1	Automatic Operator	8418 PUSH	ALM	HA
2	Actuator(s)	2-659-0175/2-659-0175 (as req'd)	US32D	HA
1	Overhead Stop(s)	1020 SL Series (Size as Req'd)	US32D	AB
1	Door Bottom(s)	SL-301 x LAR (By the Door Mfr)	MIL	SPCL
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

NOTE: Operation:
Depressing the actuator on either side of the opening cycles the automatic operator.

Set #05.00

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Exit Device(s)	4501 RIM FEC	US32D	HA
1	Night Latch Trim(s)	45NL WTN	US26D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
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 #05.01

3	Hinge(s)	BB1168 4 1/2" x 4 1/2"	US26D	HA
1	Exit Device	98L-2SI x 996L-R&V	US26D	VO
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumbturn Cylinder	XB11-979	626	SC
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 #05.02

3	Hinge(s)	BB1168 4 1/2" x 4 1/2"	US26D	HA
1	Exit Device	98L-2SI x 996L-R&V	US26D	VO
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumbturn Cylinder	XB11-979	626	SC
1	Closer(s)	5100 HDCS	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
3	Silencers	307D	GREY	HA

Set #05.03

3	Hinge(s)	BB1168 4 1/2" x 4 1/2"	US26D	HA
1	Exit Device(s)	4501 RIM F FEC	US32D	HA
1	Passage Exit Trim(s)	45BE WTN	US26D	HA
1	Closer(s)	5100	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Seal	726 x LAR	S	HA

Set #05.04

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Exit Device	98L-2SI x 996L-R&V	US26D	VO
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumbturn Cylinder	XB11-979	626	SC
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
1	Seal	726 x LAR	S	HA
1	Automatic Door Bottom	743S N x LAR	MIL	HA

Set #05.05

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Exit Device	98L-2SI x 996L-R&V	US26D	VO
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumbturn Cylinder	XB11-979	626	SC
1	Closer(s)	5100 HDCS	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Seal	726 x LAR	S	HA
1	Automatic Door Bottom	743S N x LAR	MIL	HA

Set #05.50

6	Hinge(s)	BB1168 4 1/2" x 4 1/2"	US26D	HA
1	Mullion	4900X x LAR	USP	HA
2	Exit Device	98L-2SI x 996L-R&V	US26D	VO
2	Rim Cylinder(s)	3901 SFIC	US26D	HA
2	Permanent Core	By Owner		BYOT
2	Construction Core(s)	3982-BLU	BLU	HA
2	Thumbturn Cylinder	XB11-979	626	SC
2	Closer(s)	5100-HD	ALM	HA
2	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
2	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
2	Silencers	307D	GREY	HA

Set #05.51

6	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
2	Exit Device(s)	4501 LBR FEC	US32D	HA
1	Night Latch Trim(s)	45NL WTN	US26D	HA
1	Rim Cylinder(s)	3901 SFIC	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
2	Closer(s)	5100-HD	ALM	HA
2	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
2	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
2	Silencers	307D	GREY	HA

Set #06.00

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Rachie Elec. Lock	RLA-G10-DD	630	SECT
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Mortise Cylinder(s)	3902 SFIC x LAR	US26D	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
1	Power Transfer(s)	2-679-0623	ALM	HA
3	Silencers	307D	GREY	HA
1	Power Supply	2908		HA
2	Access Control Reader	By Security Provider		BYOT

NOTE: Operation:
Circulation side of door is Fail Secure.
Door is closed and locked at all time with a fail secure lock.
A valid credential at the reader unlocks the lever for egress.
Door status monitored.

Set #07.00

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #07.01

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
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 #07.02

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
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 #07.03

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #07.04

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100 HDCS	ALM	HA
3	Silencers	307D	GREY	HA

Set #07.05

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
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
1	Seal	726 x LAR	S	HA

Set #07.06

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
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
1	Seal	726 x LAR	S	HA

Set #07.07

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100 TRK NHOTA	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Seal	726 x LAR	S	HA

Set #07.08

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100 HDCS	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Seal	726 x LAR	S	HA

Set #07.51

6	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Manual Flush Bolt Set	282D	US26D	HA
1	Dust Proof Strike	280X	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100-HD	ALM	HA
1	Overhead Stop(s)	7016 SRF	US32D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
2	Silencers	307D	GREY	HA

Set #07.52

6	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Manual Flush Bolt Set	282D	US26D	HA
1	Dust Proof Strike	280X	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
2	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
2	Silencers	307D	GREY	HA

Set #07.80

6	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Manual Flush Bolt Set	282D	US26D	HA
1	Dust Proof Strike	280X	US26D	HA
1	Storeroom Lockset	3880 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Closer(s)	5100-HD	ALM	HA
2	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
2	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
2	Silencers	307D	GREY	HA

Set #08.00

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumb Turn Indicator	ABE194 V10	626	ARRW
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #08.01

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	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 #08.02

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	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 #08.03

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	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 #08.04

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	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	Overhead Stop(s)	7016 SRF	US32D	HA
3	Silencers	307D	GREY	HA

Set #08.05

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	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 #08.06

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	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
1	Seal	726 x LAR	S	HA

Set #08.07

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	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 HDCS	ALM	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #08.08

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Thumb Turn Indicator	ABE194 V10	626	ARRW
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA
1	Automatic Door Bottom	743S N x LAR	MIL	HA

Set #09.00

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1	Cylinder Indicator	ABE190 V20	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 #09.01

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Privacy Set w/ Indicator	3896 SECT WTN ADA Turn	US26D	HA
1	Closer(s)	5100	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Mop Plate(s)	190S 4" x 1" LDW CSK	US32D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #09.02

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Lockset	3881 SECT WTN SFIC7	US26D	HA
1	Cylinder Indicator	ABE190 V20	626	ARRW
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Drop Plate(s)	5110	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Mop Plate(s)	190S 4" x 1" LDW CSK	US32D	HA
1	Seal	726 x LAR	S	HA

Set #09.03

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Corridor Lockset	3856 SECT WTN SFIC7	US26D	HA
1	Cylinder Indicator	ABE190 V20	626	ARRW
1	Closer(s)	5100	ALM	HA
1	Kick Plate(s)	190S 10" x 2" LDW CSK	US32D	HA
1	Mop Plate(s)	190S 4" x 1" LDW CSK	US32D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #10.00

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Privacy Set w/ Indicator	3896 SECT WTN ADA Turn	US26D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #11.00

1	Continuous Hinge(s)	780-112HD x LAR	CLR	HA
1	Passage Set	3810 SECT WTN	US26D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Weatherstrip	By Frame Mfr./Supplier		BYOT

Set #11.01

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Passage Set	3810 SECT WTN	US26D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
3	Silencers	307D	GREY	HA

Set #11.02

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Passage Set	3810 SECT WTN	US26D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #11.03

3	Hinge(s)	BB1168 5" x 4 1/2"	US26D	HA
1	Passage Set	3810 SECT WTN	US26D	HA
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA
1	Automatic Door Bottom	743S N x LAR	MIL	HA

Set #12.00

3	Hinge(s)	BB1279 4 1/2" x 4 1/2"	US26D	HA
1	Reverse Passage Set	L9010 06A Time Out	626	SC
1	Convex Wall Stop(s)	232W/236W (as req'd)	US32D	HA
1	Seal	726 x LAR	S	HA

Set #13.00

3	Hinge(s)	BB1168 4 1/2" x 4 1/2"	US26D	HA
1	Pull Plate(s)	34G 4" x 16"	US32D	HA
1	Push Plate(s)	30S 8" x 16"	US32D	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 #13.01

3	Hinge(s)	BB1168 4 1/2" x 4 1/2"	US26D	HA
1	Deadlock	3833S SFIC7	US26D	HA
1	Permanent Core	By Owner		BYOT
1	Construction Core(s)	3982-BLU	BLU	HA
1	Pull Plate(s)	34G 4" x 16"	US32D	HA
1	Push Plate(s)	30S 8" x 16"	US32D	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 #14.50

1	All Hardware	By Door Mfr/Supplier	BYOT

Set #15.00

1	All Hardware	By Door Mfr/Supplier	BYOT

Set #16.00

1	All 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 (Reaffirmed 2020).
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; 2023.
E. ASTM C1184 - Standard Specification for Structural Silicone Sealants; 2023.
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 (Reapproved 2023).
H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
I. ASTM C1401 - Standard Guide for Structural Sealant Glazing; 2023.
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; 2023.
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; 2021.
O. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
P. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
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 E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
T. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
U. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
V. GANA (GM) - GANA Glazing Manual; 2022.
W. GANA (SM) - GANA Sealant Manual; 2008.
X. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.
Y. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Z. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.
AA. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (2016).
BB. NFPA 251 - Standard Methods of Tests of Fire Resistance of Building Construction and Materials - 2006.
CC. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
DD. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
EE. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
FF. 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 Insulating Glass Unit, Glazing Unit, and Plastic Film Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit 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. Provide mock-up of typical exterior glazing including glassand air barrier seal..
C. Locate where directed.
D. 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.

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. 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, Inc.; Solarban 70, 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 BULLET-RESISTANT GLAZING

A. Glass-clad polycarbonate, *Clear*: Inner and outer lites shall be 3mm heat strengthened glass with a single ply polycarbonate core. Overall nominal thickness shall be 9/16". Product shall comply with:
   1. Ballistics Level 1, .38 Special (ballistics stoppage spall penetration).
   2. ASTM F1915, Grade 4
   3. Earlier versions of the HP White standard will not be accepted

B. Glass-clad polycarbonate, *Clear*: Inner and outer lites shall be 3mm heat strengthened glass with a multiply polycarbonate core. Overall nominal thickness shall be 3/4". Product shall comply with the following standards:
   1. Ballistics Level 2, .9mm (ballistics stoppage spall penetration).
   2. Earlier versions of the HP White standard will not be accepted.

2.07 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: #0-0186 Light White.
            (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: Standard color as selected by Architect.
   2. Manufacturers: Any of the manufacturers specified for float glass.

2.08 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 Wired 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: Wired float glass with surface-applied safety film.
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. Wire Pattern: Square.
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; FireDefend Wire F: www.mcgrory.com
   b. SAFTIFIRST, a division of O'Keeffe's Inc; SuperLite I-W: www.safti.com
   c. Technical Glass Products; WireLiteNT: www.fireglass.come.

C. 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.

D. 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.

E. 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

2.09 PLASTIC FILMS

A. Decorative Plastic Film: Polyester type.
   1. Application: Locations as indicated on drawings.
   2. Series Type: Frost / Matte.
   3. Color: White.
   4. Thickness Without Liner: 0.0032 inch (3.2 mils).
   5. Opacity: Translucent.
   6. Visible Light Transmittance (VLT): 56 percent, nominal.
   7. Diffuse Visible Light Reflectance, Exterior: 26 percent, nominal.
   8. Adhesive: Pressure-sensitive Acrylic.
   9. Fire Performance: Class A per ASTM E84.
      a. Flame Spread: 25, maximum.
      b. Smoke Developed: 450, maximum.
   10. Manufacturers:
      a. 3M Window Films; Fasara Cielo SH2FGCE: www.solutions.3m.com
      b. Avery Dennison; AX900 Super Cast Series Decorative Window Film - 867-W Dusted Crystal Matte: www.averydennison.com/#sle.
      c. XPEL, Inc; Vision White Frost: www.xpel.com/#sle.

2.10 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.

2.11 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.

2.12 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 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.

3.10 PROTECTION

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

3.11 GLASS SCHEDULE

A. GL-2: Low-Iron, Clear fully tempered 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 heat-strengthened laminated glass.
   1. Clear laminated safety glass.
   2. Minimum Thickness: 1/4 inch (6 mm).
   3. Safety glazing required.
C. GL-8: Clear heat-strengthened laminated glass with tinted interlayer.
   1. Clear laminated safety glass.
   2. PVB Interlayer Color: Arctic White.
   3. Minimum Overall Thickness: 1/4 inch (6 mm).
   4. Safety glazing required.
D. 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 2nd 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).
5. Performance:
   a. Winter Nighttime U-Factor: 0.28 maximum.
   b. Visible Light Transmittance: 64 percent minimum.
   c. Solar Heat Gain Coefficient: 0.27 maximum.

E. GL-18: Low-E, Clear tempered insulating spandrel 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 2nd 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. Silicone-coated Spandrel Coating: On 4th surface.
5. Performance:
   a. Winter Nighttime U-Factor: 0.28 maximum.
   b. Solar Heat Gain Coefficient: 0.27 maximum.

F. GL-19: Low-E-coated, clear tempered insulating spandrel glass with applied frit.
1. Overall Unit Thickness: 1 inch.
2. Outdoor Lite: Clear fully tempered annealed float glass.
   a. Minimum Thickness: 1/4 inch (6 mm).
   b. Low-E Coating: On 2nd surface.
3. Airspace:
   a. Width: 1/2 inch.
   b. Interspace Content: Air.
4. Indoor Lite: Clear tempered annealed float glass.
   a. Minimum Thickness: 1/4 inch (6 mm).
   b. Ceramic Frit Spandrel Coating: On 4th surface.
   c. Frit pattern as indicated on drawings.
5. Performance:
   a. Winter Nighttime U-Factor: 0.28 maximum.
   b. Visible Light Transmittance: 64 percent minimum.
   c. Solar Heat Gain Coefficient: 0.27 maximum.

G. GL-21: Clear heat-strengthen laminated insulating glass.
1. Overall Unit Thickness: 1 inch.
2. Outdoor Lite: Clear heat-strengthen laminated float glass.
   a. Minimum Thickness: 1/4 inch (6 mm).
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 Thickness: .060.
   c. PVB Interlayer Color: Clear.
5. Performance:
   a. Winter Nighttime U-Factor: 0.28 maximum.
   b. Visible Light Transmittance: 64 percent minimum.
   c. Solar Heat Gain Coefficient: 0.27 maximum.

H. GL-23: Clear tempered laminated insulating glass with tinted interlayer.
1. Overall Unit Thickness: 1 inch.

2. Outdoor Lite: Clear heat-strengthen laminated float glass.
   a. Minimum Thickness: 1/4 inch (6 mm).
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 Thickness: .060.
   c. PVB Interlayer Color: Arctic Snow.
5. Performance:
   a. Winter Nighttime U-Factor: 0.28 maximum.
   b. Visible Light Transmittance: 64 percent minimum.
   c. Solar Heat Gain Coefficient: 0.27 maximum.

I. FPGL-2: 45 minute fire-protection-rated glazing (for Door Lites and Side Lites only).
1. Specialty tempered float glass.
2. Thickness: 3/4 inch.
3. Fire Rating: 45 minutes.

J. FRGL-4: 60 minute fire-resistance-rated glazing.
1. Laminated ceramic glass.
2. Thickness: 1-1/8 inch.
3. Fire Rating: 60 minutes, ASTM E119

K. 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.

L. SSGL-2 Clear heat-strethen laminated security insulating glass.
1. Overall Unit Thickness: 1-1/16 inch.
2. Outdoor Lite: Clear fully tempered float glass.
   a. Minimum Thickness: 1/4 inch (6 mm).
3. Airspace:
   a. Width: 3/8 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 (12 mm).
5. Performance:
   a. Winter Nighttime U-Factor: 0.28 maximum.
   b. Visible Light Transmittance: 32 percent minimum.
   c. Solar Heat Gain Coefficient: 0.24 maximum.

M. SGL-1: Insulated Metal Panel.
1. Basis of design: Provide Thermolite as manufactured by Laminators Inc., Tel: (215)723-8107. Toll Free: (877) OMEGA77. Fax: (215) 721-1239.Or approved equals.
2. Overall Unit Thickness: 1 inch (25 mm).
3. Color: As selected by Architect from manufacturer’s full range.

N. SGL-2: Metal Panel

1. Basis of design: Provide Omega-Lite as manufatured by Laminators Inc., Tel: (215) 723-8107. Toll Free: (877) OMEGA77. Or approved equals.
2. Overall Unit Thickness: 1/4 inch (6 mm).
3. Color: As selected by Architect from manufacturer's full range.

END OF SECTION

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SECTION 08 8300 - MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass mirrors.
   1. Annealed float glass with safety backing.

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 (Reaffirmed 2020).
C. ASTM C1036 - Standard Specification for Flat Glass; 2021.
D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
E. GANA (GM) - GANA Glazing Manual; 2022.
F. GANA (SM) - GANA Sealant Manual; 2008.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds: Submit chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.
E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.05 FIELD CONDITIONS

A. Do not install mirrors when ambient temperature is less than 50 degrees F.
B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
B. Mirror Glass: ASTM C1036, Type 1 - Transparent Flat, Class 1 - Clear, Quality - Q1 (high-quality mirrors); silvering, protective coating, and quality requirements in compliance with ASTM C1503: Laminated Safety Glass.
   1. Thickness: 1/4 inch.
   2. Edges: Flat polished, sealed.
   3. Size: As indicated on drawings.

2.02 FRAMING

A. Framed - 4 Sides: Extruded aluminum J-trim with top mounting cleat and airspace behind mirror.
   1. Exposed Face: 13/32 inch.
   2. Corners: Mitered with tight joints.
      a. Frame Screw Holes: Top and bottom.
   3. Finish: Satin anodized.
   4. Products:
      a. C.R. Laurence Co., Inc.; custom framing: www.crlaurence.com.
         1) J-trim: Model D1680A.
         2) Top Cleat: Model D1637M.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Mirror Clips: Top adjustable mounting clips and fixed bottom clips without an airspace behind mirror.
   1. Exposed Face: 1/4 inches.
   2. Finish: Nickel plated.
   3. Products:
      a. C.R. Laurence Co., Inc.; Bishop Mirror Clips, www.crlaurence.com.
         1) 2-Piece Top Clip: Model SW5232/SW5233.
         2) Bottom Clip: SW6003
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.03 ACCESSORIES

A. Safety Backing: Pressure-sensitive adhesive coated film with embedded woven scrim.
   1. Complies with ANSI Z97.1 and 16 CFR 1201; test requirements for Class A/Category II.
   2. Products:
      a. 3M; Bidirectional Woven Copolymer Tape 960G; www.3m.com.
      b. C.R. Laurence Co., Inc.; 2MT Series: www.crlaurence.com.
      c. ShurTape Technologies, LLC; SS501 Shatterstop Safety Mirror Backing Tape: www.shurtape.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Mirror Adhesive: High strength adhesive that remains flexible and is compatible with safety backing; low VOC.
   1. Application Temperature: 60 to 100 degrees F at contact surfaces.
   2. Volatile Organic Content (VOC): Less than 250 g/L.
   3. Products:
      a. Dow Corning Corporation; DOWSIL 817 Mirror Adhesive: www.dowcorning.com.
      b. PPG Industries, Inc.; Liquid Nails Mirror Adhesive LN-730: www.liquidnails.com.
      c. Royal Adhesives & Sealants, LLC; Gunther Premier Plus Mirror Mastic: www.royaladhesives.com.
      d. Sika Corporation; Sikaflex-124 Mirror Grip: www.usa.sika.com
      e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

A. Clean contact surfaces and wipe dry.

B. Properly prepare substrates for mirror adhesives according to adhesive manufacturer's instructions.

3.03 INSTALLATION

A. Install mirrors in accordance with manufacturer's recommendations.

B. Set mirrors plumb and level, and free of optical distortion.
C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
D. Ensure that safety backing is applied over the entire surface of all mirror back sides.
E. Framed - 4 Sides:
    1. Install according to framing manufacturer's instructions.
    2. Install concealed cleat to substrate at location of mirror top.
    3. Install bottom J-trim to substrate at location mirror bottom.
    4. Apply mirror adhesive to substrates; keep 4 inches away from mirror edges to allow air circulation.
        a. Apply in vertical beads or patties.
    5. Position mirror in bottom J-trim, press firmly into adhesive and install side J-trim.
        a. Other than adhesive, verify that air space behind mirror is clear and free of debris.
    6. Install top J-trim securely on cleat.
    7. Ensure that mirror is properly aligned and secured in framing without excessive movement or vibrations; secure four sides of framing to one another with concealed screws at the top and bottom of the framing.
F. Mirror Clips:
    1. Install according to clip manufacturer's instructions.
    2. Install bottom clips to substrate at location of mirror bottom.
        a. Space clips as recommended by clip manufacturer but not more than 36 inches on center; minimum of 2 clips.
    3. Install clip receivers to substrate at location of mirror top.
        a. Space clips as recommended by clip manufacturer but not more than 36 inches on center; minimum of 2 clips.
    4. Apply mirror adhesive to substrates; keep 4 inches away from mirror edges.
        a. Apply in vertical beads or patties.
    5. Position mirror in bottom clips and press firmly into adhesive.
        a. Adhesive shall be compressed to 1/16 inch thickness, maximum.
    6. Install top clips into receivers.
    7. Ensure that mirror is properly aligned and secured by clips without excessive movement or vibrations.

3.04 CLEANING

A. Remove labels after work is complete.
B. Clean mirrors and adjacent surfaces.

END OF SECTION

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SECTION 08 9100 - LOUVERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Louvers, frames, and accessories.

1.02 REFERENCE STANDARDS

A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices; 2021, with Editorial Revision (2022).
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, and tolerances; head, jamb and sill details; blade configuration, screens, blank-off areas required, and frames.
D. Samples: Submit three samples 4 by 4 inches in size illustrating finish and color of exterior and interior surfaces.
E. Test Reports: Independent agency reports showing compliance with specified performance criteria.
F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type 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 of documented experience.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year manufacturer's warranty against distortion, metal degradation, and connection failures of louver components.
    1. Finish: Include twenty year coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Louvers - Drainable Blades:
    1. The Airolite Company, LLC; Model K6774: www.airolite.com.
    2. Arrow United Industries; Model EA-425-DD: www.arrowunited.com.
    3. Construction Specialties, Inc.; Model A4097: www.c-sgroup.com.
    4. Greenheck Fan Corporation; Model ESD-435: www.greenheck.com.
    5. Industrial Louvers, Inc.; Model 458XP: www.industriallouvers.com.
    6. Ruskin; Model ELF375DX: www.ruskin.com.
    7. Substitutions: See Section 01 6000 - Product Requirements.
B. Louvers - Nondrainable Blades:

1. The Airolite Company, LLC; Model K609: www.airolite.com.
2. Arrow United Industries; Model EA-410: www.arrowunited.com.
3. Construction Specialties, Inc.; Model A4080: www.c-sgroup.com.
4. Greenheck Fan Corporation; Model ESJ-401: www.greenheck.com.
5. Industrial Louvers, Inc.; Model 450XP: www.industriallouvers.com.
6. Ruskin; Model ELF375X: www.ruskin.com.
7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 LOUVERS

A. Louvers: Factory fabricated and assembled, complete with frame, mullions, and accessories; AMCA Certified in accordance with AMCA 511.
   1. Wind Load Resistance: Design to resist positive and negative wind load of 25 psf without damage or permanent deformation.
   2. Beginning point of water penetration at 0.01 oz/sq ft is 850 fpm, minimum.
   3. Drainable Blades: Continuous rain stop at front or rear of blade aligned with vertical gutter recessed into both jambs of frame.
   4. Screens: Provide insect screens at intake louvers and bird screens at exhaust louvers.
B. Stationary Louvers: Horizontal blade, extruded aluminum construction, with concealed intermediate mullions.
   1. Free Area: 50 percent, minimum.
   2. Blades: Drainable.
   3. Frame: 4 inches deep, channel profile; corner joints mitered.
   4. Aluminum Thickness: Frame 12 gage, 0.081 inch minimum; blades 12 gage, 0.081 inch minimum.
   5. Aluminum Finish: Superior performing organic coatings; finish welded units after fabrication.

2.03 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T5 or T6 temper.

2.04 FINISHES

A. Superior Performing Organic Coatings System: Polyvinylidene fluoride (PVDF) multi-coat superior performing organic coatings system complying with AAMA 2605, including at least 70 percent PVDF resin, and at least 80 percent of aluminum extrusion and panels surfaces having minimum total dry film thickness (DFT) of 1.2 mils, 0.0012 inch.
   1. Color: Two or three-coat custom color to match Architect's sample.

2.05 ACCESSORIES

A. Blank-Off Panels: Aluminum face and back sheets, polyisocyanurate foam core, 2 inch thick, painted black on exterior side; provide where duct connected to louver is smaller than louver frame, sealing off louver area outside duct.
B. Screens: Frame of same material as louver, with mitered and welded corners; removable, screw attached; installed on inside face of louver frame.
C. Bird Screen: Interwoven wire mesh of steel, 14 gage, 0.0641 inch diameter wire, 1/2 inch open weave, square design.
D. Insect Screen: 18 x 16 size aluminum mesh.
E. Fasteners and Anchors: Stainless steel.
F. Flashings: Sheet aluminum, formed to required shape, single length in one piece per location.
   1. Comply with ASTM B209.
   2. Minimum Thickness: 0.032 inches thick.
   3. Includes, but is not limited to, the following:
      a. Extended sill with drip edge.
G. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that prepared openings and flashings are ready to receive this work and opening dimensions are as indicated on shop drawings.

3.02 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.
B. Install louvers level and plumb.
C. Set sill members and sill flashing in continuous bead of sealant.
D. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
E. Secure louver frames in openings with concealed fasteners.
F. Coordinate with installation of mechanical ductwork.

3.03 CLEANING

A. Strip protective finish coverings.
B. Clean surfaces and components.

END OF SECTION

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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.

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 (WD).
            2) Rubber Floor Tile (RFT).
            3) Resilient Sheet Flooring (RSF)
            4) Tile Carpeting (CPT).
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 (WD).
            2) Rubber Floor Tile (RFT)
            3) Resilient Sheet Flooring (RSF)
            4) Tile Carpeting (CPT)
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; 2023.
C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.
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; 2023.
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; 2022.
J. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
K. ASTM E413 - Classification for Rating Sound Insulation; 2022.
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; 2022.
N. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.
O. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.
P. GA-600 - Fire Resistance and Sound Control Design Manual; 2021.
Q. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2017, with Editorial Revision (2020).
R. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
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 and/or Acoustic Ceiling Systems: 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 Horzontal 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

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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; 2018.
B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2019.
C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
D. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).
E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
F. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
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; 2022.
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; 2022.
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; 2023.
P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
S. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
T. ASTM E413 - Classification for Rating Sound Insulation; 2022.
U. GA-216 - Application and Finishing of Gypsum Panel Products; 2021.

V. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2019.
W. GA-600 - Fire Resistance and Sound Control Design Manual; 2021.
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. Manufacturer's Qualification Statement.
E. 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/C475Mand 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. Marino\WARE: 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 Section01 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 accomodate 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 nexessary 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.

G. Impact Resistant Gypsum Wallboard: Install up to 48 A.F.F. at locations not to receive lockers or manufactured casework.

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 teh 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 hte wall partition and loosely install fasteners in the top and bottom slotted holes ofthe 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

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SECTION 09 3000 - HARD TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hard tile.
B. Hard tile trim units.
C. Solid surfacing thresholds.
D. Tile setting materials, grout, sealants, and accessories.
E. Metal trim.
F. Waterproofing and crack isolation membranes.

1.02 REFERENCE STANDARDS

A. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2017 (Reaffirmed 2022).
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; 2019.
N. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2014 (Reaffirmed 2019).
O. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 2017.

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 A137.1 - American National Standard Specifications for Ceramic Tile; 2019.
R. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
S. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
D. Samples:
    1. Full-size units of each type of tile and each color and finish.
    2. Full-size units of each type of trim, threshold and accessory for each color and finish.
        a. Trim and Threshold Samples: 4 inches long, minimum.
E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.
    2. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than one box of each type.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.
C. Provide setting materials, grouts, and waterproofing and crack isolation membrane materials from one manufacturer.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
B. Construct mockups to demonstrate aesthetics and quality of materials and execution.
    1. Build mock-up of each type of floor tile and installation method.
    2. Build mock-up of each type of wall tile and installation method.
    3. Build mock-up of any other specific locations as requested by the Architect.
    4. Mockup sizes shall be sized as appropriate to demonstrate complete tile pattern layout; 16 square feet, minimum.
    5. Approved mock-ups may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to project site in manufacturer's original, unopened containers with labels intact. Inspect materials and notify manufacturer of any discrepancies.
B. Storage: Store materials as directed by manufacturer's written instructions.

1.08 FIELD CONDITIONS

A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Floor Tile: Floor tile shall comply with the following:
   1. Dynamic Coefficient of Friction (DCOF): 0.42 or greater when tested in accordance with DCOF AcuTest per ANSI A137.1.

2.02 HARD TILE

A. CT1 Porcelain Tile: ANSI A137.1 standard grade.
   1. Size: 24 by 48 inch, rectified.
   2. Thickness: 9 mm, nominal.
   3. Surface Finish: Matte glazed.
   4. Color(s): Chain
   5. Trim Units: Matching cove shapes in sizes coordinated with field tile.
   6. Joint Size: _____.
   7. Base: 6 by 12 inch Cove Base.
   8. Products:
      a. Caesar Ceramics; Link: www.caesarceramicsusa.com/us/.
      b. Substitutions: Not permitted.
      c. Distributor: Virginia Tile, Kathleen Black, (248) 467-4362.
      d. Lead Time: 2-3 weeks

B. CT2 Floor Tile: ANSI A137.1 standard grade.
   1. Size: 2 by 2 inch, nominal.
   2. Thickness: 9mm, nominal.
   3. Surface Finish: Unglazed.
   4. Color(s): Chain
   5. Trim Units: Matching cove and base shapes in sizes coordinated with field tile.
   6. Joint Size: 1/8 inch.
   7. Products:
      a. Caesar Ceramics; Link: www.caesarceramicsusa.com/us/.
      b. Substitutions: Not permitted.
      c. Distributor: Virginia Tile, Kathleen Black, (248) 467-4362.
      d. Lead Time: 2-3 weeks

C. CT3 Wall Tile: ANSI A137.1 standard grade. [Base at Concrete Floors]
   1. Size: 4 by 12 inch
   2. Thickness: 5/16 inch, nominal.
   3. Surface Finish: Gloss and Matte.
   4. Color(s): .
      a. CT3A Arctic White Gloss, 0190.
      b. CT3B Chalkboard Gloss, 0180.
      c. CT3C Matte Mustard, 7012.
      d. CT3D Matte Ocean Blue, 7049
   5. Joint Size: 1/8 inch.
   6. Products:
      a. Daltile; Color Wheel Linear: www.daltile.com.
      b. Substitutions: Not permitted.
      c. Distributor: Daltile, Alyssa DeShane, (616) 877-6116
      d. Lead Time: 8-10 weeks

D. CT4 Wall Tile: ANSI A137.1 standard grade.
   1. Size: 4 by 12 inch, nominal.
   2. Thickness: 5/16 inch, nominal.
   3. Surface Finish: Matte.
   4. Color(s): .
      a. CT4A Matte Tuscany, CU74.
      b. CT4B Matte Mango, CU71.

c. CT4C Matte Fern, CU80.
d. CT4D Matte Starlight, CU68
5. Joint Size: 1/16 inch.
6. Products:
a. Daltile; Colormatch: www.daltile.com.
b. Substitutions: Not permitted.
c. Distributor: Daltile, Alyssa DeShane, (616) 877-6116
d. Lead Time: 8-10 weeks

E. [CT5] Porcelain Tile: ANSI A137.1 standard grade.
1. Size: 2 by 6 inch, nominal.
2. Thickness: 8.5 mm, nominal.
3. Surface Finish: Gloss
4. Color(s):
a. CT5A: Popcorn, Gloss
b. CT5B: Mustard, Gloss
5. Joint Size: 1/8 inch.
6. Products:
a. WOW Tile: Rebels, www.wowdesigneu.com/
b. Substitutions: Not permitted.
c. Distributor: Virginia Tile, Kathleen Black, (248) 467-4362
d. Lead Time: 3-4 weeks

F. [CT6] Porcelain Tile: ANSI A137.1 standard grade.
1. Size:
a. CT6A: 7 7/8 by 47 2/8 inch (20 by 120 cm)
b. CT6B: 11 13/16 by 47 2/8 inch (30 by 120 cm)
2. Thickness: 9 mm, nominal.
3. Surface Finish: Matte.
4. Color: Nordic
5. Joint Size: 1/8 inch.
6. Products:
a. Ceaser Ceramics; Life: www.caesarceramicsusa.com/us/
b. Substitutions: Not permitted.
c. Distributor: Virginia Tile, Kathleen Black, (248) 467-4362
d. Lead Time: 8-10 weeks

G. [CT7] Porcelain Tile: ANSI A137.1 standard grade.
1. Size: 12 by 48 inch, nominal.
2. Thickness: 10 mm, nominal.
3. Surface Finish: Unglazed.
4. Color(s): Crema
5. Joint Size: 1/8 inch.
6. Products:
a. Isla Tiles; Shibusa: https://www.islatiles.it/
b. Substitutions: Not permitted.
c. Distributor: Virginia Tile, Kathleen Black, (248) 467-4362
d. Lead Time: 8-10 weeks

H. CT8 Wall Tile: ANSI A137.1 standard grade.
1. Size: 15 3/4 by 31 1/2 inch, nominal.
2. Thickness: 10mm, nominal.
3. Surface Finish: Matte glazed
4. Color(s): White
5. Joint Size: 1/8 inch
6. Products:
a. Atlas Concorde; 3D Diamond White Matte 80: www.atlasconcorde.com/en

b. Subsitutions: Not permitted.
c. Distributor: Virginia Tile, Kathleen Black, (248) 467-4362
d. Lead Time: 8-10 weeks.

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 otherwsie indicated.

2.04 THRESHOLDS **ADD4**

A. ~~**Thresholds - General:**~~
1. ~~**Beveled Edges:**~~
a. ~~**Maximum Height: 1/2 inch.**~~
b. ~~**Bevel Slope: 1:2 slope.**~~
c. ~~**Align lower bevel edge with adjacent floor finish.**~~
d. ~~**Finish bevels to match threshold face.**~~

B. ~~**Solid Surfacing Thresholds: Plastic resin casting complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler or unfilled, and pigments; homogenous, non-porous; no surface coating; color and pattern consistent throughout thickness.**~~
1. ~~**Size: 4 inches wide by full width of opening; 1/2 inch thick; beveled long edge, both sides.**~~
2. ~~**Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.**~~
3. ~~**Products:**~~
a. ~~**E. I. DuPont De Nemours and Co.; Corian Solid Surface: www.corian.com.**~~
b. ~~**Substitutions: Not permitted**~~
4. ~~**Color: Architect shall select three (3) colors from Manufacturer's full line.**~~

C. **Applications:**
1. **At doorways where tile terminates.**

2.05 SETTING MATERIALS

A. Latex-Portland Cement Thin-Set Mortar Bond Coat: ANSI A118.4 and ANSI A118.11
1. Products:
a. Bostik, Inc; Bostik PM: www.bostik.com.
b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar : www.custombuildingproducts.com.
c. LATICRETE International, Inc; 253 Gold: www.laticrete.com.
d. MAPEI Corp.; Porcelain Tile Mortar: www.mapei.com.
e. Substitutions: See Section 01 6000 - Product Requirements.

B. Large Format Tile Latex-Portland Cement Medium-Bed Mortar Bond Coat: ANSI A118.4 and ANSI A118.11.
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. TEC, H.B. Fuller Construction Products Inc; Ultimate Large Tile Mortar or Ultraflex LFT: www.tecspecialty.com.
f. Substitutions: See Section 01 6000 - Product Requirements.

2.06 GROUTS

A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.

1. Color(s):
   a. CT1: Mapei; Silver, 27
   b. CT2: Mapei; Silver, 27
   c. CT3A: Mapei; Avalanche, 38
   d. CT3B: Mapei; Charcoal, 47
   e. CT3C: Mapei; Avalanche, 38
   f. CT3D: Mapei; Avalanche, 38
   g. CT4A: Mapei; Avalanche, 38
   h. CT4B: Mapei; Avalanche, 38
   i. CT4C: Mapei; Avalanche, 38
   j. CT4D: Mapei; Avalanche, 38
   k. CT5: Mapei; Avalanche, 38
   l. CT6: Mapei; Pale Umber, 44
   m. CT7: Mapei; Pale Umber, 44
   n. CT8: Mapei; Avalanche, 38
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. LATICRETE International, Inc; SPECTRALOCK Pro Premium or SPECTRALOCK Premium: www.laticrete.com.
   d. MAPEI Corp.; Kerapoxy or Kerapoxy CQ: www.mapei.com
   e. 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.

2.07 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. Tile Trim Type A: TREP-G-B
         1) Brushed Stainless Steel support with non-slip tread
         2) Replacement Tread Color: Black, GS
         3) Application: Stair Nosing
      b. Tile Trim Type B: QUADEC
         1) Application: Outside corners of wall tile.
      c. Tile Trim Type C: RENO-TK
         1) Application: Tile (CT) to Carpet Tile (CPT)
      d. Tile Trim Type D: DILEX-AHKA
         1) Application: Cove Base for Wall Tile (CT) to Polished Concrete (CONCD)
      e. Tile Trim Type E: DECO
         1) Application: Transition from Tile (CT) to Polished Concrete (CONCD)
      f. Tile Trim Type F: Jolly
         1) Application: Tile Top Cap
      g. Other shapes as indicated on Drawings.
   2. Material: Brushed stainless steel, unless otherwise noted.
   3. Applications and Locations:
      a. Open edges of wall tile.
      b. Open edges of floor tile.
      c. Outside wall corners.
      d. Transitions between hard tile and other floor finishes.
      e. Tile perimeters not against a wall or other solid vertical surface.
      f. Other areas as indicated on Drawings.
   4. Manufacturers:
      a. Schluter-Systems: www.schluter.com.

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

2.08 WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. Waterproofing and Crack Isolation Membrane: Elastomeric liquid applied membrane complying with ANSI A118.10 and ANSI A118.12.
   1. Applications: Use at the following locations:
      a. All floor and traffic areas.
      b. Shower walls and floors.
      c. Shower pans and walls.
      d. Other areas as indicated.
   2. Thickness: As recommended by membrane manufacturer.
   3. Crack Resistance: No failure at 1/8 inch gap, minimum.
   4. Membrane system may or may not include fabric reinforcing.
   5. Products:
      a. Without Fabric Reinforcing:
         1) Custom Building Products; RedGard: www.custombuildingproducts.com.
         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. Shower walls and floors.
      c. Other areas as indicated.

C. Bond Coats:
   1. Use latex-portland cement thin-set mortar, unless otherwise indicated.

a. Exceptions:
1) For tiles that have at least one side greater than 15 inches long, use large format tile latex-portland cement medium-bed mortar.
2) For large areas of glass tile, other than accents and bands, use glass tile latex-portland cement thin-set mortar.
b. Bond Coat Color: White or gray.
1) Exception: White at glass tiles.

D. Grout:
1. Use 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. Install thresholds where indicated.

O. Sound tile after setting. Replace hollow sounding units.

P. Keep control and expansion joints free of mortar, grout, and adhesive.

Q. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

R. Grout tile joints unless otherwise indicated.

S. 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.

T. 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 INSTALLATION - SHOWERS AND BATHTUBS - WALLS AND FLOORS

A. Tile on masonry or concrete walls and sloped mortar bed floors, install in accordance with TCNA (HB) Method B421 or B421C as appropriate to substrate conditions.
1. Provide waterproofing and crack isolation membrane.

3.06 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244C .

1. Provide waterproofing and crack isolation membrane in wet areas and elsewhere as indicated.

B. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method W245.
   1. Provide waterproofing and crack isolation membrane where indicated.

C. Over concrete and masonry install in accordance with TCNA (HB) Method W202I.
   1. Provide waterproofing and crack isolation membrane in wet areas and elsewhere as indicated.

3.07 CLEANING

A. Clean tile and grout surfaces.

3.08 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

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SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended acoustical ceilings including:
   1. Metal grid suspension systems.
   2. Open Cell Metal Ceiling
   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 B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019.
E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
F. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
G. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
I. 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.
J. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
K. ASTM E1477 - Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers; 1998a (Reapproved 2022).
L. 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. 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. ACT-1 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:

1. Size: 24 by 24 inches.
   a. Use 24 by 48 inches cut to fit at locations hatched on Reflected Ceiling Plans. Product No. 1714.
2. Thickness: 3/4 inch.
3. Composition: Wet felted.
4. Light Reflectance: 0.82, determined in accordance with ASTM E1264.
5. NRC: 0.70, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.
9. Suspension System: Exposed grid Type SG-1.
10. Products:
    a. Armstrong World Industries, Inc; School Zone Fine Fissured, No. 1713 : www.armstrongceilings.com.

C. ACT-2 Acoustical Panels: Painted faced mineral fiber, ASTM E1264 Type IV, with the following characteristics:
1. Size: 24 by 24 inches.
2. Thickness: 1.75 inches.
3. Composition: Wet felted.
4. Light Reflectance: 0.85 percent, determined in accordance with ASTM E1264.
5. NRC Range: 0.90, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.
9. Suspension System: Exposed grid Type SG-1.
10. Products:
    a. Armstrong World Industries, Inc; CALLA High NRC, No. 2844: www.armstrongceilings.com.

D. ACT-3 Acoustical Panels: Paint faced mineral fiber, ASTM E1264 Type IX, 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.

E. ACT-4 Acoustical Panels: Soil-Resistant Polyester Film faced mineral fiber, ASTM E1264 Type IV, with the following characteristics:
1. Thickness: 3/4 inch.
2. Composition: Wet felted.
3. Light Reflectance: 0.79 percent, determined in accordance with ASTM E1264.
4. NRC Range: 0.55, determined in accordance with ASTM E1264.
5. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
6. Edge: Square.
7. Surface Color: White.
8. Suspension System: Exposed grid Type SG-1.
9. Products:
    a. Armstrong World Industries, Inc; Clean Room FL, No. 1715 : www.armstrongceilings.com.

F. ACT-5 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, ASTM E1264 Type IV with the following characteristics:
   1. Sizes:
      a. 24 by 72 inches Calla No. 2864.
         1) Surface Color: White.
      b. 24 by 72 inches Calla No. 2864.
         1) Surface Color: Light Grey.
      c. 24 by 72 inches Calla No. 2864.
         1) Surface Color: Dark Grey
      d. 24 by 72 inches Calla No. 2864.
         1) Surface Color: Custom Color to match Sherwin Williams SW 6381 Anjou Pear.
      e. 24 by 24 inches Calla No. 2820.
         1) Surface Color: White.
      f. 24 by 48 inches Calla No. 2821.
         1) Surface Color: White.
      g. 48 by 48 inches Calla Custom Size.
         1) Surface Color: White.
   2. Thickness: 1 inch.
   3. Composition: Wet felted.
   4. Light Reflectance: 0.85 percent, determined in accordance with ASTM E1264.
   5. NRC Range: 0.85, determined in accordance with ASTM E1264.
   6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
   7. Edge: Square.
   8. Surface Color: White.
   9. Suspension System: Exposed grid Type SG-1.
   10. Products:
      a. Armstrong World Industries, Inc; CALLA Square Lay-In Smooth Surface Design Flex: www.armstrongceilings.com.

G. ACT-6 Acoustical Panels: FilaSorb 100% Polyester Panel with the following characteristics:
   1. Size: 24 by 72 inches.
   2. Thickness: 12 mm
   3. Composition: 100% Polyester
   4. NRC Range: 0.45, determined in accordance with ASTM E1264.
   5. Edge: Square.
   6. Surface Color: Baltic Birch.
   7. Surface Print: QuietPrint
   8. Material: FilaSorb
   9. Suspension System: Exposed grid Type SG-1.
   10. Products:
      a. Acoufelt, Printed Ceiling Tile - Filasorb 12: www.acoufelt.com

H. **ACT-7: Not Used. **ADD4****

I. **ACT-8: Acoustical Panes: Paint faced mineral fibers, ASTM E1264 Type XII with the following characteristics: **ADD4****
   1. **Size: 24 by 96 inches.**
   2. **Thickness: 0.75 inch.**
   3. **Composition: Fiberglass**
   4. **NCR: 0.90**
   5. **Edge: Square**
   6. **Surface Color: White.**
   7. **Suspension System: Exposed grid Type SG-1.**
   8. **Products:**
      a. **Armstrong World Industries, Inc.; Optima Square Lay-In, No. 3162: www.armstrongceilings.com**

2.03 OPEN CELL METAL CEILING

A. OCMC Acoustical Panels
   1. Surface Texture: Open Cell.
   2. Composition: Metal.
   3. Color: White.
   4. Size: 24 inches X 24 inches.
   5. Edge Profile: Square Lay-in 9/16" for interface with SUPRAFINE XL 9/16" Exposed Tee Grid.
   6. Perforation Option: Open Cell.
   7. Flame Spread: ASTM E1264 ; Class A.
   8. Light Reflectance (LR) White Panel: ASTM E1477.
   9. Dimensional Stability: Standard.
   10. Recycle Content:
      a. Post-Consumer: 20 percent.
      b. Pre-Consumer: 0 percent.
   11. Products:
      a. Armstrong World Industries; METALWORKS Open Cell, 6194M1, www.armstrongceilings.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 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. USG Interiors, LLC; USG Donn Brand DX: www.usg.com.

C. SG-2 Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
   1. Profile: Tee; 9/16 inch wide face.
   2. Construction: Double web.
   3. Finish: White painted.
   4. Products:
      a. Armstrong World Industries, Inc; Suprafine: www.armstrongceilings.com.
      b. USG Interiors, LLC; USG Donn Brand Centricitee DXT: www.usg.com.

2.05 FASCIA TRIM

A. Fascia Trim: Metal fascia trim for free form ceiling drops and open edges of metal grid suspension systems.
   1. Material: Extruded aluminum; ASTM B221, in alloy and temper as recommended by trim manufacturer.
   2. Finishes:
      a. FT1A: White
      b. FT1B: Custom color to match Sherwin Williams SW 6108 Latte
      c. FT1C: Custom color to match Sherwin Williams SW 6381 Anjou Pear
   3. Trim Height: As indicated.
   4. Products:
      a. Armstrong World Industries, Inc; Axiom Classic: www.armstrongceilings.com.
      b. USG Interiors, LLC; Compasso Elite: www.usg.com.

2.06 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 prefabrcated corner mouldings.
   3. At Bullnose Corners: Provide radius corner moldings to match bullnose radius of adjacent walls.
   4. **Teg Tabs are not acceptable.**

D. Transition Molding for transition between Acoustical Ceiling and Gypsum Board Ceiling with no elevation change.
   1. One-piece acoustical wall modling with an integrated gypsum board taping flange.
   2. Height: 1.25 inch, minimum.
   3. Exposed Width: Match width of suspension system grid.
   4. Color: White
   5. Products:
      a. Armstrong World Industries, Inc; AXIOM Transitions Exposed Tee : www.armstrongceilings.com.
      b. USG Interiors, LLC; Donn Brand Transition Molding: www.usg.com.

E. Touch-up Paint: Type and color to match acoustical and grid units.

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; 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 REMOVAL, SALVAGING, AND REINSTALLATION OF EXISTING SUSPENDED ACOUSTICAL CEILINGS

A. Remove, salvage and reinstall existing acoustical panels and suspension system as required to facilitate new construction.
1. Take care not to scratch, chip, gouge, dent or otherwise damage acoustical panel faces or edges.
2. Take care not to scratch, bend, dent, twist, rack or otherwise damage suspension grid members.
3. Safely store removed materials and protect from damage.
B. Modify existing grid system and acoustic panels to accommodate new work.
C. Reinstall according to requirements of this Section for new work.
D. Replace any damaged or missing grid with new.
1. Match existing grid system in size, color, texture, and material.
E. Replace any damaged or missing acoustical panels with new.
1. Match existing acoustical panels in size, color, texture, and material.

3.04 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.

3.05 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. **Where called for on drawings: **ADD4**** Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions, unless otherwise indicated.

H. **Where called for on drawings: **ADD4**** Lay acoustical insulation continuously across top of acoustical panel ceiling system without gaps where indicated.

3.06 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 5426 - SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood grilles.
B. Metal suspension system. Refer to Section 09 5100 - Acoustical Ceilings.
C. Section 09 5100 - Acoustical Ceilings: Metal suspension systems.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
B. CISCA (WC) - Wood Ceilings Technical Guidelines; 2009.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure ceilings are not installed until building is enclosed, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install 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, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
C. Product Data: Provide data on wood ceiling components and suspension system components.
D. Samples: Submit three six by six inch samples illustrating material and finish of wood ceiling components.
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. Wood Ceiling Components: Provide a quantity equal to 2 percent of total product installed.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least five years documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.
B. Store in fully enclosed space, flat, level and off the floor.

1.07 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspended Wood Ceilings:
   1. 9Wood: www.9wood.com/#sle.
   2. Armstrong World Industries, Inc: www.armstrongceilings.com/#sle.
   3. Certainteed Architectural: www.certainteed.com/ceilings-and-walls/#sle.
   4. Rulon International: www.rulonco.com/#sle.
   5. USG Corporation: www.usg.com/ceilings/#sle.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:

1. Design for maximum deflection of 1/360 of span.
2. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.

B. Wood-Based Materials:
1. Solid Wood: Clear, dry, sound, plain sawn, selected for compatible species, grain and color, no defects.

C. Wood Grilles: Pre-assembled module of solid wood grilles with battens.
1. Module Size: 12 by 96 inches by 2-3/4 inches, nominal.
2. Grille Size: 1 inch width by 2-1/4 inch depth.
3. Grille Spacing: 4 slats per 12 inches.
4. Grille Orientation: Vertical
5. Mounting: Batten and Dowel
6. Acoustical Backer: Polyester Felt, 1/32 inch thick.
   a. Color: Black.
7. Solid Wood Species: Maple.
   a. Factory Finish: Clear sealer.
8. Attachment to Suspension Grid: Manufacturer's recommended method according to panel product selected.
9. Suspension System: See Section 09 5100.
10. Products:
    a. 9Wood; Wood Ceiling Grilles 1000 Series: www.9wood.com/products/grilles/#sle.
    b. Armstrong World Industries, Inc; WOODWORKS Grille Tegular : www.armstrongceilings.com/#sle.
    c. Certainteed Architectural; Wood - Grille Modules: www.certainteed.com/ceilings-and-walls/#sle.
    d. USG Corporation; True Wood Grilles: www.usg.com/ceilings/#sle.
    e. Substitutions: See Section 01 6000 - Product Requirements.

D. Metal Suspension System - Refer to Section 09 5100 - Acoustical Ceilings.

2.03 FABRICATION

A. Shop fabricate wood ceiling components to the greatest extent possible.

B. Fabricate components to allow access to ceiling plenum as required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

3.02 PREPARATION

A. Coordinate the location of hangers with other work.

B. Layout wood ceiling components in pattern according to reflected ceiling plan and as shown on shop drawings.

C. Acclimate wood ceiling materials by removing from packaging in installation area a minimum of 48 hours prior to installation.

3.03 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Wood Ceiling:
1. Install wood ceilings in accordance with manufacturer's instructions.
2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
3. Install components in uniform plane, and free from twist, warp, and dents.
4. Cut to fit irregular grid and perimeter edge trim.
5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.

6. Install acoustical backer above wood ceiling components; fit tight between grid members.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

3.05 CLEANING

A. Clean and touch up minor finish damage. Remove and replace components that cannot be successfully cleaned and repaired.

END OF SECTION

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SECTION 09 6466 - WOOD ATHLETIC FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wood gymnasium flooring systems [WD1].

1.02 RELATED REQUIREMENTS

A. Section 09 0561 - Common Work Results for Flooring Preparation: Independent agency testing of concrete slabs.

1.03 DEFINITIONS

A. NFHS; National Federation of State High School Associations.

1.04 REFERENCE STANDARDS

A. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
B. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications; 2016.
C. ASTM F2772 - Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems; 2011 (Reapproved 2019).
D. DIN 18032 P2 - Sport Halls; Halls for Gymnastics and Games; Floors for Sporting Activities; Requirements, Testing; 2001.
E. MFMA (PUR) - Performance and Uniformity Rating Sport Specific Standards; current edition.
F. MFMA (SPEC) - Guide Specifications for Maple Flooring Systems; current edition.
G. NFHS (Guide) - Court and Field Diagram Guide; current edition.
H. MFMA Position Statement 24 - Maple Floors With Multiple Sport Game Lines.
I. MFMA-RL - MFMA Random Length Strip.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Volleyball Inserts: Coordinate locations.

1.06 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for flooring, floor finish materials, and resilient cushion.
    1. Include color charts of colors and glosses available for the following:
        a. Floor finishes.
        b. Game-line, logo, and marker paints.
C. Shop Drawings: Indicate floor joint pattern and termination details.
    1. Indicate provisions for expansion and contraction, wall base, and game insert or socket devices.
    2. Indicate size and type fasteners and anchors.
    3. Show resilient pad layout and spacing.
    4. Indicate location, size, design, and color of game-lines, markings, and logos.
D. Samples: Submit 3 samples 12 by 12 inch in size illustrating floor construction, floor finish, color, and sheen.
    1. Include 3 samples of vented base, 6 inches long for each color selected.
E. Maintenance Data: Include maintenance procedures and recommended maintenance materials.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

1.07 QUALITY ASSURANCE

A. Perform work of this section in accordance with MFMA (SPEC).

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
   1. Minimum 5 years of documented experience.
   2. Member mill of the Maple Flooring Manufacturers Association, Inc (MFMA).
C. Installer Qualifications: Company specializing in installing products specified in this section.
   1. Minimum 5 years of documented experience.
   2. MFMA accredited and approved by flooring manufacturer.
D. Provide flooring system components by single manufacturer.

1.08 MOCK-UP

A. Construct mock-up of wood athletic flooring including subflooring, resilient cushioning, and wood flooring. Illustrate final finish and include example of painted game lines.
   1. Provide when requested by Architect.
B. Size of mock-up to be not less than 8 feet long by 8 feet wide.
C. See Section 01 4000 - Quality Requirements for additional requirements.
D. Mock-up may remain as part of the work.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and store off the floor in a well-ventilated, weather-tight space.

1.10 FIELD CONDITIONS

A. Do not install wood flooring until wet construction work is complete and permanent heat and air conditioning is installed and operating.
B. Maintain room temperature between 55 degrees F and 75 degrees F and relative humidity between 35 to 50 percent for a period of seven days prior to delivery of materials to installation space, during installation, and after installation.
C. Acclimate wood flooring materials to installation space a minimum of 48 hours prior to installation.

PART 2 PRODUCS

2.01 MANUFACTURERS

A. WD1Wood Athletic Flooring - Fixed Resilient Floor System
   1. Basis-of-Design: Connor Sports Flooring, Inc.; Rezillchannel: www.connorsports.com. Provide either the named product or a comparable product by one of the following:
      a. Action Floor Systems, LLC; ChannelFlex Ultra F Series: www.actionfloors.com.
      b. Horner Sports Flooring; CRP: www.hornerflooring.com.
      c. Robbins Sports Surfaces; Bio-Channel Star: www.robbinsfloor.com.
      d. Substitutions: Section 01 6000 - Product Requirements.

2.02 WOOD ATHLETIC FLOORING

A. General: Wood strip flooring.
B. Application: Gymnasium.
C. Performance Requirements: Comply with the following:
   1. MFMA (PUR).
   2. DIN 18032 P2.
   3. ASTM F2772.
D. System Description:
   1. Fixed, pre-engineered subfloor anchored using channels, wood strip flooring.
   2. Overall System Depth: 2-1/8 or 2-1/4 inches; coordinate with manufacturer.
      a. Coordinate concrete slab depression with Section 03 3000 - Cast-in-Place Concrete.

2.03 COMPONENTS

A. Wood Strip Flooring:
   1. Species: Northern hard maple, kiln dried; tongue and groove edges, end matched.
   2. Grade: Second and better.
   3. Cut: Flat grain.

4. Moisture Content: 7 to 9 percent.
5. Thickness: 25/32 inch.
6. Width: 2-1/4 inches.
7. Length: Random, minimum of 9 inches, maximum of 8 feet; finger jointed lengths not permitted. Comply with MFMA Random Length Strip standard, MFMA-RL.

B. Subflooring: Two layers of 15/32 inch thick plywood, APA rated, exposure 1, minimum span rating of 32/16.

C. Subflooring: Manufacturer's standard pre-engineered subfloor suitable for system indicated.
1. Material: Manufacturer's standard two-layer plywood construction.
2. Resilient Cushioning: Manufacturer's standard pads, continuous pad strips, or continuous pads. Factory-applied to bottom of subflooring unless otherwise recommended by manufacturer.
a. Thickness: 1/2 inch.
b. Spacing: As recommended by manufacturer.

D. Channels: Galvanized steel, manufacturer's standard size and shape for system indicated.
1. Minimum Thickness: 0.060 inch (16 gage).

E. Resilient Cushioning: Manufacturer's standard two stage rubber pads, factory-applied to bottom side of subflooring.
1. Thickness: 3/4 inch.
2. Durometer: Shore D 70; ASTM D2240.
3. Spacing: As recommended by manufacturer.

F. Vapor Retarder: Polyethylene sheet, 6 mil thick, ASTM D4397; 2 inch wide tape for sealing sheet seams.
1. Products:
a. Fortifiber Corporation; Moistop Ultra 6: www.fortifibeer.com.
b. Raven Industries Inc.; VaporBlock VB6: www.ravenefd.com.
c. Stego Industries, LLC; Stegocrawl Wrap 6-mil Vapor Retarder: www.stegoindustries.com.
d. Substitutions: Section 01 6000 - Product Requirements.

G. Fasteners and Anchors: Manufacturer's standard type and size to suit application.

2.04 FINISHES

A. Floor Finishes: Types recommended by flooring manufacturer and MFMA approved.
1. Sealer: Oil-modified urethane.
a. Products:
1) Bona US; Bona Sport Seal 350; www.www.bona.com.
2) Substitutions: Section 01 6000 - Product Requirements.
2. Finish Coats: Water based polymeric resin; high gloss.
a. Products:
1) Bona US; Bona SuperSport HD; www.www.bona.com.
2) Substitutions: Section 01 6000 - Product Requirements.
3. Game Marking Paint: Compatible with sealer and finish coats. Water based polymer.
a. Products:
1) Bona US; Bona SuperSport Paint; www.www.bona.com.
2) Substitutions: Section 01 6000 - Product Requirements.
b. Colors: Up to 4 colors, unless otherwise indicated.
1) Colors as selected by Architect; may be custom colors.
4. Stain: Compatible with sealer and finish coats. Penetrating and nonfading type; semi-transparent.
a. Products:
1) Bona US; DriFast Stain; www.www.bona.com.
2) Substitutions: Section 01 6000 - Product Requirements.
b. Colors: Up to 1 color(s), unless otherwise indicated.

1) Colors as selected by Architect; may be custom colors.

B. Game Lines, Logos, and Miscellaneous Markings:
1. Game Lines: Provide game lines as indicated on Drawings and as follows:
a. Comply with the following court layout diagrams, unless otherwise indicated:
1) NFHS high school basketball court diagram; NFHS (Guide).
2) NFHS high school volleyball court diagram; NFHS (Guide).
b. Floors with Multiple Sports: Comply with MFMA Position Statement 24.
1) Primary Sport: Basketball.
2) Secondary Sport: Volleyball.
2. Logos and Miscellaneous Markings: Provide logos and other graphic artwork as indicated.

2.05 ACCESSORIES

A. VBVented Resilient Base: Molded rubber, 4 inch high with a 3 inch toe, pre-molded outside corners; black color.
1. Manufacturers: Provide products from one of the following:
a. Johnsonite, a Tarkett Company: www.johnsonite.com.
b. Substitutions: See Section 01 6000 - Product Requirements.

B. Adhesives: Types recommended by flooring manufacturer.

C. Subfloor Filler: Trowelable leveling and patching compound; latex-modified, hydraulic-cement-based formulation.
1. Products:
a. Ardex Engineered Cements; Ardex Feather Finish: www.ardexamerica.com. .
b. Custom Building Products; Skim Coat & Patch Cement Underlayment; www.custombuildingproducts.com.
c. TEC, an H.B. Fuller Construction Products Brand; Feather Edge Skim Coat with Patch Additive: www.tecspecialty.com.
d. Substitutions: Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.

B. Verify that concrete subfloor surface is smooth and flat to plus or minus 1/8 inch in 10 feet.

C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

3.02 PREPARATION

A. Prepare substrate to receive wood flooring in accordance with manufacturer's and MFMA instructions.
1. Concrete: Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.

B. Vacuum clean substrate.

3.03 INSTALLATION

A. General:
1. Install wood gymnasium flooring systems in accordance with manufacturer's and MFMA instructions.

B. Place vapor retarder over concrete surface, overlap seams a minimum of 6 inches and seal with tape.

C. Resilient Underlayment:
1. Install pre-engineered subfloor perpendicular or diagonal to direction of finished floor with staggered joints in brick pattern, resilient pad side down,
2. Allow 1/4 inch between plywood subfloor edges unless otherwise recommended by flooring manufacturer.

3. Secure pre-engineered subfloor panels to concrete subfloor with metal channels; attach channels to concrete as recommended by flooring manufacturer.

D. Double Layer Plywood Subfloor:
1. Place first layer at 90 degree angle to direction of finished floor, resilient pad side down.
2. Fasten second layer (without pads) at 45 degree angle to first layer.
3. Allow 1/4 inch between plywood subfloor edges.

E. Install solid blocking at doorways, under stacked bleachers, under locations of heavy equipment, and as shown on drawings, in accordance with flooring manufacturer's recommendations.

F. Wood Flooring:
1. Lay flooring parallel to length of main playing area. Blind nail or staple to subfloor.
2. Install edge strips at unprotected or exposed edges, and where flooring terminates.
3. Provide 2 inch expansion space at walls and other interruptions.

G. Install vented resilient base at floor perimeter to cover expansion space in accordance with manufacturer's instructions. Miter inside corners.
1. Install after finishing floors.

H. Door Thresholds: Refer to Section 08 7100 - Door Hardware.

I. Install floor sockets, inserts, and cover plates to a depth sufficient to ensure flush top surface with floor surface.
1. Volleyball Inserts: Coordinate locations with Section 11 6623 - Gymnasium Equipment.

J. Finishing:
1. Mask off adjacent surfaces before beginning sanding.
2. Sand flooring to smooth even finish with no evidence of sander marks. Remove dust by vacuum.
3. Apply finishes in accordance with floor finish manufacturer's and MFMA instructions.
4. Apply the following number of coats in sequence indicated unless otherwise recommended by floor finish manufacturer.
   a. Apply 1 coat of stain, where indicated.
   b. Apply 2 coats of sealer.
   c. Apply game lines and logos; 2 coats.
   d. Apply 2 finish coats.
5. Between coats, buff or abrade flooring as recommended by floor finish manufacturer, clean, and vacuum or tack flooring.
6. Game lines and logos shall have sharp defined edges.

3.04 CLEANING

A. Clean floor surfaces in accordance with floor finish manufacturer's instructions.
1. Complete final cleaning of floor not more than 5 days prior to Substantial Completion.

3.05 PROTECTION

A. Prohibit traffic on finished floor for 72 hours after installation.

B. After cleaning, place protective coverings over finish floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION

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SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient sheet flooring.
B. Resilient tile flooring.

1.02 REFERENCE STANDARDS

A. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2021a.
B. ASTM F1516 - Standard Practice or Sealing Seams of Resilient Flooring Products by Heat Weld Method (when Recommended); 2018.
C. ASTM F1913 - Standard Specification for Vinyl Sheet Floor Covering Without Backing; 2019.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate seaming plans and floor patterns.
D. Verification Samples:
   1. Resilient Sheet Flooring: Submit 3 samples, 6 by 9 inch in size for each color and pattern specified.
   2. Resilient Tile Flooring: Submit 3 samples, full size, for each color and pattern specified.
E. Sustainable Design Submittal: Submit VOC content documentation for flooring and adhesives.
F. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Flooring Materials: Quantity equal to 2 percent of total installed, but not less than one box or roll for each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum 5 years documented experience.
B. Installer Qualifications: Company specializing in installing specified flooring with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

A. RSF1Vinyl Sheet Flooring: Homogeneous without backing, with color and pattern throughout full thickness.
   1. Products:
      a. Protect-All; Kitchen Flooring: www.protect-allflooring.com.

b. Substitutions: Not permitted.
2. Minimum Requirements: Comply with ASTM F1913.
3. Thickness: 0.25 inch nominal.
4. Sheet Width: 60 inch minimum.
5. Seams: Heat welded.
6. Color: Designer Series, Graphite Ultra, Matte.
7. Base: Flash Coved Base (6") with Stainless Steel Cove Cap
8. Trim: Provide all necessary trim to complete installation.

B. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color unless otherwise indicated.

2.02 TILE FLOORING

A. RFT1Rubber Tile: Homogeneous, color and pattern throughout thickness.
1. Products:
a. Nora; Norament Pado: www.nora.com.
b. Substitutions: Not permitted.
2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Size: 39.53 by 39.53 inch nominal.
4. Total Thickness: 3 mm.
5. Installation Pattern: As indicated on Drawings.
6. Colors: .
a. RTF1A Moon Mist, 5511.
b. RTF1B Concrete, 5505.
c. RTF1C Spearmint, 5512.

B. RFT2Rubber Tile: Homogeneous, color and pattern throughout thickness.
1. Products:
a. Nora~~; Norament Sentica Ed:~~ **Noraplan Sentica **ADD4**** www.nora.com.
b. Substitutions: Not permitted.
2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Size: 24.015 by 24.015 inch nominal.
4. Total Thickness: 3 mm.
5. Texture: Smooth.
6. Installation Pattern: As indicated on Drawings.
7. Colors: .
a. RTF2 Road Trip, 6523.

C. RFT3 Rubber Tile: Homogeneous, color and pattern throughout thickness.
1. Products:
a. Nora; Norament Satura: www.nora.com.
b. Substitutions: Not permitted.
2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Size: 39.53 by 39.53 inch nominal.
4. Total Thickness: 3 mm.
5. Texture: Hammered.
6. Installation Pattern: As indicated on Drawings.
7. Colors: .
a. RTF3A Castor, 5111.
b. RTF3B Titan, 5112.
c. RTF3C Venus, 5123.

D. The following information pertains to all egress stairs:
1. RFT3B, Nora Satura, Titan 5112

a. Cold Weld at seams
1) Color: Match Titan 5112
2. Refer to Section 09 6513 Resilient Wall Base and Accessories for Mechanically Fastened Nosing

2.03 ACCESSORIES

A. Subfloor Filler: Cement based rapid drying smoothing and finishing compound; type recommended by adhesive manufacturer. Moisture resistant, Low VOC.
B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
C. Filler for Coved Base: Plastic.
D. Sealer and Wax: Types recommended by flooring manufacturer.
1. Coordinate selection of products with Owner's maintenance service.
E. Floor Moldings, Stair Coverings, and Resilient Base: Refer to Section 09 6513 - Resilient Bases and Accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
B. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Prohibit traffic until filler is fully cured.
C. Clean substrate.
D. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.03 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install in accordance with manufacturer's written instructions.
C. Adhesive-Applied Installation:
1. Fully adhere resilient floor finishes to substrates using a full spread of adhesive completely covering substrate.
2. Spread only enough adhesive to permit installation of materials before initial set.
3. Fit joints and butt seams tightly.
4. Set flooring in place, press with heavy roller to attain full adhesion.
D. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
F. Install flooring in recessed floor access covers, maintaining floor pattern.
G. At movable partitions, install flooring under partitions without interrupting floor pattern.
H. Coordinate with Section 09 6513 - Resilient Bases and Accessories for installation of floor moldings, stair coverings, and resilient base.

3.04 INSTALLATION - SHEET FLOORING

A. Installed sheet flooring shall be without open cracks, raising and puckering at joints, bubbling, telegraphing of adhesive spreader marks, and other imperfections.

B. Unless otherwise indicated lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
C. Install resilient sheet flooring in floor patterns indicated on Drawings.
D. Cut sheet at seams in accordance with manufacturer's instructions.
E. Seal seams by heat welding per ASTM F1516.
   1. Permanently fuse joint together using welding rod.
   2. Finish seams flush with adjacent flooring material.
F. Coved Base: Install as detailed on drawings, using coved base filler as backing at floor to wall junction. Extend sheet flooring vertically to height indicated, and cover top edge with metal cap strip.

3.05 INSTALLATION - TILE FLOORING

A. Mix tile from containers to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
B. Installed floor tile shall be without open cracks, bubbling, telegraphing of adhesive spreader marks, and other imperfections.
C. Install resilient tile in floor patterns indicated.
D. Where no patterns are indicated, lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.06 CLEANING

A. Remove excess adhesive from floor surfaces without damage.
B. Clean, seal, and wax in accordance with manufacturer's written instructions.
   1. Seal resilient floor finishes only when recommended by resilient floor finish manufacturer.
   2. Wax resilient floor finishes only when recommended by resilient floor finish manufacturer.
      a. Apply not less than two coats as recommended by manufacturer.
   3. Do not seal or wax luxury vinyl tile.
C. Clean resilient flooring not more than 5 days prior to Substantial Completion in accordance with resilient flooring manufacturer's instructions

3.07 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.
B. After cleaning, place protective coverings over finish floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION

SECTION 09 6513 - RESILIENT BASES AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.
B. Stair coverings.
C. Floor moldings.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
C. Shop Drawings: Indicate seaming plans and floor patterns.
D. Verification Samples:
   1. Resilient Base, Floor Moldings, and Stair Coverings: Submit 3 samples, 12 inches long illustrating color, pattern, and profile for each accessory specified.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Base: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.
   3. Extra Stair Covering Materials: Quantity equal to 2 percent of total installed, but not less than 8 linear feet for each type and color.
   4. Extra Floor Moldings: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified resilient accessories with minimum 5 years documented experience.
B. Installer Qualifications: Company specializing in installing specified resilient accessories with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
B. Store all materials off of the floor in an acclimatized, weather-tight space.
C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
D. Protect roll materials from damage by storing on end.
E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. RB1 Resilient Base: ASTM F1861, Type TP, rubber, thermoplastic; top set Style B, Cove.
   1. Manufacturers: Provide products from one of the following:
      a. Armstrong Flooring Inc.: www.armstrongflooring.com.
      b. Burke Flooring: www.burkeflooring.com.
      c. Johnsonite, a Tarkett Company: www.johnsonite.com.

d. Roppe Corp: www.roppe.com.
e. Substitutions: See Section 01 6000 - Product Requirements.
2. Height: 4 inch.
3. Thickness: 0.125 inch.
4. Finish: Satin.
5. Length: Roll.
6. Colors: .
a. RB1A Grey, WG.
b. RB1B Charcoal, WG.

2.02 FLOOR MOLDINGS

A. Floor Moldings: Resilient edge and transition strips for changes in flooring materials.
1. Manufacturers:
a. Armstrong Flooring Inc.: www.armstrongflooring.com.
b. Burke Flooring: www.burkeflooring.com.
c. Johnsonite, a Tarkett Company: www.johnsonite.com.
d. Roppe Corp: www.roppe.com.
e. Substitutions: See Section 01 6000 - Product Requirements.
2. Material: Rubber
3. Profiles: As standard with manufacturer and as appropriate for floor finishes, unless otherwise indicated.
4. Provide floor moldings at the following locations unless otherwise indicated:
a. Open perimeters of resilient flooring; reducer strips.
b. Open perimeters of carpeting; edge guards.
c. Changes in floor finishes from resilient flooring to carpeting; transition strips.
d. Other areas as indicated or required for complete floor finish installations.
5. Colors: Grey, WG.

2.03 ACCESSORIES

A. Primers and Adhesives: Waterproof; types recommended by accessories manufacturer.
B. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to stair covering manufacturer, free of cracks that might telegraph through stair coverings, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of stair coverings to substrate.
B. Verify that surfaces are flat, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of floor moldings to substrate.
C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

A. Clean substrates.

3.03 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's written instructions.
B. Adhesive-Applied Installation:
1. Fully adhere resilient base, stair coverings, and floor moldings, to substrates using a full spread of adhesive completely covering substrate.
2. Spread only enough adhesive to permit installation of materials before initial set.
3. Fit joints and butt seams tightly.
C. Install floor moldings at unprotected or exposed edges, where flooring terminates, and where indicated.
1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Install with minimal amount of joints; tops of adjacent pieces shall be aligned.
C. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
D. Install base on solid backing. Bond tightly to wall and floor surfaces.
E. At masonry and other irregular substrates fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
F. Scribe and fit to door frames and other interruptions.

3.05 INSTALLATION - STAIR COVERINGS

A. Install stair coverings in one piece for full width and depth of tread, where possible.
B. Adhere over entire surface. Fit accurately and securely.
C. Use filler as recommended by stair covering manufacturer to fill substrates that do not conform tightly to stair covering contours.

3.06 INSTALLATION - FLOOR MOLDINGS

A. Install floor moldings in one piece for full width of installation, where possible.
B. Where joints are unavoidable, fit tightly together and align adjacent molding profiles.
C. Adhere over entire surface. Fit accurately and securely.

3.07 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

3.08 PROTECTION

A. Prohibit traffic on resilient stair coverings and floor moldings for 48 hours after installation.

END OF SECTION

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SECTION 09 6813 - TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2019a, with Editorial Revision (2020).
C. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
D. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
C. Shop Drawings: Indicate layout of joints, direction of carpet pile, and location of edge moldings .
D. Verification Samples:
   1. Carpet Tile: Submit 3 samples, full size, for each color and pattern specified.
E. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Carpet Tiles: Quantity equal to 2 percent of total installed, but not less than one box for each type and color.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum 5 years documented experience.
B. Installer Qualifications: Company specializing in installing carpet tile with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

A. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.06 EXTRA MATERIALS

A. Deliver stock of maintenance materials to Owner. Furnish maintenance materials from same manufactured lot as materials installed and enclosed in protective packaging with appropriate identifying labels.
   1. Carpet Tile Flooring: Furnish not less than one box for each 50 boxes or fraction thereof, for each type, color, pattern, and size installed.

PART 2 PRODUCTS

2.01 MATERIALS

A. CPT1Tile Carpeting:
   1. Product:
      a. Forbo Flooring System; Coral Brush Tile: www.forbo.com/flooring/en-us/.
      b. Substitutions: Not permitted.
   2. Construction: Tufted, manufactured in one color dye lot.
   3. Tile Size: 50 x 50 cm, nominal.
   4. Color:
      a. CPT1 Hurricane Grey, 5721.

5. Installation Pattern: Vertical Ashlar.
6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
8. Fiber Content: Econyl 100%-regenerated yarn.
9. Secondary Backing Material: EVERFORT vinyl.

B. CPT2Tile Carpeting:
1. Product:
   a. Forbo Flooring Systems; Flotex, Montage Planks: www.forbo.com/flooring/en-us/.
   b. Substitutions: Not permitted.
2. Construction: Flocked high performance carpet tile.
3. Tile Size: 39.37 by 9.48 inch, nominal.
4. Color: Custom Colors
   a. CPT2A Field, INCT5897T9d-8-.
   b. CPT2B Yellow, INCT5867Q9c-8-.
   c. CPT2C Red, INCT5897S9c-8-.
   d. CPT2D Orange, INCT5897Z9b-8-
   e. CPT2E Green, INCT5897P9c-8-
   f. CPT2F Blue, INCT5897R9c-8-
   g. CPT2G Teal, INCT5897T9b-8-
5. Installation Pattern: Half-drop, as indicated on drawings
6. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
8. Fiber Content: 100% polyamide 6.6.
9. Gage: 5.3 mm (0.21) inch.
10. Primary Backing Material: Recycled vinyl cushioned backing.
11. Manufacturer's Rep: Stephanie Gutowsky, stephanie.gutowsky@forbo.com, (248) 385-8805

2.02 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.
C. Floor Moldings, Stair Coverings, and Resilient Base: Refer to Section 09 6513 - Resilient Bases and Accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
1. Test in accordance with Section 09 0561 - Common Work Results for Flooring Preparation.

3.02 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
B. Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
C. Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
D. Vacuum clean substrate.

3.03 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.
B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
C. Blend carpet from different cartons to ensure minimal variation in color match.
D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
E. Install carpet tile in floor patterns indicated.
F. Locate change of color or pattern between rooms under door centerline.
G. Trim carpet tile neatly at walls and around interruptions.
H. Coordinate with Section 09 6513 - Resilient Bases and Accessories for installation of floor moldings, stair coverings, and resilient base.

3.04 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
B. Clean and vacuum carpet surfaces.
C. Complete final cleaning of floor not more than 5 days prior to Substantial Completion.

3.05 PROTECTION

A. After cleaning, protect finish floors from damage until Date of Substantial Completion.

END OF SECTION

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SECTION 09 7200 - WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall coverings.
B. Window Flim

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on wall covering and adhesive.
C. Shop Drawings: Indicate wall elevations with seaming layout.
D. Samples: Submit 3 samples of each wall covering, 8 by 10 inch in size illustrating color, finish, and texture.
E. Test Reports: Indicate verification of flame and smoke ratings, when tested by an agency approved by authority having jurisdiction.
F. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.
G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Wall Covering Materials: 25 linear feet of each color and pattern of wall covering.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.05 MOCK-UP

A. Provide panel, 8 feet wide, full height, illustrating installed wall covering and joint seaming technique.
B. Locate where directed.
C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.
B. Protect packaged adhesive from temperature cycling and cold temperatures.
C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.
B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

PART 2 PRODUCTS

2.01 WALL COVERINGS

A. General Requirements:
   1. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
B. VWC1Wall Covering: Vinyl-coated fabric wall covering.
   1. Products:

a. Gravity Digital Walls; Framework: www.gravitydigitalwalls.com.
b. Substitutions: Not permitted.
2. Color/Pattern: Framework, Oak.
3. Weight: 20 oz/sq yd.
4. Width: 54 inches.
5. Backing: Osnaburg.

C. VWC2 Wall Covering: Vinyl-coated fabric wall covering.
1. Products:
a. Designtex; Custom Wallcovering: www.designtex.com.
b. Substitutions: Not permitted.
c. Sale's Representative: Tanya Romanelli, tromanelli@designtex.com, 810-444-8797
d. Project Reference Number: 30060008, Refer to Designtex Custom Digital Process Guide for installation process
2. Color/Pattern: Custom Pattern.
3. Fiber Content: 100% Vinyl.
4. Weight: 20 ounces/linear yard.
5. Width: 52 inches.
6. Thickness/Gage: 17 mil.
7. Backing: Cotton, Polyester, Non-Woven.

D. VWC3 Wall Covering: Vinyl-coated fabric wall covering.
1. Products:
a. MDC Interior Solutions; Sennett: www.mdcwall.com.
b. Substitutions: Not permitted.
2. Color/Pattern: Sennett, Vineyard TFC1640.
3. Fiber Content: Type II Vinyl.
4. Weight: 20 oz/sq yd.
5. Width: 54 inches.
6. Backing: Osnaburg.
7. Match: Non-reversible straight across match

E. DWF1 Decorative Window Film
1. Products:
a. Designtex; Custom Window Film GF07 Clear Glass Film: www.designtex.com
b. Substitutions: Not permitted.
c. Sale's Representative: Tanya Romanelli, tromanelli@designtex.com, 810-444-8797
d. Project Reference Number: 30060008, Refer to Designtex Custom Digital Process Guide for installation process
2. Color/Pattern: Custom Pattern
3. Film Color: Opaque Gradient to Transparent
4. Design Color: White

F. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

G. Substrate Primer and Sealer: Water-based type recommended by wall covering manufacturer to suit application to substrate. Allows for easy removal of wall coverings.

H. Manufacturer's Representative: Ryan Scott 248-910-5518

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
B. Apply two coats of primer sealer to substrate surfaces in accordance with manufacturer's instructions. Allow to dry. Lightly sand smooth.
C. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
B. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
C. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
D. Butt edges tightly.
E. Horizontal seams are not acceptable, unless otherwsie indicated.
F. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
G. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.
B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

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SECTION 09 8433 - ACOUSTIC WALL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Absorption panels:
   1. Fabric-wrapped, glass-fiber board panels.
   2. Cementitious wood fiber panels.
   3. Polyester felt panels.

1.02 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2022.
B. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
D. ASTM E795 - Standard Practices for Mounting Test Specimens During Sound Absorption Tests; 2016.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Verification Samples: Submit 3 samples of each type and finish of panel specified; 12 by 12 inch, showing construction, edge details, finish, and mounting method.
E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.
B. Installer Qualifications: Company specializing in installing acoustic wall units with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
B. Store units flat, in dry, well-ventilated space; do not stand on end.
C. Protect edges from damage.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
B. For each type of acoustical wall unit, build mockup of typical wall area include a minimum of 2 acoustical wall units. Include typical joint between acoustical wall units. Construct mock-ups of acoustical units at locations indicated by Architect.
   1. Approved mock-ups may remain as part of the Work.

PART 2 PRODUCTS

2.01 FABRIC-WRAPPED GLASS-FIBER BOARD PANELS

A. Drawing Designations: AWP1
   1. Products:
      a. Acoustic Surfaces, Inc; Fabrisorb High Impact: www.acousticalsurfaces.com.

b. Conwed Designscape/Wall Technology, an Owens Corning company; Respond IR Series www.conweddesignscape.com.
c. Decoustics, a Saint-Gobain company; High Impact Resistant Wall Panel (H.I.R. #1): www.decoustics.com.
d. Integrated Interiors, Inc.; 1000 Series Acoustic Panel: www.integratedinteriors.com

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

B. Panel Core: Manufacturer's standard rigid glass-fiber board; complying with ASTM C612.
1. Density: 6 to 7 lb/cu ft.

C. Edges: Perimeter edges reinforced by a formulated resin hardener.
1. Fabrics:
a. AWP1
b. Products:
1) Carnegie Xorel; Meteor 6427; Nexus 6425; Linen 6291: https://carnegiefabrics.com/carnegie-xorel.
2) Substitutions: Not permitted.
3) Manufacturer's Representative: Carol Stewart, 248-860-6936, cstewart@carnegiefabrics.com/
c. Color/Pattern:
1) AWP1A: Nexus 6425, 906 (gray)
2) AWP1B: Meteor 6427, 735 (green)
3) AWP1C: Linen 6291, 10 (light gray)
4) AWP1D: 759 (white)
d. Fiber Content: 100% IFR Xorel.
e. Weight: 12 oz/sq yd.
f. Width: 56 inches.
2. Panel Shape: Flat.
3. Edge Profile: Square.

D. Corner Detail in Elevation: Square, unless otherwise indicated.

E. Nominal Overall Panel Thickness:
1. AWP1: 2 inches.

F. Panel Sizes and Shapes - Width and Height: As indicated on Drawings.

G. Mounting Method: Back mounted with manufacturer's standard metal z-clips.

H. Performance Requirements:
1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
2. Noise Reduction Coefficient (NRC):
a. 2 inch panels: 1.05 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.

I. Drawing Designations: AWP2

J. Products:
1. Carnegie Xorel Artform: www.carnegiefabrics.com/xorel-artform
2. Substitutions: Not permitted.

K. Panel Core: Manufacturer's standard rigid glass-fiber board; complying with ASTM C612.
1. Density: 6 to 7 lb/cu ft.

L. Edges: Perimeter edges reinforced by a formulated resin hardener

M. Fabrics:
1. AWP2
a. Products:
1) Carnegie Xorel; Strie, 6423 and Linen, 6291: https://carnegiefabrics.com/carnegie-xorel.
2) Substitutions: Not permitted.

3) Manufacturer's Representative: Carol Stewart, 248-860-6936, cstewart@carnegiefabrics.com/
b. Color/Pattern:
1) Shape: Ripple Kit (Shape A-F)
(a) AWP2A: Strie, 6423, 817
(b) AWP2B: Linen, 6291, 10
c. Fiber Content: 100% IFR Xorel.
d. Weight: 12 oz/sq yd.
e. Width: 56 inches.

N. Substrate: 3/4 inch Mi-Core
O. Edge Treatment: Bevel and Rolled Edge
P. Insatllation Method: Quick Grab (wall mounted)
Q. Refer to Opportunity #447102, Layout #2 for layout

2.02 CEMENTITIOUS WOOD FIBER PANELS

A. Cementitious Wood Fiber Panels:
1. Drawing Designations: WFP1
2. Products:
a. Armstrong World Industries, Inc.; Tectum Direct-Attach: www.armstrongceilings.com.
b. Substitutions: See Section 01 6000 - Product Requirements.
3. Composition: Wood fibers bonded with inorganic hydraulic cement.
4. Panel Thickness: 1-1/2 inches.
5. Long Panel Edges: Beveled.
6. Short Panel Edges: Beveled.
7. Panel Sizes Shapes - Width and Height: As indicated on Drawings.
8. Color(s): Field painted; refer to Section 09 9100 Painting
a. WFP1A Sherwin Williams, 7029 Agreeable Gray
b. WFP1B Sherwin Williams, 7030 Anew Gray
c. WFP1C Sherwin Williams, 7674 Peppercorn
d. WFP1D Sherwin Williams, 9133 Jasper Stone
e. WFP1E Sherwin Williams, 6381 Anjou Pear
f. WFP1F Sherwin Williams, 9006 Rojo Dust
9. Mounting Method: Direct-attached; stainless steel screw fasteners of type recommended by manufacturer for applicable substrate.
a. Finish: Color of fastener heads to match panel finish.
b. Mounting Accessories:
1) Furring: Wood, 1-1/2 inches (2 inch nominal) thick.
2) Acoustic Insulation Backing Material: Manufacturer's standard mineral fiber/rock wool; 2.5 pcf density; Flame Spread/Smoke Developed: 0/0 per ASTM E84.
10. Performance Requirements:
a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
b. Noise Reduction Coefficient (NRC):
1) 1-1/2 inches panels: 0.5 when tested in accordance with ASTM C423 for Type A mounting, per ASTM E795.

2.03 FABRICATION

A. Use manufacturer's standard methods of construction; fabricate panels to sizes and configurations as indicated.
B. Provide cutouts for electrical outlets and similar items.
C. Fabric facings shall be installed without sagging, wrinkles, blisters, or visible seams.
1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.

D. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.04 ACCESSORIES

A. Spline-Mounting Accessories: Manufacturer's standard concealed connecting splines of extruded aluminum or plastic designed for screw attachment to walls, with coordinating moldings and trim for miscellaneous conditions.

B. Back-Mounting Accessories: Manufacturer's standard accessories for concealed support, designed to allow panel removal, and as follows:

1. Designed to support full weight of panels and provide lateral support, with one part mechanically attached to back of panel and the other attached to substrate.

C. Furring Strips: Wood furring, minimum 2 inches wide by depths indicated; straight and without significant knots or other defects.

D. Panel Adhesive: Acceptable to acoustical panel manufacturer for application as indicated.

1. Products:
   a. Franklin International, Inc; Titebond GREENChoice Heavy Duty Construction Adhesive; www.titebond.com.
   b. PPG Architectural Coatings; Liquid Nails LN-903 Heavy Duty Construction Adhesive: www.liquidnails.com.
   c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.

B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.

1. Maintain panel joint widths/reveals as indicated

C. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:

1. Plumb and level.
2. Flatness.
3. Width of joints.

3.03 CLEANING

A. Clean acoustical units upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.

B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 8436 - ACOUSTIC CEILING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Baffles:
   1. Cementitious wood fiber baffles.
   2. Polyester felt baffles.
B. Diffuser panels:
   1. Molded diffuser panels.

1.02 REFERENCE STANDARDS

A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2022.
B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's printed data sheets for products specified.
C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
D. Verification Samples: Submit 3 samples of each type and finish of panel specified; 12 by 12 inch, showing construction, edge details, finish, and mounting method.
E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.
B. Installer Qualifications: Company specializing in installing acoustic wall units with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
B. Store units flat, in dry, well-ventilated space; do not stand on end.
C. Protect edges from damage.

1.06 MOCK-UP

A. See Section 01 4000 - Quality Requirements, for additional mock-up requirements.
B. For each type of acoustical ceiling unit, build mockup of typical ceiling area include a minimum of 2 acoustical ceiling units. Construct mock-ups of acoustical units at locations indicated by Architect.
   1. Approved mock-ups may remain as part of the Work.

PART 2 PRODUCTS

2.01 CEMENTITIOUS WOOD FIBER BAFFLES

A. Cementitious Wood Fiber Panels:
   1. Drawing Designations: WFP
   2. Products:
      a. Armstrong World Industries, Inc.; Tectum Baffles: www.armstrongceilings.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.
   3. Composition: Wood fibers bonded with inorganic hydraulic cement.
   4. Panel Thickness: 2 inches.

5. Bottom Edge Profile: Beveled edges.
6. All Other Edges: Square.
7. Corner Detail in Elevation: Square, unless otherwise indicated.
8. Panel Sizes Shapes - Length and Height: As indicated on Drawings.
9. Color(s): Natural. Primed to be Field Painted.
10. Mounting Method: Manufacturer's standard Mounting Method D-20.
    a. Refer to Section 09 2216 Non-Structural Metal Framing for Suspsension systems for interior ceilings and soffits.
    b. Provide additional thin-gauge metal furring as required.
    c. Include cables, clamps, and accessories for complete installation.
11. Performance Requirements:
    a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
    b. Sound Asorption:
        1) 2 inch Panels: 0.5 Sabins/sq. ft. when tested in accordance with ASTM C423.

2.02 POLYESTER FELT BAFFLES

A. Drawing Designations: Acoustic Baffles AB1
B. Products:
    1. Turf Design; Acoustic Ceiling Baffle, Straight: https://turf.design/
    2. Substitutions: See Section 01 6000 - Product Requirements.
C. Composition: Polyethylene terephthalate (PET) plastic with a felt-like appearance.
D. Panel Thickness: 9 mm.
E. Panel Edges: Square.
F. Corner Detail in Elevation: Square, unless otherwise indicated.
G. Panel Sizes and Shapes - Width and Height: As indicated on Drawings.
H. Color(s):
    1. AB1A09 Damascus.
    2. AB1B30 Cyan.
    3. AB1C 26 Faded Denim
    4. AB1D 12 Grasshopper
    5. AB1E 63 Safflower
    6. AB1F 18 Ultisol
I. Mounting Method: Manufacturer's standard Gridlock and Cable to Deck System
    1. Include cables, clamps, and accessories for complete installation; stainless steel material.
J. Performance Requirements:
    1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.03 MOLDED DIFFUSER PANELS

A. Drawing Designations: DFP
B. Products:
    1. Acoustic Surfaces, Inc; Acoustical Diffusor Panels: www.acousticalsurfaces.com.
    2. Conwed Designscape/Wall Technology, an Owens Corning company; Respond www.conweddesignscape.com.
    3. Kinetics Noise Control, Inc.; Geometric Diffusers: www.kineticsnoise.com.
    4. MBI Products Company, Inc; MBI Diffusers: www.mbiproducts.com.
    5. Sound Concepts; Interact Diffusers: www.soundconceptscan.com.
    6. Sound Seal, Inc; Sound Quality Sound Diffusers: www.soundseal.com.
    7. Wenger Corp; Traditional Diffuser Panels: www.wengercorp.com.
    8. Substitutions: See Section 01 6000 - Product Requirements.
C. Construction: Manufacturer's standard, thermo-formed fire-resistant plastic, glass-fiber resin, or fiberglass reinforced gypsum panels.
    1. Material Thickness: 1/8 inch, minimum.

D. Panel Shape:
   1. DFP Barrel.
E. Panel Size:
   1. DFP 48 by 48 inches.
F. Panel Depth: Manufacturer's standard depth.
G. Finish: Provide manufacturer's standard plastic, gel coated, or factory painted finish.
   1. Plastic Finish: Manufacturer's standard textured finish.
      a. Color: White.
   2. Gel Coat: Manufacturer's standard textured finish.
      a. Color: White.
   3. Factory Painted Finish: Manufacturer's standard paint finish.
      a. Color: White.
H. Mounting Method: Install in lay-in suspended grid system.
   1. Refer to Section 09 5100 - Acoustical Ceilings for metal grid suspension system.
I. Performance Requirements:
   1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

2.04 FABRICATION

A. Use manufacturer's standard methods of construction; fabricate panels to sizes and configurations as indicated.
B. Fabric facings shall be installed without sagging, wrinkles, blisters, or visible seams.
   1. Where contoured surfaces or corners are indicated, install fabric to avoid seams or gathering of material.
C. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.05 ACCESSORIES

A. Mounting Hardware - General: Manufacturer's standard hardware designed to support full weight of panels.
B. Ceiling-Suspended Accessories: Manufacturer's standard accessories at locations as indicated on each acoustical unit, sized appropriately for weight of acoustical unit.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install acoustical units in locations as indicated, following manufacturer's installation instructions.
B. Suspend ceiling baffles at locations and heights as indicated
C. Set diffuser panels in metal grid suspension system at locations indicated.
D. Hang suspended panels independent of walls, columns, ducts, pipes and conduit.
   1. Connect hangers directly to structure, inserts, eye screws, or other connections that are secure and appropriate for substrate. Connections shall not deteriorate or corrode.
   2. 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.
      a. Do not attach hangers to metal forms, steel deck tabs, or metal decking.
   3. Install hangers plumb except where required to miss obstructions; brace splayed hangers as required to offset horizontal forces.

4. 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.
5. Size hangers and supplemental supports to support panel loads.
6. Hangers shall not contact adjacent materials within the ceiling plenum.

E. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
1. Plumb and level.
2. Flatness.
3. Width of joints.

3.03 CLEANING

A. Clean acoustical units upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

A. Provide protection of installed acoustical panels until Date of Substantial Completion.
B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Glass.
   9. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
D. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
E. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.03 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.
   4. Manufacturer's installation instructions.
   5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
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.

1.04 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.

1.05 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. 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.

C. Paints:

1. PPG Paints; _____: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company; _____: www.sherwin-williams.com/#sle.

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required 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. Supply each paint material in quantity required to complete entire project's work from a single production run.
4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, brick, fiber cement siding, primed wood, and primed metal.

1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex; MPI #10, 11, 15, 119, or 214.
   a. Products:
      1) PPG Paints Speedhide Exterior Latex, 6-610XI Series, Flat. (MPI #10)
3. Top Coat(s): Exterior Light Industrial Coating, Water Based; MPI #161, 163, or 164.
   a. Products:
      1) PPG Paints Advantage 900 Interior/Exterior Latex, 919-10 Series, Semi-Gloss.

B. Paint E-TR-C - Transparent Finish on Concrete Floors:

1. 1 coat stain.
2. Stain: Solid Color Stain for Concrete.
   a. Products:

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Interior/Exterior Latex Block Filler; MPI #4.
   a. Products:
      1) PPG Paints Speedhide Masonry Hi Fill Latex Block Filler, 6-15XI. (MPI #4)
      2) Sherwin-Williams ConFlex Block Filler. (MPI #4)
      3) Substitutions: Section 01 6000 - Product Requirements.
2. Water Based Primer for Galvanized Metal; MPI #134.
   a. Products:
      1) PPG Paints Pitt-Tech Plus DTM Industrial Primer, 4020 PF Series. (MPI #134)

2) Sherwin-Williams DTM Primer/Finish (MPI #134)
3) Substitutions: Section 01 6000 - Product Requirements.

3. Rust-Inhibitive Water Based Primer; MPI #107.
   a. Products:
      1) PPG Paints Pitt-Tech Plus DTM Industrial Primer, 4020 PF Series.
      2) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer. (MPI #107)
4. Latex Primer for Exterior Wood; MPI #6.
   a. Products:
      1) PPG Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #6)
      2) Sherwin-Williams Exterior Latex Primer, B42W8041. (MPI #6)
      3) 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. Sacrificial Anti-Graffiti Coating: Clear, wax emulsion for coating porous or painted surfaces; capable of being removed from substrate with only hot water.
   1. Products:
      a. DryWired; Anti-Graffiti: www.drywired.com/#sle.
      b. Substitutions: Section 01 6000 - Product Requirements.
C. Patching Material: Latex filler.
D. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of paints and finishes until substrates have been properly prepared.
B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
D. Test shop-applied primer for compatibility with subsequent cover materials.
E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Fiber Cement Siding: 12 percent.
   2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
   3. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.
   4. Concrete Floors and Traffic Surfaces: 8 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 mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
D. Seal surfaces that might cause bleed through or staining of topcoat.
E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
F. Concrete:
G. Masonry:
   1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
   2. Prepare surface as recommended by top coat manufacturer.

H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

J. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

K. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

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 exterior 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.
1. Small affected areas shall be touched up.
2. Large affected areas shall be repainted.
3. Small and large areas shall be as defined by the Architect.
4. Areas without sufficient dry film thickness shall be repainted.
5. Paint runs and sags shall be removed by scraper or sanding and repainted.

3.05 CLEANING

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

3.06 PROTECTION

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

END OF SECTION

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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. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
D. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).

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 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.

1.06 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. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

D. Primer Sealers: Same manufacturer as top coats.

E. Substitutions: Not permitted.

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, concrete masonry units, wood, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
2. Drawing Designation: PT
3. Top Coat(s): Interior Latex; MPI #43, 52, 53.
   a. Products:
      1) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat B30W12651 (MPI #53).
      2) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
      3) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eggshell. (MPI #52)
4. 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 .
5. 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 doors, door frames, railings, handrails, guardrails, and balustrades.
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 Pre-Catalyzed Waterbased Epoxy, K46W01151 Semi-Gloss. (MPI #141)
4. Top Coat(s): Interior Light Industrial Coating, Aluminum, Ferrous Metal Galvanized Steel except Steel Door and Frames Water Based; MPI #153.
   a. Products:
      1) Sherwin-Williams Pro Industrial DTM Acrylic Semi-Gloss, B66W01150 Series. (MPI #153)
5. Top Coat Sheen:
   a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.

C. Paint I-OP-MD-WC - Medium Duty Vertical: Including gypsum board and concrete masonry units.
   1. Two top coats and one coat primer.
   2. Drawing Designation: EP
   3. Top Coat(s): High Performance Architectural Interior Latex; MP #139, 141.
      a. Products:
         1) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
         2) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)

D. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
   1. Shop primer by others.
   2. One top coat.
   3. Top Coat: Latex Dry Fall; MPI #118.
      a. Products:
         1) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
         2) Substitutions: Section 01 6000 - Product Requirements.
   4. Top Coat Sheen:
      a. Flat: MPI gloss level 1; use this sheen at exposedd ceiling.
   5. Primer: As recommended by top coat manufacturer for specific substrate.

E. Paint I-TR-C - Solid Color Stain Finish on Concrete Floors.
   1. 1 coat stain.
   2. Stain: Solid Color Stain for Concrete. Drawing Designation: CONCS
      a. Products:
         1) PPG Paints Perma-Crete Color Seal WB Interior/Exterior Acrylic Concrete Stain, 4-4210XI Series, Satin.
         2) H&C; Colortop Water-Based Solid Color Concrete Stain.
         3) Substitutions: Section 01 6000 - Product Requirements.

F. Interior Surfaces to be Finished with Green Screen Coating.
   1. Twp top coats and two primer coats.
   2. Top Coat(s):
      a. Products:
         1) Goo Systems Global; Screen Goo 2.0, Chroma Key Green: www.goosystemsglobal.com
         2) Subsitutions: Section 01 6000-Product Requirements
   3. Primer:
      a. Products:
         1) Goo Systems Gloval; Screen Goo Preminum 100% Acrylic Base Primer: www.goosystemsglobal.com

2) Subsitutions: Section 01 6000-Product Requirements

G. Paint I-OP-AC - Acoustical Restoration Coating over Interior Walls (Acoustical Wall Tiles):
1. One top coat.
2. Acoustical Tile Cleaner: As recommended by manufacturer.
3. Primer: As recommended by manufacturer.
4. Top Coat: Acoustical Tile and Ceiling Coating, Vinyl Acrylic Resin.
a. Products:
1) ProCoat Products ProCoustic Acoustical Tile and Ceiling Coating.
2) Acoustical Surfaces, Inc.; Sonokote by Romabio; WFT as recommended by manufacturer..
3) Substitutions: Section 01 6000 - Product Requirements.

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 Concrete ; MPI #3.
a. Products:
1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-W60020 Series (MPI #3).
2) 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. Alkali Resistant Water Based Primer - Dry Erase Primer Gypsum; MPI #3.
a. Products:
1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-W60020 Series (MPI #3).
5. Interior Rust-Inhibitive Water Based Primer (Aluminum and Non-Gavlanized Ferrous Metals); MPI #107.
a. Products:
1) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #107)
2) Substitutions: Section 01 6000 - Product Requirements.
6. 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.
7. Latex Primer for Interior Wood; MPI #39.
a. Products:
1) Substitutions: Section 01 6000 - Product Requirements.
8. Bonding Primer, Water Based for Dryfall; MPI #17.
a. Products:
1) Sherwin Williams, Multi-Purpose Latex Primer/Sealer B51W00450 (MPI #17).

2.05 CONCRETE STAINS AND SEALER

A. General:
1. Locations:

a. Use at following locations: Unless otherwise indicated, unfinished exposed concrete floors, equipment pads, ramps, steps, and stairs are to be finished using concrete stains.

B. Concrete Stains:
1. For traffic surfaces:
a. Water-based, film forming, solid color, acrylic concrete stain; two coats.
1) Benjamin Moore; Insl-X Tuffcrete WB Acrylic Waterproofing Concrete Stain, CST-2XXX; DFT 1.0 mils.
2) H&C: H&C Colortop Water-Based Solid Color Concrete Stain; DFT As recommended by manufacturer.
3) PPG; Perma-Crete Color Seal WB Interior/Exterior Concrete Stain, 4-4210XI Series, DFT 1.5 mils.

2.06 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. Interior Wood: 15 percent, measured in accordance with ASTM D4442.
4. Concrete Floors and Traffic Surfaces: 8 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. Acoustical Panel Ceilings:
H. 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.
I. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.

J. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
K. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
L. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
M. Galvanized Surfaces:
    1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
N. Ferrous Metal - Non-galvanized:
    1. Solvent clean according to SSPC-SP 1.
    2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
    3. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
        a. Re-prime entire shop-primed item.
    4. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning." Protect from corrosion until coated.
O. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
P. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
Q. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

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 wood and 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. Wood: Finish surfaces exposed to view.
   1. Interior trim and frames: WI-OP-3A, semi-gloss.

D. Steel Doors and Frames: Finish surfaces exposed to view; MI-OP-MD-DT, semi gloss.

E. Steel Fabrications: Finish surfaces exposed to view.
   1. Interior: MI-OP-3L, semi gloss.

F. Galvanized Steel: Finish surfaces exposed to view.
   1. Interior: Mgl-OP-3L.

G. Shop-Primed Metal Items: Finish surfaces exposed to view.
   1. Finish the following items:
      a. Elevator pit ladders.
      b. Exposed surfaces of steel stairs and railings.

H. Pipe and Duct Insulation Jackets: Finish surfaces exposed to view; FI-OP-2L, flat.

END OF SECTION

SECTION 09 9600 - HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Interior epoxy paints - non-traffic surfaces.
B. High performance coatings for structural steel, steel joists, and metal decking, including exposed steel lintels.

1.02 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this section
B. DFT: Dry film thickness, measured in mils.
C. WFT : Wet film thickness, measured in mils.

1.03 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; 2016.
C. ASTM D1653 - Standard Test Methods for Water Vapor Transmission of Organic Coating Films; 2013.
D. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2012).
E. ASTM D4442 - Standard Test Methods fASTM D3359 or Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2016.
F. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
G. ASTM D3359 - Standard Test Methods For Rating Adhesion By Tape Test; current edition.
H. ASTM E96/E96M - Standard Test Methods of Water Vapor Transmission of Materials - 2016
I. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health; v1.1, 2010.
J. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2007.
K. SCAQMD 1113 - South Coast Air Quality Management District Rule No.1113; current edition.
L. SSPC-SP 1 - Solvent Cleaning; 2015.
M. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
N. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 SUBMITTALS

A. Refer to Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide product data for each coating product. Include complete list of products to be used with preparation and application instructions, and with the following information for each:
    1. Manufacturer's name, product name and/or catalog number, and general product category.
        a. Example of general product categories:
            1) Two component, waterbased, acrylic epoxy - Gloss Sheen.
            2) Interior primer for concrete masonry units.
    2. For each high-performance coating system and substrate, indicate which products are to be used.
        a. Examples:
            1) Interior Waterborne Acrylic Epoxy Paint for Concrete Masonry Units:
                (a) Primer: Name of specific product provided.

(b) Finish Coats: Name of specific product provided.
2) Interior High Performance Coating For Structural Steel.
(a) Primer: Name of specific product provided.
(b) Intermediate Coat: Name of specific product provided.
(c) Top Coat: Name of specific product provided.
b. Use same designations indicated on Drawings and Schedules.

C. Samples: Submit 3 samples, 8-1/2 by 11 inches in size, illustrating each color and sheen specified.
1. High-performance coating color submittals will not be considered until color submittals for major materials not to be painted, such as masonry and storefront finishes, have been approved.
2. Existing high-performance coatings in the Natatorium for each type of coating system and in each color and gloss of topcoat indicated:
a. Submit Samples on aluminum Q-panel backing, 3” x 6”.
b. Step coats on Samples to show each coat required for system.
c. Label each Sample for location and application area.

D. Manufacturer's Qualification Statement.

E. Installer's Qualification Statement.

F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, and color samples of each color and finish used.

G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Extra Materials: 1 gallon of each color, sheen, and type; from the same product run.
3. Label each container with color, type, and finish in addition to the manufacturer's label.

H. Field Quality Control Reports.

1.05 QUALITY ASSURANCE

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

B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum 5 years documented experience.

1.06 ADHESION TEST

A. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils)

B. Test to be completed after primer has been installed but before finish coats.

1.07 MOCK-UPS

A. See Section 01 4000 - Quality Requirements0, for general requirements for mock-up.

B. Mock-ups shall demonstrate aesthetic effects and set quality standards for materials and execution.
1. Approval of mockups does not constitute approval of deviations from the Contract Documents unless Architect specifically approves such deviations in writing.

C. Provide a mock-up for each high-performance coating system, substrate, color and sheen as follows:
1. Vertical and Horizontal Surfaces: Provide mockup samples of at least 100 sq. ft.
2. Doors and Frames: Provide mock-up samples of one complete door and frame.
3. Railings and Other Lineal Materials: Provide mock-up samples of at least 8 lineal feet.

D. Locate where directed by Architect.

E. Mock-ups may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

C. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
D. Coating 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.
E. Maintain containers in clean condition, free of foreign materials and residue.
F. Remove rags and waste from storage areas daily.

1.09 FIELD CONDITIONS

A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.
C. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
E. Comply with governing codes and regulations for paint products being used.

1.10 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide high-performance coating products from same manufacturer, unless otherwise specified. For each high performance coating system, provide one of the indicated products for each coating within the system.
   1. Exceptions shall be permitted, provided approval of Architect is obtained using specified procedures for substitutions.
B. High Performance Coating Manufacturers.
   1. Benjamin Moore: Benjamin Moore & Co.: www:benjaminmoore.com.
   2. PPG: PPG Industries, Inc., Architectural Coatings: www.ppgpaints.com.
   3. Sherwin-Williams: The Sherwin-Williams Company: www:sherwin-williams.com.
   4. Tnemec: Tnemec Company Inc.: www.tnemec.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 HIGH-PERFORMANCE COATINGS - GENERAL

A. Provide epoxy paints and high performance coatings where indictaed on Drawings; otherwise provide paints as specified in Sections 09 9113 - Exterior Painting and 09 9123 - Interior Painting.
B. 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.
C. Supply each coating material in quantity required to complete entire project's work from a single production run.
D. Do not reduce, thin, or dilute coatings or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
E. Volatile Organic Compound (VOC) Content and Emissions:
   1. Volatile Organic Compound (VOC) Content:
      a. Provide paints and finishes that comply with the most stringent requirements specified in the following:
         1) 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
         2) Architectural coatings VOC limits of 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.

F. Sheen/Gloss Criteria.
1. Product names are not acceptable as gloss level identification.
2. Determine gloss value of paint finish by testing paint samples according to ASTM D523, using 60 degree geometry. Sheen/Gloss levels shall be defined as follows:
a. Gloss Level 1: Flat/Matte, value between 0 and 5 units.
b. Gloss Level 2: Velvet, value between 5 and 10 units.
c. Gloss Level 3: Eggshell, value between 10 and 20 units.
d. Gloss Level 4: Satin, value between 20 and 35 units.
e. Gloss Level 5: Semigloss, value between 35 and 70 units.
f. Gloss Level 6: Gloss, value between 70 and 85 units.
g. Gloss Level 7: High Gloss, value more than 85 units.
3. Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

G. Colors: To be selected from manufacturer's full range of available colors

2.03 INTERIOR EPOXY PAINTS - NON-TRAFFIC SURFACES

A. General:
1. Excludes the following:
a. Structural steel, steel joists, and metal decking.
b. Exposed exterior steel lintels.

B. Waterborne Acrylic Epoxy Paint - Non-Traffic Systems.
1. Primers: For all sheens unless otherwise indicated.
a. Primer for concrete; one coat.
1) Sherwin Williams; Loxon Concrete and Masonry Prime/Sealer Interior/Exterior Latex, A24W8300 Series; DFT 2.5 mils.
b. Primer for concrete masonry units; one coat.
1) PPG; Speedhide Interior/Exterior Masonry Hi Fill Latex Block Filler, 6-15; DFT 7.0 mils.
2) Sherwin Williams:
(a) Semigloss and Eggshell Sheens: Loxon Block Surfacer A24W00200; DFT 2.5 mils.
c. Primer for ferrous metal and galvanized steel; one coat.
1) Sherwin Williams; Pro Industrial Pro-Cryl Universal Primer, B66W310 Series; DFT 3.0 mils.
d. Primer for gypsum board; one coat.
1) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W02600; DFT 1.0 mils.
e. Primer for previously painted surfaces; one coat.
1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.
f. Primer for insulated piping and insulated ductwork; one coat.
1) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-600 Series; DFT 1.4 mils.
2. Semigloss Sheen: One component, pre-catalyzed, waterbased, acrylic epoxy.
a. Finish coats for all surfaces; two coats.
1) PPG; Pitt-Glaze WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy, 16-510 Series; DFT 2.0 mils.
2) Sherwin Williams; Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-150 Series, Semi-Gloss; DFT 1.5 mils.

2.04 INTERIOR EPOXY PAINTS - TRAFFIC SURFACES (FLOORS)

A. Heavy Duty, Polyamine, Epoxy Paint - Traffic Systems.

1. Locations:
   a. As indicated.
2. Gloss Sheen: Two component, polyamine, epoxy.
   a. Primer for concrete, including previously painted surfaces; one coat.
      1) Benjamin Moore; Corotech 100 pct Solids Epoxy Pre-Primer, V155; DFT 2.0 mils.
      2) PPG; HPC High Gloss Epoxy 95-501 Series; DFT 3.0 mils.
      3) Sherwin Williams; Pro Industrial High Performance Epoxy, B67-W00200 Series, Gloss; DFT 4.0 mils.
      4) Tnemec; Epoxoprime Series 201; DFT 9.0 mils.
   b. Finish coats; two coats.
      1) Benjamin Moore; Corotech Polyamide Epoxy Coating, Gloss, V400; DFT 4.5 mils.
      2) PPG; HPC High Gloss Epoxy 95-501 Series; DFT 3.0 mils.
      3) Sherwin Williams; Pro Industrial High Performance Epoxy, B67 Series; DFT 6.0 mils.
      4) Tnemec: Power-Tread Series 237; DFT 12.0 mils.

2.05 HIGH PERFROMANCE COATINGS FOR STRUCTURAL STEEL, METAL DECKING, AND STEEL JOISTS

A. General:
   1. Includes interior and exterior high performance coatings for the following:
      a. Structural steel, steel joists, and metal decking.
      b. Exposed exterior steel lintels.

B. Steel Coating Systems.
   1. Primer; one coat.
      a. Zinc-rich primer.
         1) Locations:
            (a) Exterior locations.
            (b) Natatorium/pool environments.
            (c) Wet areas.
            (d) Galvanized steel.
            (e) Other areas as indicated.
         2) Primer:
            (a) Sherwin Williams; Protective and Marine Coatings Zinc Clad IV (85) Organic Zinc Rich Coating; DFT 4.0 mils.
            (b) Tnemec; Tneme-Zinc Series 90-97; DFT 3.0 mils.
      b. Epoxy primer.
         1) Locations:
            (a) Where zinc-rich primer is not required.
         2) Primer:
            (a) Sherwin Williams; Protective and Marine Coatings Macropoxy 5000 Penetrating Epoxy Primer/Sealer, B58 Series; DFT 1.5 mils.
            (b) Tnemec; Hi-Build Epoxoline Series 66; DFT 4.0 mils.
      c. Primer at previously painted surfaces:
         1) Sherwin Williams; Protective and Marine Coatings Macropoxy 5000 Penetrating Epoxy Primer/Sealer, B58 Series; DFT 1.5 mils.
         2) Tnemec; Hi-Build Epoxoline Series 66; DFT 4.0 mils.
   2. Intermediate Coat; one coat, polyamide epoxy.
      a. Sherwin Williams; Protective and Marine Coatings Macropoxy 646 Fast Cure Epoxy; DFT 7.5 mils.
      b. Tnemec; F.C. Typoxy Series 27; DFT 5.0 mils.
   3. Top Coat; one coat, semi-gloss sheen, aliphatic acrylic polyurethane.
      a. Sherwin Williams; HI-Solid Polyurethane 250, Semi-gloss; DFT 5.0 mils.

b. Tnemec; Endura-Shield Series 73; DFT 4.0 mils.

2.06 ACCESSORY MATERIALS

A. Accessory Materials: Provide sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of high-performance coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin application of high performance coatings until substrates have been properly prepared.

B. Verify that surfaces are ready to receive work as instructed by product manufacturer.

C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials; report incompatible primer conditions and submit recommended changes for Architect's approval.

1. Do not proceed with remedial action or change without receiving written authorization from Architect.

E. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below following maximums:

1. Interior Materials:
   a. Gypsum Wallboard: 12 percent.
   b. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
2. Report unacceptable conditions and submit recommended remedial action for Architect's approval.
   a. Do not proceed with remedial action or change without receiving written authorization from Architect.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

A. General:

1. Clean surfaces thoroughly and correct defects prior to application.
2. Prepare surfaces using the methods recommended by the top coat manufacturer for achieving the best result for the substrate under the project conditions.
3. Remove or repair existing paints or finishes that exhibit surface defects.
4. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
   a. After work is completed, reinstall removed items.
5. Seal surfaces that might cause bleed through or staining of topcoat.
6. Remove mildew from impervious surfaces by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
7. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils) of primer. Adhesion test to be performed on primer.

B. Concrete - Non-Traffic Surfaces:

1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
2. Clean concrete according to ASTM D4258. Allow to dry.

C. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.

D. Gypsum Board:

1. Interior:
   a. Fill minor defects with filler compound; make smooth and flush with adjacent surfaces.
   b. Spot prime defects after repair.

E. Ferrous Metal - Non-galvanized:
1. Solvent clean according to SSPC-SP 1.
2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
   a. Re-prime entire shop-primed item.
3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning." Protect from corrosion until coated.

F. Galvanized Surfaces:
1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
2. Remove loose paint and other debris according to SSPC-SP 2.

G. Previously Painted Existing Surfaces:
1. Remove all loose paint, dust, dirt, mold, mildew, oil, grease, rust, loose mill scale, mortar, and any other surface contamination.
2. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.
   a. Tightly adhered existing paint may remain unless primer manufacturer recommends removal.
3. Test for proper primer adhesion, as defined by the primer manufacturer, prior to proceeding with application of high performance coatings.
   a. Notify Architect of improper adhesion results; do not proceed with work until additional instructions are received from Architect.
4. Spot prime all bare areas with appropriate primer before re-priming entire surface.

H. Existing Steel in Natatorium
1. Steel Substrates: Remove rust, loose mill scale, and disbanded or incompatible shop primer if any. Clean using methods recommended in writing by paint manufacturer, but not less than the following:
   a. SSPC-SP WJ-4/NACE WJ-4 Light Cleaning by use of Low Pressure Water Cleaning (LP WC) between 3,500 and 5,000 psi using a 0 degree rotating nozzle used in conjunction with either Holdtite 102 or Chlor*Rid.
   b. If all visible contaminates, loose mill scale, loose rust and other corrosion products, and loose paint have not been removed, SSPC-SP2 Hand Tool Cleaning or SSPC-SP3 Power Tool Cleaning should be employed until the surface cleanliness definition is met.

3.03 APPLICATION - HIGH PERFORMANCE COATINGS

A. Apply products in accordance with manufacturer's written instructions.

B. Provide smooth, opaque coatings of uniform finish, color, appearance, and coverage without brush marks, runs, sags, laps, ropiness, holidays, spotting, cloudiness, or other surface imperfections.

C. Terminate high performance coatings in neat lines.

D. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

E. Apply high performance coatings to properly prepared surfaces.

1. Do not apply coatings over dirt, rust, scale, grease, moisture, or other conditions detrimental to application of coatings

F. Primers:
1. Apply first coat of primer to surfaces as soon as practical after preparation and before subsequent surface deterioration.
2. Re-prime shop-primed surfaces.

G. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer.

H. Provide completed work matching approved samples for color, sheen, texture, coverage and quality of work.
1. Remove, refinish, or reapply work not complying with requirements.

I. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.

J. Use applicators and methods best suited for substrate and type of material being applied and according to manufacturer's instructions.
1. Brush Application: Use brushes best suited for type of material applied; use brush of appropriate size for surface or item being painted; produce results free of visible brush marks.
2. Roller Application: Use rollers of fiber type and nap length as recommended by manufacturer for material and texture required.
3. Spray Application: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

K. Number of Coats: Each high performance coatings system specifies a number of coats. This is the minimum number required.
1. If undercoats, stains, or other imperfections are visible after final coat of high performance coatings is applied, apply additional coats until high performance coating is of uniform finish, color, and appearance without defects or imperfections.

L. Minimum Coating Thickness: Provide dry film thickness for each coat as indicated, but not less than that recommended by the coating manufacturer.
1. Number of coats and film thicknesses required are same regardless of application method.
2. Ensure edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent to that of flat surfaces.

3.04 SURFACES TO BE PAINTED

A. Refer to Section 09 9113 - Exterior Painting for exterior items.

B. Refer to Section 09 9123 - Interior Painting for interior items.

3.05 SURFACES NOT TO BE PAINTED

A. Refer to Section 09 9113 - Exterior Painting for exterior items.

B. Refer to Section 09 9123 - Interior Painting for interior items.

3.06 IDENTIFICATION AND COLOR CODING

A. Refer to Section 099100 - Painting.

3.07 FIELD QUALITY CONTROL

A. Owner may provide field inspection.

B. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils)

C. All high performance 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.

D. 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.

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

3.08 CLEANING

A. At end of each workday, remove empty cans, rags, and other discarded paint materials from site.
1. Collect waste material which may constitute fire hazard, place in closed metal containers, and remove daily from site.
2. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

3.09 PROTECTION

A. Protect other work, whether being painted or not, against damage from high performance painting activities.
1. Correct damage by cleaning, repairing, replacing as approved by Architect

B. Protect finishes until completion of project.

C. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

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SECTION 10 0100 - MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Knox Box.
B. Barstool.
C. Table.
D. Wall Mounted Illuminated Optical Resin Panel Fixture.
E. Greenery Wall

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of products specified in this section with size, location and installation of service utilities.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide general construction, material descriptions, finishes, dimensions and details.
C. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, and installation details.
   1. Include plans, elevations, sections, details, and attachments to other Work.
   2. Include wiring diagrams of electrical components.
D. Samples:
   1. Submit 3 samples of each finish, 4 by 4 inch in size, minimum; illustrating color, finish, and texture.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Test Reports: Show compliance to specified surface burning characteristics requirements.
G. Operation Data: Include normal operation, troubleshooting, and adjusting.
H. Maintenance Data: Include data on regular cleaning.
I. 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. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package specified products as required to prevent damage before installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturers' standard warranties for material and workmanship.

PART 2 PRODUCTS

2.01 KNOX BOX

A. Description: Recessed mounted with hinged door. Box and Lock to be UL Listed.

B. Construction: 1/4 inch thick steel house, 1/2 inch thick steel door with interior gasket seal and stainless steel door hinge, Lock has a 1/8 inch thick stainless steel dust cover with tamper seal mounting capability.
C. Exterior Dimensions: Body is Recessed 7 inches H by 7 inches W by 3-7/8 inches D.
D. Lock: UL listed, double-action rotating tumblers and harden steel pins accessed by a biased cut key.
E. Finish: Knox-Coat proprietary finish process.
F. Color: Dark Bronze
G. Accessories: Provide 3200 Hinged Door Recessed Mounting Kit
H. Manufacturer: Knox Company, P/N: 3200 Series Knox-Box.

2.02 SALLY BARSTOOL

A. Basis of Design: Grand Rapids Chair - Sally Barstool
   1. Model 2261BS-10
   2. Series: Sally Bolt Down Barstool
B. Material: 3 inches round tube, steel frame.with foot rest
   1. Color: Gray White
C. Seat: 1-1/2 solid maple, natural finish.
   1. Wood Seat Finish: Honey
D. Attachment: Bolted-Down.
E. Height: 30.25 inches

2.03 FIXED TABLE

A. Basis of Design: Grand Rapids Chair - Core-Drilled/Bolt-Down Table
   1. Model: BD4100-30
   2. Series: Bolt-Down
   3. Installation: Bolt Down
   4. Base Height: Table Height, 28.75"
   5. Construction: 3" structural-grade steel column
   6. Base Finish: Gray White
   7. Top: Square Top
      a. Material: Solid Surface, SS1
         1) Dupont Corian, Ash Aggregate
      b. Size: 24 by 24 inches

2.04 WALL MOUNTED ILLUMINATED OPTICAL RESIN PANEL FIXTURE

A. Basis of Design: 3-Form Translucent Resin Panel System
   1. Material: 3form Chroma Boxes: Engineered acrylic resin.
      a. Sheet size: 48 inch by One-hundred and Twenty inch by 0.5 inch thick.
      b. Diffusion layer for even light diffusion. Basis of Design: 3form Powder.
      c. Panels fused with heat and pressure.
      d. PVC-free acrylic resin made with pigments, UV stable color.
   2. Box Size: Thirty-six inches wide by Six inches deep by Forty-eight inches long.
   3. Back Reflective Panel with Lighting and Attachment Clips to match size of boxes.
   4. Fixture configuration: Six boxes configured for a Ninety-six inch tall vertical section, transitioning into a One-hundred and Ninety-two inch horizontal section.
   5. Fixture: 3form standard 3ft series natural white lighting solution.
   6. Color:
      a. Style: Flek Chamomile
      b. Material: Varia 3/8 inch / 9.5 mm
      c. Finish on Front: Sandstone F01
      d. Finish on Back: Sandstone F01
   7. Provide all mounting hardware and accessories for a complete installation.
      a. Including, but not limited to:

1) Mounting hardware.
2) Dimmable Power Supply.
3) Wall Dimmer.

8. Warranty Period: One year

2.05 GREENERY WALL

A. Basis of Design: Greenmood Dense Forest Preserved Green Wall
B. Material:
1. Dense Forest - Preserved Green Wall
2. Foliage: To be selected by Architect from manufacturer's full range.
3. 100% Natural plants and foliage sustainably grown and harvested
4. 100% Maintenance free (does not need water, pruning, nor sunlight)
5. Backing Panel: 1/4 inch, Fire-Resistant MDF Panel
6. Edges: Moss Covered
C. Health:
1. Non-toxic / Non-allergen
2. Does not attract insects
3. 100% Biodegradable
D. Installation: Back panel fixed to wall
E. Size: As indicated on drawings

2.06 ACCESSORIES

A. Mounting Hardware: Provide all related fasteners and hardware required for a complete installation at substrates indicated.
B. Miscellaneous Trim and Accessories: Provide all trim and accessories required for a complete installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as required by the specified products.
C. Verify that electrical service requirements are correct and properly located for specified products.

3.02 INSTALLATION

A. Install specified products in accordance with manufacturer's instructions.
B. Install specified products in locations indicated.
C. Install specified products level and plumb.
D. Connect specified products to electrical service in accordance with manufacturer's instructions.

3.03 SYSTEM STARTUP

A. Prepare and start equipment and systems in accordance with manufacturers' instructions and recommendations.
B. Adjust for proper operation within manufacturer's published tolerances.

3.04 ADJUSTING

A. Adjust operable elements for smooth operation.

3.05 CLEANING

A. Clean specified products accordance with manufacturer's instructions

3.06 CLOSEOUT ACTIVITIES

A. Demonstrate proper operation of equipment to Owner's designated representative.
1. Briefly describe function, operation, and maintenance of each component.

3.07 PROTECTION

A. Protect installed products from subsequent construction operations.

END OF SECTION

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SECTION 10 1100 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Porcelain enamel steel markerboards.
B. Glass markerboards.
C. Tackboards.
D. Tack strips
E. Tackable wall surfaces.

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 (Reaffirmed 2020).
C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
D. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
E. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data on markerboard, tackboard, tackboard surface covering, trim, and accessories.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations.
    1. Include locations and layout of graphics.
    2. Include sections indicating trim profiles.
D. Samples:
    1. Markerboard Finishes: Submit 3 samples of each finish 2 by 2 inch in size illustrating finish, color, and texture.
    2. Composition and Natural Cork Sheet: Submit 3 samples of each finish, 2 by 2 inch in size illustrating finish, color, and texture.
    3. Fabrics: Submit 3 samples of each fabric, 8 by 10 inch inch in size illustrating color, finish, and texture.
    4. Trim: Submit 3 samples, 6 inches long, of each trim profile, including chalk trays, map rails, tack strips, and edge trim
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Test Reports: Show compliance to specified surface burning characteristics requirements.
G. Maintenance Data: Include data on regular cleaning, stain removal.

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 experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package visual display boards as required to prevent damage before installation.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide Life of the building warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Visual Display Boards:
   1. ADP Lemco, Inc.; www.adplemco.com.
   2. ASI Visual Display Products, Inc., an ASI Group Company: www.asi-visualdisplayproducts.com.
   3. Claridge Products and Equipment, Inc: www.claridgeproducts.com/.
   4. Egan Visual, Inc.; www.egan.com.
   5. Ghent, a GMi company; www.ghent.com.
   6. Marsh Industries, Inc.; www.marsh-ind.com.
   7. Platinum Visual Systems; www.pvsusa.com.
   8. PolyVision Corporation: www.polyvision.com.
   9. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.03 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards:
   1. Drawing Designation: Horizontal: MB1
   2. Drawing Designation: Vertical: MB2
   3. Color: As selected from manufacturer's full range.
   4. Sizes: As indicated on drawings.
   5. Frame: Extruded aluminum , with concealed fasteners.
   6. Accessories: Provide marker tray and map rail.
   7. Frame and Accessories Finish: Anodized, natural.

B. Magnetic Glass Markerboards:
   1. Drawing Designation: MB3
   2. Glass: Laminated, low iron, 1/4 inch thick, with bevel edges and radiused corners, laminated to steel backing sheet for use with magnets. Coated or treated for use as dry erase board or projection surface.
   3. Glass Color(s):
      a. MB3A: Match Pantone Color 7524 C (red)
      b. MB3B: Match Pantone Color 772 C (orange)
      c. MB3C: Match Pantone Color 7403 C (yellow)
      d. MB3D: Match Pantone Color 5767 C (green)
      e. MB3E: Match Pantone Color 645 C (blue)
      f. MB3F: Match Pantone Color 5483 C (teal)
   4. Steel Backing Sheet Thickness: 24 gauge, 0.0239 inch .
   5. Size: 16:9 aspect ratio for projection: 40 inches by 70 inches.
   6. Frame: Same as for porcelain enamel steel markerboards.
   7. Frame Finish: Anodized, natural.
   8. Mounting: Concealed Z clips.
   9. Accessories: Provide magnetic marker tray and magnetic marker holder.
   10. Products:
      a. Egan Visual Corporation; Egan Visual GlassBoards: www.egan.com/#sle.

C. Tackboards: Fabric laminated to natural cork facer on fiberboard.
   1. Cork Thickness: 1/8 inch.
   2. Fabric: Vinyl coated fabric.
   3. Backing: Fiberboard, 3/8 inch thick, laminated to tack surface.
   4. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
   5. Sizes: As indicated on drawings.
   6. Frame: Extruded aluminum , with concealed fasteners.

7. Accessories: Provide map rail.
8. Frame and Accessories Finish: Anodized, natural.

D. Combination Units and Units Made of More Than One Panel: Factory-assembled markerboards and tackboards in a single frame, of materials specified above.
1. Join panels of different construction with H-shaped extruded aluminum molding finished to match frame.
2. Join panels of similar construction with butt joints, aligned and secured with steel spline concealed in edge of core.
3. Configurations: As indicated on drawings.
4. Units Too Large to Ship Assembled: Fully assembled in factory, then disassembled for shipping.

2.04 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.

B. Float Glass: Provide float-glass-based glazing unless otherwise indicated.

C. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Comply with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

D. Natural Cork Sheet: Seamless, compressed, fine-grain cork sheet; bulletin board quality; sanded face for natural finish.

E. Composition Cork Sheet: Seamless, homogeneous, self-sealing, plastic-impregnated, colored cork sheet.
1. Construction: Granulated cork, linseed oil, resin binders, and dry pigments calendared on fabric backing; with integral color throughout. Washable surface.
2. Color(s): Standard color(s) as selected by Architect.

F. Vinyl-Coated Fabric:
1. Products:
a. Momentum; Aries: www.momentumtextilesandwalls.com.
b. Substitutions: Not permitted.
2. Color/Pattern: A188-72 Akoya.
3. Fiber Content: 100% Vinyl.
4. Weight: 20 oz/sq yd..
5. Width: 52/54 inches.
6. Backing: Osnaburg.

G. Fiber Board: ASTM C208, cellulosic fiber board.

H. Adhesives: Type used by manufacturer.

2.05 TRIM AND ACCESSORIES

A. Frame Profile: Extruded aluminum. Manufacturer's standard J-trim.

B. Tack Strips: Extruded aluminum, manufacturer's standard profile, 1 inch wide, with cork insert.
1. Cork Insert: Composition cork sheet.
2. Locations: As indicated.

C. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame.
1. Cork Insert: Composition cork sheet.

D. Map Supports: Formed aluminum sliding hooks to fit map rail.
1. Provide 1 hook per lineal foot of map rail.
2. Provide manufacturer's standard end stop at each map rail end; designed to retain map supports on map rail.

E. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit map rail.
1. Provide 1 flag holder per room.

F. Mounting Hardware: Concealed. Include brackets and all related fasteners and hardware required for a complete installation on substrates indicated.

2.06 VISUAL DISPLAY UNIT GRAPHICS

A. Graphics: Manufacturer's standard fused or painted graphics; types as follows:
   1. Music staff lines.
B. Color: Black.
C. Locations and Types: As indicated.

2.07 TACKABLE WALL SURFACE

A. Tackable Wall Surface: Tackable sheet material, wall-applied, with perimeter metal edge trim.
   1. Drawing Designation: BB
   2. Tackable Sheet Material: Composition cork sheet; seamless, homogeneous, self-sealing, plastic-impregnated, colored cork sheet.
      a. Construction: Granulated cork, linseed oil, resin binders, and dry pigments calendared on fabric backing; with integral color throughout. Washable surface.
      b. Product:
         1) Forbo Flooring Systems; Bulletin Board: www.forbo.com.
         2) Substitutions: Not permitted.
         3) Manufacturer's Representative:
            (a) Stephanie Gutowsky, stephanie.gutowsky@forbo.com, 248-385-8805
      c. Color(s):
         1) BB1A: Duck Egg, 2162
         2) BB1B: Potato Skin, 2182
   3. Perimeter Metal Edge Trim:
      a. Metal Trim: Provide metal profiles in heights to match tackable sheet material thickness
         1) Profiles:
            (a) Angle or L-shaped.
      b. Material: Satin nickel anodized aluminum.
      c. Manufacturers:
         1) Schluter-Systems; JOLLY profile: www.schluter.com.
         2) Substitutions: See Section 01 6000 - Product Requirements.
   4. Adhesives: Provide manufacturer's recommended adhesive for substrates indicated.
   5. Fasteners: Provide manufacturer's recommended fasteners for substrates indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that internal wall blocking is ready to receive work and positioning dimensions are as instructed by the manufacturer.

3.02 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.
B. Install visual display units in locations and at heights indicated.
C. Secure units level and plumb using adhesive and mechanical fasteners.
   1. Adhesive: Adhere units to substrates with adhesive placed in patches 16 inches on center each way.
   2. Fasteners: Mechanically attach units to substrates with concealed mounting brackets not more than 16 inches on center along tops and bottoms of units.
      a. Minimum of 2 fasteners at top and bottom of each board, or panel in a combination unit.
   3. Where possible, locate wall fasteners at masonry and tile joints; do not penetrate masonry or tile faces.
D. Butt Joints: Install with tight hairline joints.
E. Install tack strips in locations and at heights indicated.

1. Install in longest lengths possible to minimize joints; align and tightly butt joints.
2. Fasteners: Concealed fasteners, 24 inches on center, minimum.

3.03 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 10 1416 - PLAQUES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Plaques.

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's product literature for each type of plaque sign, indicating style, font, foreground and background colors, locations, and overall dimensions of each sign.
C. Shop Drawings: Indicate dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
D. Samples: One sample of each type of plaque sign, of size similar to that required for project, indicating style, font, and method of attachment.
E. Selection Samples: Where materials, colors, and finishes are not specified, submit two sets of color selection charts or chips.
F. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum five years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package plaque signs as required to prevent damage before installation.
B. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plaques:
   1. A.R.K. Ramos: www.arkramos.com.
   2. Gemini Inc.: www.geminisignproducts.com.
   3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PLAQUES

A. Metal Plaques:
   1. Material: Aluminum casting.
   2. Material Thickness: 1/8 inch, minimum.
   3. Size: As indicated on drawings.
   4. Text and Typeface:
      a. Character Font: As indicated on drawings..
      b. Character Case: Upper case only.
      c. Character Color: Contrast with background color.
   5. Border Style: Double line.
   6. Background Texture: Pebble.

7. Surface Finish: As selected by Architect from manufacturer's full range.
8. Painted Background Color: As selected by Architect from manufacturer's standard background colors.
9. Protective Coating: Manufacturer's standard clear coating.
10. Mounting: Blind studs.

2.04 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel or galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install with horizontal edges level.
C. Prtect from damage until Date of Substantial Completion; repair or replace damaged items.
D. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION

SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Dimensional letter signage.
B. Illumination system.

1.02 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
D. UL 879 - Electric Sign Components; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
C. Shop Drawings:
    1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.
E. Selection Samples: Where materials, colors, and finishes are not specified, submit two sets of selection charts or chips.
F. Verification Samples: Submit samples showing colors and finishes specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
H. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
B. Installer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package dimensional letter signs as required to prevent damage before installation.
B. Store under cover and elevated above grade.
C. Store tape adhesive at a normal room temperature of 68 to 72 degrees F.

1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Dimensional Letter Signs:
    1. 3M: www.3m.com
    2. A.R.K. Ramos; www.arkramos.com.
    3. Gemini Inc.: www.geminisignproducts.com.
    4. Inpro Corporation: www.inprocorp.com/#sle.
    5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 DIMENSIONAL LETTERS

A. Applications: Interior.
   1. Use individual metal letters.
   2. Mounting Location: Interior as indicated on drawings.
   3. Metal Letters:
      a. Material: Aluminum casting.
      b. Thickness: Manufacturer's standard for letter size.
      c. Letter Height: As indicated on drawings.
      d. Text and Typeface:
         1) Character Font: Helvetica, Arial, or other sans serif font.
         2) Character Case: As indicated on drawings..
      e. Finish: Anodized.
      f. Color: Up to two custom colors.
         1) Color A: To match Sherwin Williams SW 7069 Iron Ore
         2) Color B: To match Sherwin Williams SW 6381 Anjou Pear
      g. Mounting: Concealed screws.

B. Applications: Building identification and Room Identification at Interior locations.
   1. Use individual metal letters.
   2. Mounting Location: Exterior and Interior as indicated on drawings.
   3. Metal Letters:
      a. Material: Aluminum casting.
      b. Thickness: Manufacturer's standard for letter size.
      c. Letter Height: As indicated on drawings.
      d. Text and Typeface:
         1) Character Font: Helvetica, Arial, or other sans serif font.
         2) Character Case: As indicated on drawings..
      e. Finish: Anodized.
      f. Color: Up to two custom colors.
         1) Color A: To match Sherwin Williams SW 7069 Iron Ore
         2) Color B: To match Sherwin Williams SW 6381 Anjou Pear
      g. Mounting: Concealed screws.
      h. Illumination System: Halo-lit reverse channel letters.
         1) Provide products that are listed and labeled as complying with UL 879, where applicable.
         2) Power: 120 V, 60 Hz, 1 phase, 15 A.

C. Applications: Logo.
   1. Precision cut metal logo.
   2. Mounting Location: Interior as indicated on drawings.
   3. Metal:
      a. Material: Cut aluminum..
      b. Thickness: 1/4 inch minimum.
      c. Logo Height: As indicated on drawings.
      d. Finish: Glossy.
      e. Color: Up to six custom colors.
         1) Custom colors to match school logo.
      f. Mounting: Concealed Screws on Standoffs.

D. Plastic Letters:
   1. Material: Vinyl sheet, flat cutout.
      a. Opaque, non-reflective film with pressure-sensitive adhesive backing.

b. Signs shall be cut from sufficiently large rolls of material to minimize seams or joining of material to creat one sign.
2. Thickness: Manufacturer's standard for letter size.
3. Letter Height: As indicated on drawings.
4. Text and Typeface:
   a. Character Font: Helvetica, Arial, or other sans serif font.
   b. Character Case: As indicated on drawings..
5. Finish: As selected by Architect from manufacturer's full range.
6. Color: White.
7. Mounting: Pressure-sensitive adhesive.
8. Installation Method:
   a. Signs shall be installed free of bubbles, wrinkles, or other anomalies.
   b. Provide signs as either front applied (first surface) or reverse applied (second surface) as required.

2.04 ACCESSORIES

A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.
B. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Verify that electrical service is correctly sized and located to accommodate dimensional letter signs.
C. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install with horizontal edges level.
C. Protect from damage until Date of Substantial Completion; repair or replace damaged items.

END OF SECTION

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SECTION 10 1423 - PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel signage.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
C. Shop Drawings:
    1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
    2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
        a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
        b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
        c. Submit for approval by Owner through Architect prior to fabrication.
D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.
E. Selection Samples: Where colors, materials, and finishes are not specified, submit two sets of color selection charts or chips.
F. Verification Samples: Submit samples showing colors, materials, and finishes specified.
G. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
H. Manufacturer's qualification statement.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package signs as required to prevent damage before installation.
B. Package room and door signs in sequential order of installation, labeled by floor or building.
C. Store under cover and elevated above grade.
D. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Panel Signage:

1. ASI Signage Innovation: www.asisignage.com.
2. Foresight Supersign: www.foresightsupersign.net.
3. Inpro Corporation: www.inprocorp.com/#sle.
4. Summit Advertising, Inc.: www.summit-signco.com
5. The Supersine Company: www.supersine.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PANEL SIGNAGE

A. Panel Signage:
1. Application: Room and door signs.
2. Description: Flat signs photopolymer media, tactile characters and Braille shall be integral to sign face; separate adhesivly-fixed characters are not permitted. Frameless.
3. Sign Size: As indicated on drawings.
4. Total Thickness: 1/8 inch.
5. Sign Edges: As indicated.
6. Letter Edges: As indicated.
7. Corners: As indicated.
8. Color and Font, unless otherwise indicated:
   a. Character Font: Helvetica, Arial, or other sans serif font.
   b. Character Case: Upper and lower case (title case).
   c. Background Color: As scheduled.
   d. Character Color: Contrasting color.
9. Material: Single sheet of photopolymer etched through exposure to UV light.
   a. Tactile graphics, text, and Braille integral to surface of sign.
   b. Matte topcoat to protectagainst cleaning agnets and vandalism.
10. Profile: Flat panel without frame.
    a. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, nonglare on front.
11. Tactile Letters: Raised 1/32 inch minimum.
12. Braille: Grade II, ADA-compliant.
13. One-Sided Wall Mounting: Tape adhesive.

2.04 SIGNAGE APPLICATIONS

A. Room and Door Signs:
1. Classroom and Office Doors: Identify with room names and numbers as indicated on signage schedule; provide "window" section for replaceable occupant name.
2. Conference and Meeting Rooms: Identify with room names and numbers as indicated on signage schedule.
3. Service Rooms: Identify with room names as indicated on signage schedule.
4. Rest Rooms: Identify with pictograms, and the names as indicated on signage schedule, and braille.
5. Stairways: Identify with pictograms and the name "STAIR", and braille.
6. Elevators: Identify with pictograms and the name "ELEVATOR", and braille.
   a. Emergency text and Pictograms: Comply with requirements of authorities having jurisdiction indicating that in case of fire, elevators are out of service and stairway exits should be used instead.
7. Exits: Identify with text and braille.

B. Interior Directional and Informational Panel Signs:
1. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.

2.05 ACCESSORIES

A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are ready to receive work.
B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install with horizontal edges level.
C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
D. Protect from damage until date of Substantial Completion; repair or replace damaged items.

END OF SECTION

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SECTION 10 1426 - EXTERIOR SIGNAGE

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. Exterior illuminated panel signs.
B. Related Requirements:
   1. Division 26 Sections for Electrical Systems for power, labels, tags, and nameplates for electrical equipment.

1.03 DEFINITIONS

A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.04 COORDINATION

A. Fabricate signage to utilize existing sign-anchorage devices and electrical service embedded in existing concrete base construction.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For panel signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   3. Show message list, typestyles, graphic elements and layout for each sign.
   4. Show locations of electrical service connections.
   5. Include diagrams for power, signal, and control wiring.
C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of typestyles and graphic symbols.
D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
   1. Panel Signs: Not less than 12 inches (300 mm) square, including corner.
E. Delegated-Design Submittal:
   1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer and manufacturer.
B. Sample Warranty: For special warranty.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: For signs to include in maintenance manuals.

1.08 FIELD CONDITIONS

A. Field Measurements: Verify locations of existing anchorage devices and electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.09 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering.
      b. Deterioration of embedded graphic image.

c. Separation or delamination of sheet materials and components.
2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Division 1 Section "Quality Requirements," to design sign structure and anchorage of illuminated panel sign with reader board to withstand design loads.
B. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
C. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.02 SIGNS

A. Manufacturers:
1. ASI Sign Systems, Inc. - Troy, MI (248)680-8970; www.asisignage.com
2. Diskey Architectural Signage, Inc. – Fort Wayne, IN (800)669-4472; www.diskeysign.com
3. J. L. Geisler Corporation, - Warren, MI (888) 637-7111
4. Poblocki Sign Company, LLC – Milwaukee, WI (800)776-7064; www.poblocki.com
5. Stamprite Supersine – Lansing, MI (517)487-5071; www.supersignstamps.com
6. Phillips Sign & Lighting, Harrison Twp., MI 586-468-7110; www.phillipssign.com
7. Universal Sign, Inc., Grand Rapids, MI 616-554-9999; www.universalsignsystems.com
B. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
1. Illuminated Panel Sign: Backlighted construction with LED lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from sign surfaces as needed to illuminate evenly.
2. Sign-Panel Faces:
a. Prefinished aluminum face sheet with computer-routed text and white translucent fiberglass-reinforced acrylic modified polyester backer panels. All materials to be UV stable.
3. Sign-Panel Perimeter: Finish edges smooth.
a. Edge Condition: Vertical and Horizontal Edges: Square cut.
b. Corner Condition in Elevation: Square.
4. Frame: Entire perimeter and horizontal and vertical retainers.
a. Material: Aluminum.
b. Material Thickness: 0.125” (3.2mm).
c. Frame Depth: Match existing.
d. Profile: Square.
e. Corner Condition in Elevation: Square.
f. Finish and Color: Match Architect's sample.
5. Mounting: Utilize existing anchor bolts embedded in concrete base. If a different bolt layout is required, include installation of new drilled chemical adhesive anchors. Cut off existing bolts if necessary for clearance.
6. Surface Finish:
a. Baked enamel or powder coat finish: in color to match Architect's sample.

7. Text and Typeface: Cutout letters in face of panel to expose white acrylic lighted lens behind. Sizes and fonts as indicated on drawings.
8. Flatness Tolerance: Sign panel shall remain flat under installed conditions as indicated and within a tolerance of plus or minus 1/16 inch (1.5 mm)

2.03 PANEL-SIGN MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Steel Materials:
1. Steel Members Fabricated from Plate or Bar Stock: ASTM A 529/A 529M or ASTM A 572/A 572M, 42,000-psi (290-MPa) minimum yield strength.
2. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.

D. Fiberglass-Reinforced Acrylic Sheet: Multiple laminations of translucent glass-fiber-reinforced acrylic-modified polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.

2.04 ELECTRONIC READER BOARDS

A. See Section 10 1500 - Video Display Systems.

2.05 DIMENSIONAL CHARACTERS

A. See Section 10 1419 - Dimensional Letter Signage.

2.06 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:
   a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
   b. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant slots unless otherwise indicated.
4. Sign Mounting Fasteners:
   a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated. Letter centers should be mounted to acrylic backup in this manner, along with adhesive.
   b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
   c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.

B. Adhesive: As recommended by sign manufacturer.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.07 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.

2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.08 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.09 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

B. Silkscreen Text: Shop-applied silkscreen text shall be UV-stable, weather and abrasion resistant, and compatible with base sign finish.

2.10 METALLIC-COATED STEEL FINISHES

A. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

2.11 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating according to coating manufacturer's written instructions.
   1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of 2 mils (0.05 mm).

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 signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that anchor inserts are correctly sized and located to accommodate signs.

D. Verify that electrical service is correctly sized and located to accommodate signs.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
   1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
   2. Install signs so they do not protrude or obstruct according to the accessibility standard.
   3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
   4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:
   1. Concealed Studs: Reuse existing studs embedded in concrete base. Where not possible, install new studs using a template for layout, drill holes in substrate aligning with studs on bottom of sign. Remove loose debris from hole and substrate surface and install chemical adhesive anchors. Cut off existing studs if necessary for clearance.
   2. Shim-Plate Mounting: Provide 1/8-inch- (3-mm-) thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using method specified above.

3.03 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION

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SECTION 10 1500 - VIDEO DISPLAY SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panelized LED video display systems.

1.02 REFERENCE STANDARDS

A. ANSI/Infocomm 10 - Audiovisual Systems Performance Verification; 2013.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting two weeks prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data sheets on panelized LED display systems including recommendations for preparation, storage and handling, and installation.
C. Shop Drawings: Indicate cable routing, connections between equipment, anchor and support details, and adjacent construction.
D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
E. Project Record Documents: Provide quantities, type, and location for components, cabling and accessories.
F. System Setting Backup: Provide an electronic file of all system settings.
G. Security Items:
   1. Provide one set of keys for each locked equipment enclosure.
   2. Provide passwords to access control functions for hardware and software user interfaces.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
B. Authorized Manufacturer Representative: System shall be configured and commissioned by an authorized manufacturer representative.
C. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

1.07 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Barco, Inc.: www.barco.com/#sle.
B. Daktronics, Inc.: www.daktronics.com/#sle.
C. LG Electronics: www.lg.com/us/business/#sle.
D. Watchfire Signs, LLC: www.watchfiresigns.com
E. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANELIZED LED VIDEO DISPLAY

A. Performance Requirements:
   1. Comply with performance standards based on tests conducted in accordance with ANSI/Infocomm 10.
B. System Type: Flat.
   1. Pixel Pitch: 10mm
   2. Horizontal Viewing Angle: 60 degrees.
   3. Vertical Viewing Angle: 70 degrees.
   4. Brightness: 8,000 maximum; adjustable

5. Mount Type: Free Standing/Self Supporting.
6. Location: Outdoor.
7. Panel Height: 35 inches (0.89 meters).
8. Panel Length: 104 inches (2.64 meters).
9. Panel Depth: 7 inches (0.18 meters).
10. Service Access: Front.
11. Data Connections: Shielded twisted pair CAT 5e/6e (Ethercon), Fiber Optic, or Remote Cellular.
12. Input Source Compatibility: HDMI.
13. Message Capability: Text, graphics, logos, basic animation, video clips, multiple font styles and sizes.
14. Display Dimming: 64 levels (Automatic, Scheduled or Manual Control).

C. Basis of Design: Daktronics Galaxy GT6x 10 MM

2.03 CONTROLS

A. Interface Unit:

1. Working Voltage: 120 VAC / 240 VAC at 60Hz.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrates and support structure is in place and properly prepared.
B. Verify that required power and data sources are provided.
C. Verify that space is available for centrally located components.
D. Notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Prepare substrates using the methods recommended by the manufacturer for achieving the best result under the project conditions.
B. Do not proceed with installation until support structure and substrates have been prepared using the methods recommended by the manufacturer and deviations from manufacturer's recommended tolerances are corrected. Commencement of installation constitutes acceptance of conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions .
B. Install message center and signs level and plumb with fasteners reccommended by the manufacturer.
C. Record any necessary changes to the system design.

3.04 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
B. See Section 01 7900 - Demonstration and Training, for additional requirements.
C. Demonstrate proper operation and maintenance of equipment to Owner's designated representative.
D. Review service and support contacts.

3.05 PROTECTION

A. Protect installed products from subsequent construction operations.

END OF SECTION

SECTION 10 2113.15 - FRP-CLAD TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. FRP-clad toilet compartments.
B. Urinal screens.

1.02 ABBREVIATIONS

A. FRP: Fiberglass reinforced plastic.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
E. ASTM D1621 - Standard Test Method for Compressive Properties Of Rigid Cellular Plastics; 2016.
F. ASTM D1622/D1622M - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2014.
G. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics; 2017 (Reapproved 2023).
H. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging; 2020.
I. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010 (Reapproved 2018).
J. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
K. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
L. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
M. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor; 2013a.
N. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact); 2016.
O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
P. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with placement of support framing and anchors in walls and ceilings.
   2. Coordinate the work with floor drain locations.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on panel construction, hardware, and accessories.
C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
   1. Indicate reinforcement locations for partition-mounted grab bars and surface-mounted toilet accessories.
   2. Show floor drain locations.
D. Samples:

1. Submit 3 samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.
2. Submit 3 sample sets of hardware and accessories indicating material and finish; each set to include door latch, hinge, and panel bracket.

E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

F. Test Reports: Show compliance to specified surface burning characteristics requirements.

G. Maintenance Data: Include data on regular cleaning.

H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Door Hinges: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
3. Door Latch, Strike, and Keeper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
4. Door Bumper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
5. Door Pull: Quantity equal to 2 percent of total installed, but not less than 2; including fasteners.
6. Fasteners: Quantity equal to 2 percent of each fastener type and size installed, but not less than 10 fasteners of each type and size.

1.06 QUALITY ASSURANCE

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

B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package partition panels and material as required to prevent damage before installation.

1.08 WARRANTY

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

B. Provide 10 year warranty against defects in workmanship and materials, including breakage and corrosion.

C. Provide limited lifetime warranty against failure of corner joinery, core deterioration, delamination or bubbling of panel skin, and fiberglass corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. FRP-clad Toilet Compartments:

1. Special-Lite, Inc.: www.special-lite.com.
2. Substitutions: Section 01 6000 - Product Requirements.

2.02 FRP-CLAD TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of FRP-clad foam core panels with extruded aluminum framing, floor-mounted headrail-braced.

1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Surface Burning Characteristics:
   a. Class C per ASTM E84; flame spread 25, maximum, and smoke developed 450, maximum.

B. Panel Construction: Extruded aluminum perimeter framing with poured-in-place foam core and FRP face sheets.

1. Framing: Extruded aluminum, ASTM B221, alloy 6063, temper T5.
   a. Channel profile with integral reglets to accept FRP face sheet on both sides of panel.
      1) Channel shall secure face sheets in place with flush appearance.

2) Provide mitered corners, mechanically fastened with stainless steel fasteners.

2. Foam Core: Poured-in-place foam.
   a. Manufacturer's standard polyurethane foam.
      1) Density: 5 pcf; ASTM D1622/D1622M.
      2) Compressive Strength: 60 psi; ASTM D1621.
      3) Tensile and Tensile Adhesion Properties: ASTM D1623.
         (a) FRP Facer, 3 inches square: 53 psi, minimum.
         (b) FRP Facer, 5 inches square: 104 psi, minimum.
      4) Thermal and Humid Aging: ASTM D2126; volume change at 158 degrees F and 100 percent humidity; 13 percent, maximum at 14 days.
3. Face Sheets: Fiberglass reinforced plastic (FRP).
   a. Thickness: 0.090 inch.
   b. Texture: Pebble grain.
   c. Color: Design Intent: Black..
   d. Performance:
      1) Flexural Strength: 8,500 psi, ASTM D790.
      2) Flexural Strength: 5,000 psi, ASTM D638.
      3) Barcol Hardness: 35, ASTM D2583.
      4) Izod Impact: 6 ft-lb per in, ASTM D256
      5) Gardner Impact Strength: 30 in-lb, ASTM D5420.
      6) Water Absorption: 0.16 percent, maximum after 24 hours at 77 degrees F, ASTM D570.
      7) Taber Abrasion Resistance: Taber test, CS-17 wheels, 1,000g weight, 25 cycles; 0.01 percent maximum weight loss.

C. Doors:
   1. Thickness: 1-1/4 inch.
   2. Width: 24 inch, unless otherwise indicated.
   3. Width for Handicapped Use: 36 inch, out-swinging, unless otherwise indicated.
   4. Height: 58 inch.

D. Panels:
   1. Thickness: 1-1/4 inch.
   2. Height: 58 inch.
   3. Widths: As indicated.

E. Pilasters:
   1. Thickness: 1-1/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

F. Urinal Screens: Wall mounted with continuous panel brackets.
   1. Thickness: 1-1/4 inch.
   2. Width: 24 inches, unless otherwise indicated.
   3. Height: 42 inches, unless otherwise indicated.

2.03 FRP-CLAD CHANGING COMPARTMENTS

A. Changing Compartments: Factory fabricated doors, pilasters, and divider panels made of FRP-clad foam core panels with extruded aluminum framing, floor-mounted headrail-braced.
   1. Accessibility: Comply with ICC A117.1 and ADA Standards.
   2. Surface Burning Characteristics:
      a. Class C per ASTM E84; flame spread 25, maximum, and smoke developed 450, maximum.

B. Panel Construction: Extruded aluminum perimeter framing with poured-in-place foam core and FRP face sheets.
   1. Framing: Extruded aluminum, ASTM B221, alloy 6063, temper T5.
      a. Channel profile with integral reglets to accept FRP face sheet on both sides of panel.
         1) Channel shall secure face sheets in place with flush appearance.
         2) Provide mitered corners, mechanically fastened with stainless steel fasteners.

2. Foam Core: Poured-in-place foam.
   a. Manufacturer's standard polyurethane foam.
      1) Density: 5 pcf; ASTM D1622/D1622M.
      2) Compressive Strength: 60 psi; ASTM D1621.
      3) Tensile and Tensile Adhesion Properties: ASTM D1623.
         (a) FRP Facer, 3 inches square: 53 psi, minimum.
         (b) FRP Facer, 5 inches square: 104 psi, minimum.
      4) Thermal and Humid Aging: ASTM D2126; volume change at 158 degrees F and 100 percent humidity; 13 percent, maximum at 14 days.
3. Face Sheets: Fiberglass reinforced plastic (FRP).
   a. Thickness: 0.090 inch.
   b. Texture: Pebble grain.
   c. Color: Standard color as selected by Architect.
   d. Performance:
      1) Flexural Strength: 8,500 psi, ASTM D790.
      2) Flexural Strength: 5,000 psi, ASTM D638.
      3) Barcol Hardness: 35, ASTM D2583.
      4) Izod Impact: 6 ft-lb per in, ASTM D256
      5) Gardner Impact Strength: 30 in-lb, ASTM D5420.
      6) Water Absorption: 0.16 percent, maximum after 24 hours at 77 degrees F, ASTM D570.
      7) Taber Abrasion Resistance: Taber test, CS-17 wheels, 1,000g weight, 25 cycles; 0.01 percent maximum weight loss.

C. Doors:
   1. Thickness: 1-1/4 inch.
   2. Width: 24 inch, unless otherwise indicated.
   3. Width for Handicapped Use: 36 inch, out-swinging, unless otherwise indicated.
   4. Height: 58 inch.
D. Panels:
   1. Thickness: 1-1/4 inch.
   2. Height: 58 inch.
   3. Widths: As indicated.
E. Pilasters:
   1. Thickness: 1-1/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

2.04 ACCESSORIES

A. Pilaster Shoes: Formed aluminum ASTM B209, 4 inch high, concealing floor fastenings.
   1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
B. Head Rails: Extruded anodized aluminum with anti-grip profile.
C. Wall, Pilaster, and Urinal Screen Brackets: Aluminum; continuous type.
   1. Provide full height T-shaped brackets at walls.
   2. Provide full height T-shaped brackets at urinal screens.
   3. Provide U and H-shaped brackets at all other locations.
D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
   1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
E. Hardware:
   1. Continuous Hinges: Full mortise continuous aluminum hinge, gravity self-positioning.
   2. Door Latch: Aluminum strike and slide-type latch; surface-applied and through bolted.
      a. Latches shall have exterior emergency access feature.
   3. Doorstop: Manufacturer's standard hollow bulb type.
      a. Install full length door stop to pilasters; for outswinging doors, apply stop to door.

4. Door Pull: Manufacturer's standard pull; install on outswinging doors and all ADA/barrier free doors.
5. Coat hook with rubber bumper; one per compartment, mounted on door.

2.05 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: Clear anodic coating; AAMA 611, minimum dry film thickness 0.7 mils.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
C. Align tops of doors and panels.
D. Attach panel brackets securely to walls using anchor devices.
E. Wall fasteners shall be located at masonry and tile joints; do not penetrate masonry or tile faces.
F. Align wall brackets and pilaster brackets.
G. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
H. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

3.05 SCHEDULES

A. Toilet / Shower A116: FRP Toilet Compartments as shown on plan.
B. Toilet / Shower A126: FRP Toilet Compartments as shown on plan.
C. Toilets A129 & A131: FRP Toilet Compartments as shown on plan.
D. Toilets B142 & B143: FRP Toilet Compartments as shown on plan.

END OF SECTION

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SECTION 10 2113.17 - PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Phenolic toilet compartments.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
D. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with placement of support framing and anchors in walls and ceilings.
   2. Coordinate the work with floor drain locations.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on panel construction, hardware, and accessories.
C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, door swings.
   1. Indicate reinforcement locations for partition-mounted grab bars and surface-mounted toilet accessories.
   2. Show floor drain locations.
D. Samples:
   1. Submit 3 samples of partition panels, 6 by 6 inch in size illustrating panel finish, color, and sheen.
   2. Submit 3 sample sets of hardware and accessories indicating material and finish; each set to include door latch, hinge, and panel bracket.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Test Reports: Show compliance to specified surface burning characteristics requirements.
G. Maintenance Data: Include data on regular cleaning.
H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Door Hinges: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
   3. Door Latch, Strike, and Keeper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
   4. Door Bumper: Quantity equal to 2 percent of total installed, but not less than 4; including fasteners.
   5. Door Pull: Quantity equal to 2 percent of total installed, but not less than 2; including fasteners.
   6. Fasteners: Quantity equal to 2 percent of each fastener type and size installed, but not less than 10 fasteners of each type and size.

1.05 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 experienced in installing the products specified in this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package partition panels and material as required to prevent damage before installation.

1.07 WARRANTY

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

B. Provide 10 year warranty against defects in workmanship and materials, including delamination, breakage, and corrosion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Toilet Compartments:

1. Accurate Partitions Corp., an ASI Group company: www.accuratepartitions.com.
2. All American Metal Corp - AAMCO: www.allamericanmetal.com.
3. Bobrick Washroom Equipment, Inc.: www.products.bobrick.com.
4. Bradley Corporation: www.bradleycorp.com.
5. Global Partitions Corp., an ASI Group company: www.globalpartitions.com.
6. Substitutions: Section 01 6000 - Product Requirements.

2.02 PHENOLIC TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted headrail-braced.

1. Accessibility: Comply with ICC A117.1 and ADA Standards.
2. Surface Burning Characteristics:
   a. Class A per ASTM E84; flame spread 75, maximum, and smoke developed 450, maximum.
3. Color: Two standard colors as selected by Architect.

B. Doors:

1. Thickness: 3/4 inch.
2. Width: 24 or 30 inch, as noted on plans.
3. Width for Handicapped Use: 36 inch, out-swinging, unless otherwise indicated.
4. Height: 96 inch.
5. Zero Sightline Rabbet.

C. Panels:

1. Thickness: 1/2 inch.
2. Height: 96 inch.
3. Widths: As indicated.

D. Pilasters:

1. Thickness: 3/4 inch.
2. Width: As required to fit space; minimum 3 inch.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.

1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.

B. Head Rails: Hollow stainless steel, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.

C. Wall and Pilaster Brackets: Satin stainless steel; continuous type.

D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.

1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.

E. Hardware: Satin stainless steel; heavy-duty type.

1. Barrel hinges, gravity type, adjustable for door close positioning; minimum two per door (aditional barrel hinges as recommended by manufacturer for doors over 58 inches in height).
2. Door Latch: Occupancy Indicator type with exterior emergency access feature.

3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
4. Coat hook with rubber bumper; one per compartment, mounted on door.
5. Provide door pull for outswinging doors.

F. Valance from top of door to bottom of ceiling at locations scheduled.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify correct spacing of and between plumbing fixtures.
C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
C. Align tops of doors and panels.
D. Attach panel brackets securely to walls using anchor devices.
E. Wall fasteners shall be located at masonry and tile joints; do not penetrate masonry or tile faces.
F. Align wall brackets and pilaster brackets.
G. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
H. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

A. Maximum Variation From True Position: 1/4 inch.
B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
C. Adjust adjacent components for consistency of line or plane.

3.05 SCHEDULES

A. Lockers A113 & Lockers A123: Phenolic Changing Compartments as indicated on plans.
B. Toilets E124, F124, & E224: Phenolic Toilet Compartment front attached to CMU wing walls as indicated on plans. Include valance above doors from top of door to bottom of ceiling.

END OF SECTION

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SECTION 10 2213 - WIRE MESH PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wire mesh systems for walls.

1.02 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
C. ASTM A510/A510M - Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel; 2020.
D. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for mesh materials, finishes.
C. Shop Drawings: Indicate plan and vertical dimensions, elevations, component details; head, jamb, and sill details; location of hardware. Provide component details, anchorage, and type and location of fasteners.
D. Samples: When requested by Architect:
   1. Submit 3 samples, 12 by 12 inch in size, illustrating mesh material and typical framing.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 5 years of documented experience.
B. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package wire mesh partitions and accessories as required to prevent damage before installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wire Mesh Partitions:
   1. Acorn Wire and Iron Works, Inc: www.acornwire.com.
   2. American Wire Corp.: www.americanwirecorp.com.
   3. Central Wire & Iron: www.centralwireandiron.com.
   4. Indiana Wire Products, Inc.: www.indianawireproducts.com.
   5. Spaceguard Products: www.spaceguardproducts.com.
   6. Standard Wire & Steel Works: www.standardwiresteel.com.
   7. WireCrafters: www.wirecrafters.com.
   8. Substitutions: See Section 01 6000 - Product Requirements.

2.02 WIRE MESH PARTITIONS

A. Wire Mesh Partitions: Factory-fabricated modular assemblies of panels, doors, anchors, hardware, and accessories as required to provide a complete system.
   1. Design Criteria:
      a. Design partition system to provide for movement of components without damage, undue stress on fasteners or other detrimental effects, when subject to design loads.
      b. Design system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.
   2. Performance Requirements:

a. Structural Performance: Wire mesh partitions shall withstand gravity loads and the following:
   1) Concentrated load of 50 lbf applied horizontally on 1 sq. ft. area at any location on panel.
   2) Total load of 200 lbf applied uniformly over panel.
   3) Concentrated load and total load need not be applied concurrently.

2.03 COMPONENTS

A. Woven Wire Mesh: Standard duty.
   1. Material: ASTM A510/A510M uncoated crimped steel wire.
   2. Wire Size: 10 gauge, 0.135 inch.
   3. Mesh Opening Size: 1-1/2 inch diamond shape.
   4. Mesh Weave: Plain weave, inter-crimped.

B. Framing and Support Members:
   1. Material: ASTM A36/A36M steel shapes and ASTM A500/A500M cold-formed steel tubing.
   2. Framing, Corner Posts, and Intermediate Support Members: Manufacturer's standard sizes for system specified and as indicated on drawings.
   3. Vertical Stiffeners: As required for partitions greater than 144 inches in height.

C. Doors: Same material as partitions, fully framed; manufacturer's standard construction and hardware for swing operation.
   1. Hinges: 3 per door, minimum; welded to door and jamb framing.
   2. Locking: Mortise type cylinder locks, keyed on outside, operated by recessed turn knob inside.
      a. Cylinder locks as specified in Section 08 7100 - Door Hardware.

2.04 FASTENERS

A. Bolts, Nuts and Washers: Hot dip galvanized.

B. Anchorage Devices: Provide power driven, drilled expansion bolts, and screws with sleeves.

C. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of structure.

2.05 ACCESSORIES

A. Bracing: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined for conditions encountered, manufacturer's standard shapes, same finish as framing members.

C. Post Caps: Manufacturer's standard.

D. Floor and Ceiling Pilaster Shoe: Manufacturer's standard.

E. Floor Base: Manufacturer's standard.

2.06 FABRICATION

A. Fit and assemble in largest practical sections for delivery to site, ready for installation.

B. Make exposed joints flush or tight.

C. Weld framing joints and grind smooth.

D. Provide components and fasteners required for anchorage to adjacent construction.

E. Frame openings for penetrating mechanical, electrical, and other components.

F. Provide stiffeners as required by panel span and as recommended by wire mesh manufacturer. Weld stiffeners to framing.

G. Fabricate wire mesh partitions with bottom horizontal framing 3 to 4 inches above finished floor.

H. Align bottom of doors with bottom horizontal framing of adjacent panels.

2.07 FINISHES

A. Painted Finish: Manufacturer's standard powder coat finish.

1. Color: Black or gray.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces and required openings are ready to receive work.

3.02 PREPARATION

A. Clean substrate surfaces.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install items plumb and level, accurately fitted, free from distortion or defects.
C. Perform field welding in accordance with AWS D1.1/D1.1M.
D. After installation, touch-up field welds and scratched or damaged surfaces as recommended by wire mesh partition manufacturer.

3.04 TOLERANCES

A. Maximum Variation From Plumb or Level: 1/4 inch.
B. Maximum Misalignment From True Position: 1/4 inch.

3.05 ADJUSTING

A. Adjust doors to achieve free movement.

3.06 CLEANING

A. Remove temporary protection to prefinished surfaces.

END OF SECTION

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SECTION 10 2239 - FOLDING PANEL PARTITIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Top-supported folding panel partitions, horizontal opening.
   1. Manual paired panels.
   2. Manual single panels.
B. Self-supporting truss system.

1.02 REFERENCE STANDARDS

A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2020.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2021a.
E. ASTM A513/A513M - Standard Specification for Electric-Resistance-Welded Carbon and Alloy Steel Mechanical Tubing; 2020a.
F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
J. ASTM E413 - Classification for Rating Sound Insulation; 2022.
K. ASTM E557 - Standard Guide for Architectural Design and Installation Practices for Sound Isolation Between Spaces Separated by Operable Partitions; 2012 (Reapproved 2020).

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene at project site seven calendar days prior to scheduled beginning of construction activities of this section to review section requirements.
   1. Require attendance by representatives of installer.
   2. Notify Architect 5 business days in advance of scheduled meeting date.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on partition materials, operation, hardware and accessories, electric operating components, and track switching components.
C. Design Data: Design calculations, bearing seal and signature of structural engineer licensed to practice in the State in which the Project is located, showing loads at points of attachment to the building structure.
D. Shop Drawings: Indicate opening sizes, track layout, details of track and required supports, static and dynamic loads, adjacent construction and finish trim, and stacking depth.
   1. Include wiring diagrams of power and control wiring.
E. Samples:
   1. Fabric Finishes: Submit 3 samples of each fabric, 8 by 10 inch in size illustrating color, finish, and texture.
F. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.
I. Operation and Maintenance Data: Operating procedures, troubleshooting and repair methods, wiring diagrams, parts lists, and identification of authorized maintenance firms located in vicinity of project.
J. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods. Describe cleaning materials detrimental to finish surfaces and hardware finish.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified this section with minimum 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least 5 years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide two year manufacturer warranty against defects in material and workmanship, excluding abuse.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manual Individual Omni-Directional Panels.
1. Kwik-Wall Company; Hufcor Series 641: www.kwik-wall.com.
2. Modernfold, a DORMA Group Company; Acousti-Seal Premier: www.modernfold.com.
3. Moderco, Inc.; Signature 841 Series: www.moderco.com.
4. Substitutions: See Section 01 6000 - Product Requirements.
B. Manual Paired Panels.
1. Kwik-Wall Company; Hufcor Series 642: www.kwik-wall.com.
2. Modernfold, a DORMA Group Company; Acousti-Seal Premier: www.modernfold.com.
3. Moderco, Inc.; Signature 842 Series: www.moderco.com.
4. Substitutions: See Section 01 6000 - Product Requirements.
C. Self-supporting Truss System.
1. Kwik-Wall Company; Hufcor Unispan Self Support System: www.kwik-wall.com.
2. Modernfold, a DORMA Group Company; Truss System: www.modernfold.com.
3. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panel Partitions:
1. Manually Operated: Side-opening; paired panels or indivdiual panels; side stacking; manually operated.
B. Panel Construction:
1. Frame: 16 gauge, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
2. Panel Substrate Facing: Steel sheet, manufacturer's standard thickness.
3. Hinges: Panel manufacturer's standard butt type; minimum of 3 hinges per panel joint.
4. Panel Properties:
a. Thickness Without Finish: 4 inches.
b. Width: Up to 48 inches (1219 mm).
c. Weight: 8 lb/sq ft.
C. Panel Finishes:
1. Facing Paired Panels: Markerboard, **Type 2 Vinyl Coated Fabric **ADD4****

2. Facing Omni Directional Panels: Black Hardware, Black Type 2 Vinyl Coated Fabric
3. Exposed Metal Trim: Custom powder coated paint finish.

D. Panel Seals:
1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
2. Acoustic Seals: Flexible acoustic seals at jambs and ceilings, retractable floor seals.

E. Suspension System:
1. Track: Formed steel or extruded aluminum; thickness and profile designed to support loads.
   a. Track shall provide support for adjacent ceiling materials.
   b. Connect track to structural support with adjustable steel hanger brackets and 3/8 inch diameter threaded rods.
      1) Hanger bracket thickness and profile designed to support track and associated loads.
   c. Include all associated hardware and accessories.
2. Carriers: Nylon wheels on trolley carrier at top of every panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Performance Requirements:
1. Acoustic Performance:
   a. Sound Transmission Class (STC): 43 to 47 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90, on panel size of 100 sq ft.
2. Surface Burning Characteristics of Panel Finish: Flame spread/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
3. Installed partition system track capable of supporting imposed loads, with maximum deflection of 1/360 of span.

G. Accessories:
1. Work Surfaces:
   a. Markerboard: Bonded to panel face.
      1) Material: Porcelain enameled steel sheet.
      2) Size: Width of panel by 48 inches high.
      3) Trim: Manufacturer's standard horizontal trim without exposed fasteners; for uninterrupted work surface, panel-to-panel, no vertical trim permitted.
      4) Locations: As indicated.
   b. Tackable Surface: Bonded to panel face.
      1) Material: Vinyl-Coated fabric over 1/4 inch natural cork sheet.
      2) Size: Full width and height of panel.
      3) Trim: Manufacturer's standard horizontal trim without exposed fasteners; for uninterrupted work surface, panel-to-panel, no vertical trim permitted.
      4) Locations: As indicated.
2. Pocket Door/Enclosures: Manufacturer's standard pocket door, frame, and trim.
   a. Omni-Directional Doors only. No pocket door enclosure at paired doors.
   b. Same construction as panels.
   c. Frame: Adjustable metal frame; flush design.
   d. Hardware: Manufacturer's standard hardware including:
      1) Hinges: 3, minimum.
      2) Recessed operating hardware.
      3) Keyed lock.
         (a) Cylinder and core as specified in Section 08 7100 - Door Hardware.
   e. Safety Features:
      1) Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.
   f. Factory finished to match partition panels.

2.03 SELF-SUPPORTING TRUSS SYSTEM

A. Self-Supporting Truss System: Manufacturer's standard, engineered, steel or aluminum, floor supported, sectional truss system designed to support folding panel partitions and track independent of building structure except for lateral bracing.
   1. Configuration: Horizontal truss supported by vertical post at each end.
   2. Fabrication:
      a. Component Sizes: As engineered by truss system manufacturer.
      b. Fabricate truss in sections for field assembly.
      c. Design posts to be securely anchored to floor.
   3. Provide lateral bracing to building's overhead structure at intervals recommended by truss system manufacturer; bracing size and configuration engineered by truss system manufacturer.

2.04 MATERIALS

A. Aluminum Extrusions: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
C. Steel Tubes: ASTM A500/A500M or ASTM A513/A513M, Type 5
D. Steel Sheet: Cold rolled commercial steel or structural steel; ASTM A1008/A1008M.
E. Vinyl-Coated Fabric:
   1. Products:
      a. Fabric: As selected from manufacturer's full line.
      b. Color: Architect to select **up to two colors** from manufacturer's full line. ****ADD4****
F. Markerboard - Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
   1. Color: As selected from manufacturer's full range.
G. Tackboard - Natural Cork Sheet: Seamless, compressed, fine-grain cork sheet; bulletin board quality; sanded face for natural finish
H. Acoustic Insulation:
   1. Type: Manufacturers standard.
   2. Thickness: As required for acoustic performance indicated.

2.05 FINISHES

A. Steel and Aluminum Finishes: Manufacturer's standard powder coated paint.
   1. Color: Standard color as selected by Architect.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.
B. Verify that required utilities are available, of the correct characteristics, in proper location, and ready for use.
C. Verify floor flatness of 1/8 inch in 10 feet, non-cumulative.
D. Verify wall plumbness of 1/8 inch in 10 feet, non-cumulative.

3.02 INSTALLATION

A. Install partition in accordance with manufacturer's instructions and ASTM E557.
B. Install self-supporting truss system including lateral bracing in accordance with manufacturer's instructions.
C. Install components level and plumb.
D. Install electric operator, wiring, and controls. Locate control station(s) as indicated.
E. Fit and align partition assembly and pocket doors level and plumb.

3.03 ADJUSTING

A. Adjust partition assembly to provide smooth operation from stacked to full open position. Do not over-compress acoustic seals.

B. Visually inspect partition in full extended position for light leaks to identify a potential acoustical leak.
C. Adjust partition assembly to achieve lightproof seal.

3.04 CLEANING

A. Clean finish surfaces and partition accessories.
B. Condition markerboard surfaces in accordance with manufacturer's instructions.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION

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SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.
B. Protective wall covering.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, and anchorage details.
C. Shop Drawings: Include plans, elevation, sections, and attachment details.
D. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
   1. For each type and finish of corner guard, submit 3 samples, 12 inches long.
E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
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. Corner Guard Covers: Quantity equal to 2 percent of total installed, but not less than 4; in same lengths as installed units.
G. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
B. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.
C. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide five year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Corner Guards:
   1. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Corner Guards: www.c-sgroup.com/#sle.
   2. Inpro; Solid Color Corner Guards: www.inprocorp.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.
B. Protective Wall Panels: Fiber Reinforced Laminate (WP1):
   1. Inpro; Palladium Rigid Sheet: www.inprocorp.com.
   2. Construction Specialties, Inc; Acrovyn Wall Panels: www.c-sgroup.com/acrovyn-wall-protection.

2.02 PRODUCT TYPES

A. CG1Corner Guards - Plastic, Surface Mounted:

1. Material: One of the following, with full height extruded aluminum retainer:
   a. High impact vinyl.
   b. Polyethylene terephthalate (PET or PETG); PVC-free.
2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
4. Width of Wings: 3 inches.
5. Corner: Radiused, 1/4 inch.
6. Corner Angle: 90 degrees; and as otherwise indicated.
7. Color: Corner Guard to match adjacent wall color or adjacent wall protection color.
   a. To match Inpro Wall Protection: Pebble Gray, 0387
   b. To match Inpro Wall Protection: Castle, 0256
   c. To match Inpro Wall Protection: Crystal Jade, 0187
   d. To match Inpro Wall Protection: Rattan 0276
   e. To match Inpro Wall Protection: Sonora, 0282
   f. To match Inpro Wall Protection: Buoyant Blue, 0132
   g. To match Inpro Wall Protection: Island Blue, 03814
   h. To match Acrovyn Wall Protection: Cucumber, 1595
   i. To match Acrovyn Wall Protection: Tea Rose, 1588
8. Projection From Wall to Outside of Guard: 3/8 inch, maximum.
9. Length: One piece.
   a. Height: 84 inches.
10. Products:
    a. Construction Specialties, Inc; Model SM-20AN: www.c-sgroup.com.
    b. Inpro Corp; Model 150 High Impact: www.inprocorp.com.
    c. Substitutions: Not permitted.

B. Protective Wall Panels (WP1):
1. Material: Fiber Reinforced Laminate (FRL): Thermofused melamine overlay, decorative paper and fire-rated phenolic paper with fiber reinforcing inner layers.
2. Thickness: 1 mm
3. Panel Size: 4 feet by 8 feet.
4. Color and Pattern:
   a. WP1A: Pebble Gray, 0387
   b. WP1B: Castle, 0256
   c. WP1C: Crystal Jade, 0187
   d. WP1D: Rattan 0276
   e. WP1E: Sonora, 0282
   f. WP1F: Buoyant Blue, 0132
   g. WP1G: Island Blue, 03814
5. Texture: As selected from manufacturer's standard textures.
6. Accessories: Provide manufacturer's standard PVC color-matched trim, moldings, and caulk.
   a. Outside Corner Trim: G2-3412.
   b. Inside Corner Trim: G2-409
   c. Top Cap: G2-407
   d. Vertical Divider Bar: G2-408
   e. Color Matched Caulk: Match adjacent wall paneling
7. Products:
   a. Inpro, Palladium Rigid Sheet
   b. Substitutions: Not permitted

C. Protective Wall Panels(WP2):

1. Material: Fiber Reinforced Laminate (FRL): Thermofused melamine overlay, decorative paper and fire-rated phenolic paper with fiber reinforcing inner layers.
2. Thickness: 0.040
3. Panel size:
4. Color and Pattern:
   a. WP2A: Cucumber, 1595
   b. WP2B: Tea Rose, 1588
   c. WP2C: Warm Sugar Maple, 1717
5. Texture: As selected from manufacturer's standard textures
6. Accessories: Provide manufacturer's standard PVC color-matched trim, moldings and caulk.
7. Products:
   a. Construction Specialties, Inc., Acrovyn Wall Panels
   b. Substitutions: Not permitted

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.04 SOURCE QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.

B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work of this Section.

B. For flush mounted corner guards, verify that gypsum board recess is properly sized.

C. Verify that substrate surfaces for adhered items are clean and smooth.

1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches above finished floor to ceiling; unless otherwise indicated.

C. Corner Guards - Plastic, Surface Mounted:

1. Mechanically fasten continuous metal retainers to substrate.
2. Snap-on plastic finish cover.

D. Position protective wall covering no less than Four (4) inch above finished floor to allow for floor level variation.

1. Full-Height Installation: Establish a plumb line located at edge of starting point of first sheet to ensure following sheets will be installed plumb.
2. Wainscot Installation: Establish a level line at the specified height for entire length of run. Install by aligning top of edge of covering with this line.
3. Apply adhesive with 1/8 inch V-notch trowel to an area of wall surface that can be completed within cure time of the adhesive.
4. Install trim pieces as required for a complete installation. Allow tolerance for thermal movement.
5. Use a roller to ensure maximum contact with adhesive.
6. At inside and outside corners cut covering sheets to facilitate installation of trim pieces or corner guards.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

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SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.
B. Commercial shower and bath accessories.
C. Electric hand dryers.
D. Diaper changing stations.
E. Utility room accessories.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
E. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2018.
H. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use; 2022.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
C. Samples: When requested by Architect.
    1. Submit 3 sample for each color and finish, 2 by 2 inch in size.
D. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
E. Operation and Maintenance Data: Include operating procedures and recommended cleaning 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. Hand Dryer Filters: For units with filters, provide quantity equal to 2 filters per unit installed. .

1.05 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 experienced in installing the products specified in this section with minimum 5 years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package toilet, bath, and laundry accessories as required to prevent damage before installation.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Mirrors: Provide 15 year warranty against silver spoilage.
C. Electric Hand Dryers: Provide 5 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design:
    1. Commercial Toilet, Shower, and Bath Accessories, including Utility Room Accessories: Provide product indicated or a comparable product by one of the following:
        a. American Specialties, Inc, (ASI): www.americanspecialties.com.
        b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
        c. Bradley Corporation: www.bradleycorp.com.
        d. Substitutions: Section 01 6000 - Product Requirements.
    2. Electric Hand Dryers: Provide product indicated or a comparable product by one of the following:
        a. American Specialties, Inc, (ASI): www.americanspecialties.com.
        b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
        c. Bradley Corporation: www.bradleycorp.com.
        d. Excel Dryer Inc.: www.exceldryer.com.
        e. World Dryer Corp.: www.worlddryer.com.
        f. Substitutions: Section 01 6000 - Product Requirements.
    3. Diaper Changing Stations: Provide product indicated or a comparable product by one of the following:
        a. American Specialties, Inc, (ASI): www.americanspecialties.com.
        b. Bobrick Washroom Equipment, Inc.: www.bobrick.com.
        c. Bradley Corporation: www.bradleycorp.com.
        d. World Dryer Corp.: www.worlddryer.com.
        e. Substitutions: Section 01 6000 - Product Requirements.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
B. Keys: Provide 2 keys for each accessory to Owner; master key lockable accessories.
C. Stainless Steel Sheet: ASTM A666, Type 304.
D. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
E. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
F. Zinc Alloy: Die cast, ASTM B86.
G. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
H. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.
I. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

A. Toilet Paper Dispenser - Owner Furnished, Contractor Installed.
B. Paper Towel Dispenser: Owner Furnished, Contractor Installed.
C. Waste Receptacle: Owner Furnished, Contractor Installed.
D. Soap Dispenser: Owner Furnished, Contractor Installed.

E. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
   1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
   2. Size: As indicated on drawings.
   3. Frame: Angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
   4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
   5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-290.
F. Grab Bars: Stainless steel, smooth surface.
   1. Standard Duty Grab Bars:
      a. Push/Pull Point Load: 250 pound-force, minimum.
      b. Dimensions: 1-1/2 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
      c. Finish: Satin, slip-resistant surface.
      d. Length and Configuration: As indicated on drawings.
      e. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6806 Series.
G. Combination Sanitary Napkin/Tampon Dispenser: Owner Furnished, Contractor Installed.
H. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, removable receptacle.
   1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-270.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

A. Shower Curtain Rod: Stainless steel tube, 1-1/4 inch outside diameter, 0.05 inch wall thickness, satin-finished, with 2-1/2 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for concealed mounting.
   1. Length: As indicated on Drawings.
   2. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6047.
B. Shower Curtain and Hooks:
   1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
   2. Size: As indicated on Drawings, hemmed edges.
   3. Grommets: HDPE grommets; pierced through top hem on 6 inch centers.
   4. Color: White.
   5. Shower Curtain Hooks: Stainless steel spring wire designed for snap closure.
   6. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-204 Series.
C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped reversible seat.
   1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of white color.
   2. Size: ADA Standards compliant.
   3. Load: Supports 350 pounds, minimum.
   4. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-5181.
D. Soap Dish - Surface-Mounted: Normal duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.
   1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-6807.
E. Robe Hook - Vandal-Resistant: Heavy-duty stainless steel; single-prong hook that releases at 40 pound load; rectangular-shaped base with sloped edges; satin finish; tamper-resistant exposed fasteners.
   1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-983.

2.06 ELECTRIC HAND DRYERS

A. Electric Hand Dryers: Traditional fan-in-case type, with downward fixed nozzle.
   1. Operation: Automatic, sensor-operated on and off.
   2. Mounting: Surface mounted.
      a. Maximum Projection From Wall: 4 inches.
   3. Cover: Epoxy painted steel or die-cast zinc alloy.
      a. Color: White.
      b. Tamper-resistant screw attachment of cover to mounting plate.
      c. Screened or shielded air intake.
      d. Screen or shield to prevent access to motor/heater.
   4. Air Flow: 70 CFM, minimum.
   5. Noise: 70, maximum, 39 inches from unit; with hands under nozzle.
   6. Total Wattage: 1000 W, maximum.
   7. Runtime: 60 to 90 seconds, maximum.
   8. Supply Voltage: 240 V, single phase, 60 Hz, nominal, unless otherwise indicated.
   9. Warranty: 10 years.
   10. Basis-of-Design Product: Bobrick Washroom Equipment.; QuietDry Series Terra Dry B-7180: www.bobrick.com. Provide the basis-of-design product or one of the following:
      a. American Specialties, Inc, (ASI) ; Model 0185: www.americanspecialties.com.
      b. World Dryer Corp.; SLIMdri: www.worlddryer.com.
      c. Substitutions: Section 01 6000 - Product Requirements.

2.07 DIAPER CHANGING STATIONS

A. Diaper Changing Station: Wall-mounted, horizontal, folding diaper changing station for use in commercial toilet facilities, meeting or exceeding ASTM F2285.
   1. Material: Polyethylene.
   2. Mounting: Surface.
   3. Color: Standard color as selected by Architect.
   4. Minimum Rated Load: 250 pounds.
   5. Include an integral bed liner dispenser; 50 liner capacity.
   6. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; KB300-SS

2.08 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
   1. Drying rod: Stainless steel, 1/4 inch diameter.
   2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
   3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
   4. Length: 36 inches.
   5. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-224.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify exact location of accessories for installation.
C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
B. Install plumb and level, securely and rigidly anchored to substrate.
C. Mounting Heights: As indicated and as required by accessibility regulations.
D. Where possible, locate wall fasteners at masonry and tile joints; do not penetrate masonry or tile faces.

3.03 PROTECTION

A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 4400 - FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.
B. Fire extinguisher cabinets.

1.02 REFERENCE STANDARDS

A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
B. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
C. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, and anchorage details.
C. Shop Drawings: Indicate locations of cabinets, cabinet physical dimensions, rough-in measurements for recessed cabinets, locations of individual fire extinquishers, mounting measurements for wall bracket, and accessories required for complete installation.
D. Samples: When requested by Architect.
   1. Submit 3 sample for each color and finish, 2 by 3 inch in size.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

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 experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Fire Extinguishers: 5 year warranty against defects in workmanship and materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
   2. Croker Division of Fire-End and Croker Corp.: www.croker.com.
   3. Larsen's Manufacturing Co: www.larsensmfg.com.
   4. Nystrom, Inc: www.nystrom.com.
   5. Potter-Roemer: www.potterroemer.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.
B. Fire Extinguisher Cabinets and Accessories:
   1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com.
   2. Croker Division of Fire-End and Croker Corp.: www.croker.com.
   3. Larsen's Manufacturing Co: www.larsensmfg.com.
   4. Nystrom, Inc: www.nystrom.com.
   5. Potter-Roemer: www.potterroemer.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
   1. Provide extinguishers labeled by UL (DIR) or testing firm acceptable to authorities having jurisdiction for purpose specified and as indicated.
B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
   1. Class: A:B:C type.
   2. Size: 10 pound.
      a. UL Rating: 4A-60B:C.
   3. Finish: Baked polyester powder coat, red color.
   4. Minimum Operational Temperature: Minus 65 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
B. Cabinet Construction: Non-fire rated.
   1. Formed primed steel sheet; minimum 0.036 inch (20 gage) thick base metal.
C. Fire Rated Cabinet Construction: Fire rating equal to wall in which installed.
   1. Primed steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
      a. Minimum Thickness: 0.036 inch (20 gage).
D. Cabinet Configuration: Recessed and semi-recessed type.
   1. Size to accommodate fire extinguisher.
   2. Trim - Recessed Cabinets: Flat square edge, with minimum 1-3/4 inch wide face. Stainless steel.
   3. Projected Trim - Semi-Recessed Cabinets: Returned to wall surface, with 2-1/2 inch rolled-edge projection, and 1-3/4 inch wide face. Stainless steel.
   4. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim.
E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with roller type catch. Hinge doors for 180 degree opening with continuous piano hinge.
   1. Metal: Stainless steel.
F. Door Glazing: Tempered glass, clear, 1/8 inch thick, and set in resilient channel glazing gasket.
   1. Style: Vertical duo panel glazing.
G. Door Pull: Manufacturer's standard flush/recessed pull handle.
H. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
I. Fabrication: Weld, fill, and grind components smooth.
J. Finish of Cabinet Exterior Trim and Door: No. 4 - Brushed stainless steel.
K. Finish of Cabinet Interior: White; powder coat.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, painted black. Sized for fire extinguishers specified.
B. Lettering: “FIRE EXTINGUISHER” diecut self-adhering black, equally spaced, lettering; provide in accordance with authorities having jurisdiction (AHJ).
   1. Locations: Unless otherwise indicated:
      a. Fire Extinguisher Cabinets: Locate on door.
         1) Lettering shall be applied at the factory.
      b. Wall brackets: Locate above fire extinguisher and bracket.
   2. Orientation: Vertical.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.
B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install cabinets and fire extinguisher brackets plumb and level at mounting heights indicated and in accordance with authorities having jurisdiction (AHJ).
C. Secure rigidly in place.
D. Place extinguishers in cabinets and on wall brackets.
E. Apply fire extinguisher lettering to walls above wall bracket mounted fire extinguishers in accordance with authorities having jurisdiction (AHJ).
F. Adjust cabinet doors for smooth operation.

3.03 PROTECTION

A. Protect installed fire protection specialties from damage due to subsequent construction operations.

END OF SECTION

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SECTION 10 5113 - METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.
B. Locker benches.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
C. Shop Drawings: Indicate locker plan layout, numbering plan.
D. Samples: Submit 3 samples 2 by 3 inches in size showing each color and finish of metal locker material.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
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 Hooks: For each type, quantity equal to 2 percent of total installed, but not less than 50.

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 experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect locker finish and adjacent surfaces from damage.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Lockers: Provide the following warranty lengths against defects in workmanship and materials.
    1. Knock-down Lockers: 2 years.
    2. All-welded Lockers: 10 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain lockers and locker benches from one manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Accessibility: Comply with ICC A117.1 and ADA Standards.

2.03 CORRIDOR LOCKERS - KNOCK DOWN

A. Corridor Lockers:
    1. Basis of Design: Republic Storage Products, LLC; Multi Point II Corridor Lockers: www.republicstorage.com.
        a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
            1) ASI Storage Solutions; Traditional Plus Collection: www.asistorage.com.
            2) Hadrian Inc.; Emperor Lockers: www.hadrian-inc.com.
            3) List Industries, Inc.; Marquis Student KD Lockers: www.listindustries.com.
            4) Lyon Workspace Products: www.lyonworkspace.com.

5) Penco Products, Inc; Guardian Defiant II Lockers: www.pencoproducts.com.
6) Lockers Manufacturing; Knock Down Plus: www.lockersmfg.com.
7) Substitutions: See Section 01 6000 - Product Requirements.

2. L-1
   a. Configuration: Single tier.
      1) Overall Width: 12 inches.
      2) Overall Depth: 15 inches.
      3) Overall Height: 72 inches.
   b. Fittings:
      1) Book shelf.
      2) Hooks:
         (a) Back Wall: One single prong hook.
         (b) Side Walls: One single prong hook on each wall.
      3) Number Plate: Locate at top of door.
   c. Ventilation: Concealed perforations in top and bottom door returns.
   d. Locking: Multi-point latching. Recessed handle and latch with padlock hasp.
   e. Provide continuous sloping top, filler panels, recess trim, boxed end panels, and continuous metal base.
   f. Color:
      1) Standard color(s) as selected by Architect.
3. L-2
   a. Configuration: Two tier.
      1) Overall Width: 12 inches.
      2) Overall Depth: 15 inches.
      3) Overall Height: 60 inches.
      4) Height of Each Compartment: 30 inches
   b. Fittings:
      1) Book shelf.
      2) Hooks:
         (a) Back Wall: One single prong hook.
         (b) Side Walls: One single prong hook on each wall.
      3) Number Plate: Locate at top of door.
   c. Ventilation: Concealed perforations in top and bottom door returns.
   d. Locking: Multi-point latching. Built-in combination locks.
   e. Provide continuous sloping top, filler panels, recess trim, boxed end panels, and continuous metal base.
   f. Color: Allow for 2 different colors.
      1) Standard color(s) as selected by Architect.
4. L-3
   a. Configuration: Single tier.
      1) Overall Width: 12 inches.
      2) Overall Depth: 15 inches.
      3) Overall Height: 30 inches.
   b. Fittings:
      1) Hooks:
         (a) Back Wall: One single prong hook.
         (b) Side Walls: One single prong hook on each wall.
      2) Number Plate: Locate at top of door.
   c. Ventilation: Concealed perforations in top and bottom door returns.
   d. Locking: Multi-point latching. Built-in combination locks.
   e. Provide filler panels, recess trim, boxed end panels, and continuous metal base.
   f. Color: Allow for 2 different colors.
      1) Standard color(s) as selected by Architect.
         (a) Color A: Grey

(b) Color B: Yellow

B. Lockers: Knock-down assembly, made of formed sheet steel, Cold-rolled mild steel, uncoated, stretcher leveled; metal edges finished smooth without burrs; baked enamel/powder coat finished inside and out. Minimum sheet steel thickness are indicated below.
1. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
a. Back: 0.024 inch (24 gage).
b. Sides and Top: 0.024 inch (24 gage).
c. Bottom: 0.060 inch (16 gage).
d. Shelf: 0.024 inch (24 gage).
2. Frames: Formed channel shape, welded and ground flush, welded to body.
a. Door Frames: 0.060 inch (16 gage).
3. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
a. Door Thickness: 0.075 inch (14 gage).
b. Ventilation: Standard visible louvers at top and bottom of doors.
4. Handles: Stainless steel or aluminum recessed cup.
a. Locking Device: Padlock hasp.
b. Frame Hook: 0.12 inch (11 gage) steel.
5. Hinges: Provide one of the following.
a. Continuous piano hinge with powder coat finish to match locker color.
b. Heavy duty, 5-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
6. Sloping Top: 0.060 inch (16 gage).
7. Filler Panels: 0.060 inch (16 gage).
8. Recess Trim: 0.060 inch (16 gage).
9. End Panels: Boxed end panels; 0.060 inch (16 gage).
10. Metal Bases: Zee bases, 0.075 inch (14 gage).
a. Galvannealed ASTM A653/A653M, A40.
b. Base Height: 4 inches.
11. Coat Hooks: Stainless steel or zinc-plated steel.
12. Number Plates: Provide rectangular or oval shaped aluminum plates. Form numbers 1/2 inch high, in block font style; black color.

2.04 ATHLETIC LOCKERS - ALL-WELDED

A. Athletic Lockers:
1. Basis of Design: Republic Storage Products, LLC; Multi Point II Athletic Lockers - All Welded: www.republicstorage.com.
a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
1) ASI Storage Solutions; Competitor Collection - All-Welded: www.asistorage.com.
2) DeBourgh Manufacturing Company; Corregidoor Team Lockers: www.debourgh.com.
3) List Industries, Inc.; Marquis Champion Lockers: www.listindustries.com.
4) Penco Products, Inc; All Welded Defiant II SPL Lockers : www.pencoproducts.com.
5) Substitutions: See Section 01 6000 - Product Requirements.
2. L-4
a. Configuration: Single tier.
1) Overall Width: 15 inches.
2) Overall Depth: 15 inches.
3) Overall Height: 60 inches.
b. Fittings:
1) Hooks:

(a) Back Wall: One single prong hook.
(b) Side Walls: One single prong hook on each wall.
2) Number Plate: Locate at top of door.
c. Ventilation: Perforated doors and side panels.
d. Locking: Multi-point latching. Recessed handle and latch with padlock hasp.
e. Provide continuous sloping top, filler panels, and recess trim.
f. Color:
1) Standard color(s) as selected by Architect.

3. L-5
a. Configuration: Five tier.
1) Overall Width: 15 inches.
2) Overall Depth: 15 inches.
3) Overall Height: 60 inches.
4) Height of Each Compartment: 12 inches
b. Fittings:
1) Hooks:
(a) Back Wall: One single prong hook.
(b) Side Walls: One single prong hook on each wall.
2) Number Plate: Locate at top of door.
c. Ventilation: Perforated doors and side panels.
d. Locking: Multi-point latching. Recessed handle and latch with padlock hasp.
e. Provide continuous sloping top, filler panels, and recess trim.
f. Color:
1) Standard color(s) as selected by Architect.

4. L-6
a. Configuration: Two tier.
1) Overall Width: 15 inches.
2) Overall Depth: 15 inches.
3) Overall Height: 60 inches.
4) Height of Each Compartment: 30 inches
b. Fittings:
1) Hooks:
(a) Back Wall: One single prong hook.
(b) Side Walls: One single prong hook on each wall.
2) Number Plate: Locate at top of door.
c. Ventilation: Perforated doors and side panels.
d. Locking: Multi-point latching. Recessed handle and latch with padlock hasp.
e. Provide continuous sloping top, filler panels, and recess trim.
f. Color:
1) Standard color(s) as selected by Architect.

5. L-7
a. Configuration: Two tier.
1) Overall Width: 15 inches.
2) Overall Depth: 15 inches.
3) Overall Height: 60 inches.
4) Height of Each Compartment: 30 inches
b. Fittings:
1) Hooks:
2) Back Wall: One single prong hook.
3) Side Walls: One single prong hook on each wall.
4) Number Plate: Locate at top of door.
c. Ventilation: Perforated doors and side panels.
d. Locking: Multi-point latching. Recessed handle and latch with padlock hasp.
e. Provide continuous sloping top, filler panels, and recess trim.

f. Color:
1) Standard color(s) as selected by Architect.

B. Lockers: All-welded assembly, made of formed sheet steel, Cold-rolled mild steel, uncoated, stretcher leveled; metal edges finished smooth without burrs; baked enamel/powder coat finished inside and out. Minimum sheet steel thickness are indicated below.
1. Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
a. Back: 0.048 inch (18 gage).
b. Sides and Top: 0.060 inch (16 gage).
1) Side Ventilation: Diamond or oval perforated side panels.
c. Bottom: 0.060 inch (16 gage).
d. Shelf: 0.060 inch (16 gage).
2. Frames: Formed channel shape, welded and ground flush, welded to body.
a. Door Frames: 0.060 inch (16 gage).
3. Doors: Channel edge; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
a. Door Thickness: 0.075 inch (14 gage).
b. Ventilation: Diamond or oval perforated door faces.
c. Manufacturer's Option: Provide the following door construction instead of the above construction:
1) Doors: Hollow double pan construction with manufacturer's standard honeycomb core, 1 inch thick; welded construction, grind and finish edges smooth.
(a) Door Outer Face: 0.060 inch (16 gage), minimum.
(b) Door Inner Face: 0.048 inch (18 gage), minimum.
4. Handles: Stainless steel recessed cup.
a. Locking Device: Padlock hasp.
b. Frame Hook: 0.12 inch (11 gage) steel.
5. Hinges: Provide one of the following.
a. Continuous piano hinge with powder coat finish to match locker color.
b. Heavy duty, 5-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
6. Sloping Top: 0.060 inch (16 gage).
7. Filler Panels: 0.060 inch (16 gage).
8. Recess Trim: 0.060 inch (16 gage).
9. End Panels: Boxed end panels; 0.060 inch (16 gage).
10. Coat Hooks: Stainless steel or zinc-plated steel.
11. Number Plates: Provide rectangular or oval shaped aluminum plates. Form numbers 1/2 inch high, in block font style; black color.
a. Back: 0.048 inch (18 gage).
b. Sides and Top: 0.060 inch (16 gage). For expanded metal use 0.089 inch (13 gage) thickness.
1) Side Ventilation: Perforated or expanded metal side panels.
c. Bottom: 0.060 inch (16 gage).
d. Shelf: 0.060 inch (16 gage).
e. Thickness: 0.060 inch (16 gage).
1) Minimum Width: 12 inches.
2) Depth: Full depth of locker and shelf.
f. Door Thickness: 0.075 inch (14 gage).
g. Side Panel Thickness: 0.060 inch (16 gage).
h. Channel Framing: 0.060 inch (16 gage).
i. Door shall have manufacturer's standard padlock hasp and hinges.
j. Door Thickness: 0.075 inch (14 gage).
k. Front Panel Thickness: 0.075 inch (14 gage).

1) Front Panel Ventilation: Manufacturer's standard privacy ventilation that prevents contents from being easily seen.

12. Coat Hooks: Stainless steel or zinc-plated steel.
13. Coat Rod: Stainless steel or zinc-plated steel.
14. Number Plates: Provide rectangular or oval shaped aluminum plates. Form numbers 1/2 inch high, in block font style; black color.

2.05 LOCKER BENCHES

A. Manufacturer:
   1. Locker benches shall be by the same manufacturer as the lockers.
B. Overall Bench Height: 17-1/2 inches.
C. Wood Bench Tops: Laminated clear maple or other hardwood species with rounded corners and edges.
   1. Size:
      a. Thickness: 1-1/4 inches.
      b. Widths: 9-1/2 inches, unless otherwise indicated.
      c. Lengths: As indicated.
      d. Exception: ADA compliant bench tops shall be 24 inches wide and 48 inches long, minimum.
   2. Finish: Manufacturer's standard clear sealer and finish.
D. Fixed Bench Pedestals: Steel tube with steel flanges welded to each end. Flanges shall have 3 holes equally spaced for fasteners; complete with fasteners and anchors. Baked enamel/powder coat finish.
   1. Steel Tube: 1-1/4 inch outside diameter, minimum.
   2. Steel Flange Thickness: 0.134 inch (10 gage), minimum.
   3. Flange Diameter: 8 inches.
   4. Height: 16-1/4 inches.
   5. Color: Standard color(s) as selected by Architect..
E. Moveable Bench Pedestals: Trapezoidal frame.
   1. Material: Stainless steel, 0.060 inch (16 gage), or aluminum, 1/4 inch thick bar stock; 3 inches wide.
   2. Base Width: 14 inches.
   3. Provide 2 holes in base for rubber non-skid pads or optional floor fixed mounting.
   4. Height: 16-1/4 inches.
   5. Finish: Manufacturer's standard finish.

2.06 FABRICATION

A. Fabrication - General:
   1. Fabricate lockers with metal faces flat and free of warps and dents.
   2. Metal edges shall be finished smooth without burrs.
   3. Assembled lockers shall be rigid, square, and plumb.
   4. Provide fasteners, anchors, trim, closures, all all related hardware and accessories for a complete installation.
B. Fabricate continuous sloping top, filler panels, recess trim, and continuous metal base in longest lengths possible, minimizing joints.
C. Continuous Metal Base:
   1. Zee Base:
      a. Flanged outward at top to provide locker support and toe space below locker and flanged inward at bottom for concealed anchoring to floor substrate.
   2. Provide vertical flat closure panels at exposed sides of lockers.
   3. Provide corner pieces for changes in direction.
D. Continuous Sloping Tops:
   1. Sloped tops shall be continuous across multiple lockers.
   2. At exposed ends provide verticle end cap closures.

3. Provide sloped mitered corner pieces for changes in direction.
4. Install with concealed fasteners.

E. End Panels - Boxed End Panel: Provides a finished look to exposed locker ends.
1. Boxed End Panels:
a. Boxed end panels shall conceal exposed fasteners and unused holes on an exposed locker side panel.
b. Boxed end panels shall be fabricated to 1 inch overall thickness.
c. Boxed end panels shall be installed with concealed fasteners.
2. Flat Sheet End Panels:
a. Flat sheet end panels shall conceal exposed fasteners and unused holes on an exposed locker side panel.
b. Flat sheet end panels shall be installed with exposed fasteners at the perimeter of the end panel.
3. Provide one-piece end panels at back-to-back metal lockers.

F. Recess Trim:
1. Recess trim covers gaps between recessed lockers and adjacent walls and soffits.
2. Install with concealed fasteners.

G. Filler Trim:
1. Filler trim fills gaps between lockers, and gaps between lockers and other obstructions.
2. Install with concealed fasteners.

2.07 ACCESSORIES

A. Fasteners and Anchors: As recommended by locker manufacturer.
1. Anchors shall be of material and type suitable for indicated substrates.
a. Size as required to properly secure lockers to substrates.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that floors and walls are in compliance with requirements for locker installations.
B. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION

A. Install lockers and benches in accordance with manufacturer's instructions.
B. Place and secure on prepared base.
C. Install metal bases plumb and square with concealed fasteners.
D. Install lockers plumb and square.
E. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
F. Bolt adjoining locker units together to provide rigid installation.
G. Bolt adjoining welded locker groups together.
H. Install end panels, filler panels, recess trim, and sloped tops.
1. Provide tight hairline joints.
2. Use concealed fasteners unless otherwise indicated.

I. Install fittings if not factory installed.
J. Benches:
1. Space pedestals uniformly not more than 60 inches on center; minimum of 2 pedestals per bench.
2. Securely fasten pedestals to undersides of bench tops; minimum 3 fasteners.
3. Securely anchor fixed pedestals to floor; minimum of 3 anchors.

K. Replace components that do not operate smoothly.

3.03 CLEANING AND ADJUSTING

A. Clean locker interiors and exterior surfaces.
B. Adjust door hardware for smooth operation and proper latching.

3.04 PROTECTION

A. Protect installed lockers and benches from damage due to subsequent construction operations.

END OF SECTION

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SECTION 10 7500 - FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum Flagpoles.
B. Section 03 3000 - Cast-in-Place Concrete: Concrete base and foundation construction.

1.02 REFERENCE STANDARDS

A. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).
B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
C. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2016.
D. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data on pole, accessories, and configurations.
C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
D. Samples: When requested by Architect.
    1. Submit 3 sample for each color and finish, 2 by 3 inch in size.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Designer's Qualification Statement.
G. Manufacturer Qualification Statement.
H. Installer Qualification Statement.

1.04 QUALITY ASSURANCE

A. Designer Qualifications: Design flagpole foundation under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
C. Installer Qualifications: Company experienced in installing the products specified in this section with minimum 5 years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flagpoles:
    1. Concord American Flagpole: www.concordamericanflagpole.com.
    2. Eder Flag Manufacturing Company, Inc.: www.ederflag.com.
    3. Ewing Flagpole Company, Inc.: www.ewingflagpole.com.
    4. Pole-Tech Company, Inc.: www.poletech.com.
    5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FLAGPOLES

A. Flagpoles: Designed in accordance with NAAMM FP 1001
    1. Material: Aluminum.

2. Design: Cone tapered.
3. Pole Sections: 1-piece.
4. Mounting: Ground mounted type.
5. Outside Butt Diameter: 7 inches, minimum.
6. Outside Top Diameter: 3-1/2 inches, minimum.
7. Nominal Wall Thickness: 0.156 inches, minimum.
8. Nominal Height: 35 ft; measured from nominal ground elevation.
9. Halyard: Interior type.

B. Performance Requirements:
1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 110 miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

2.03 POLE MATERIALS

A. Aluminum: ASTM B241/B241M , 6063 alloy , T6 temper.

2.04 ACCESSORIES

A. Finial Ball: Aluminum, 6 inch diameter, minimum.
B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
C. Flag: American flag design, 6 ft by 10 ft size, nylon fabric, brass grommets, hemmed edges. Provide one flag per flagpole.
D. Halyard: 5/16 inch, minimum, diameter stainless steel aircraft cable. Includes:
1. Stainless steel swivel flagsnaps.
2. Neoprene flagsnap covers.
3. Retainer ring assembly.
4. Counterweight,

2.05 OPERATORS

A. Hand Crank: Removable hand crank type.

2.06 MOUNTING COMPONENTS

A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch steel, galvanized, depth of 42 inches, unless otherwise recommended by flag pole manufacturer.
B. Lighting Ground Rod: Copper rod, 3/4 inch diameter, length as standard with flag pole manufacturer.

2.07 FINISHING

A. Metal Surfaces in Contact with Concrete: Asphaltic paint.
B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
C. Aluminum: Satin or clear anodized.
D. Finial: Spun finish.

PART 3 EXECUTION

3.01 PREPARATION

A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.02 INSTALLATION

A. Install flagpole , base assembly, and fittings in accordance with manufacturer's instructions.
B. Fill foundation tube sleeve with concrete specified in Section 03 3000.

3.03 TOLERANCES

A. Maximum Variation From Plumb: 1 inch.

3.04 ADJUSTING

A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 00 8200 - AVAILABILITY OF ELECTRONIC FILES

PART 1 GENERAL

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: $0.00 / No Charge.
7. A signed copy of the Release Form 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 , allow five working days for processing.
3. Transmission of Drawings will be provided electronically .

1.03 RELEASE FORM

A. Release Form is located immediately after this Section. Refer to Section 00 8200.02 Electronic Files Release Form.

END OF SECTION

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SECTION 11 4000 – FOOD SERVICE EQUIPMENT
****ADD1****

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 l/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

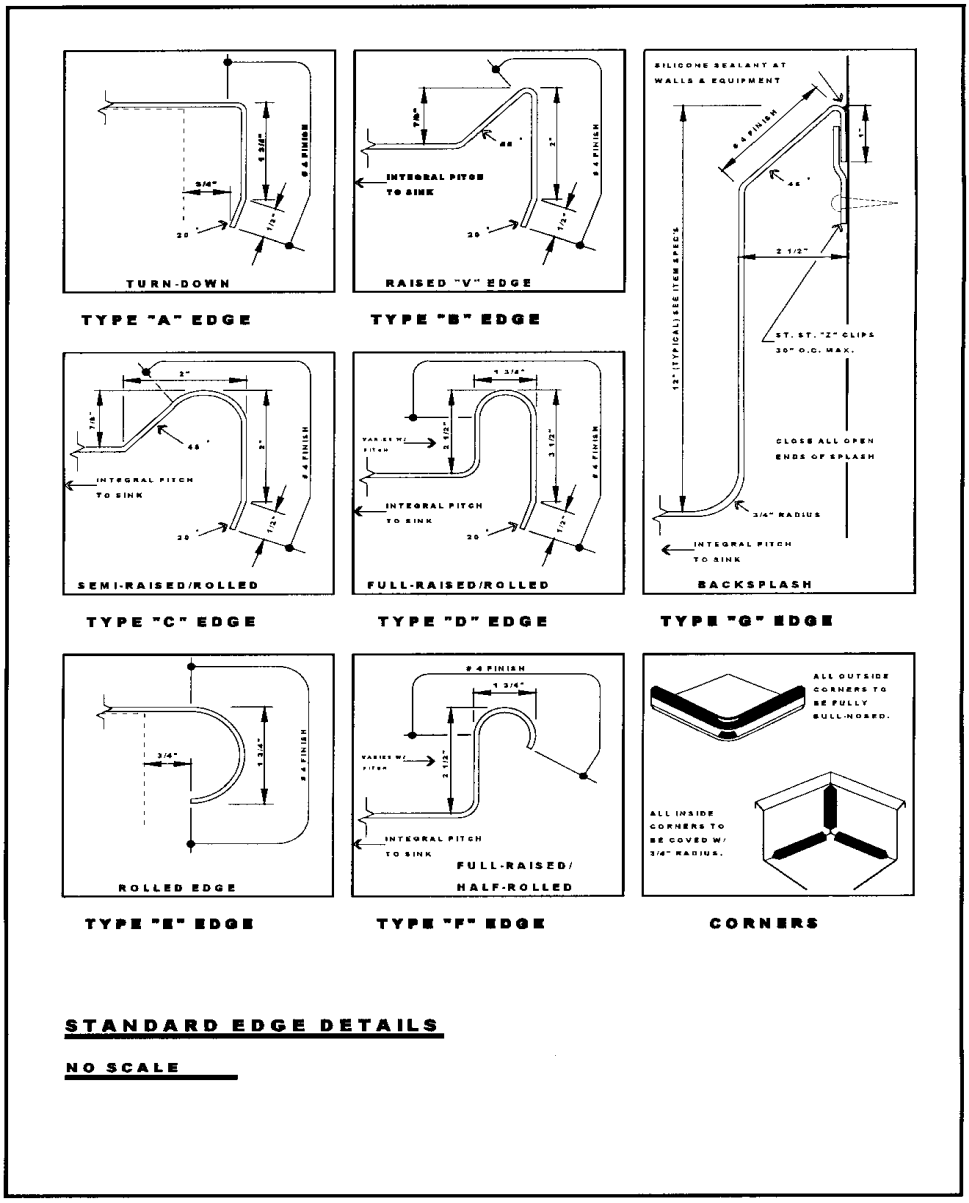
The words "weld", "welded", or "welding" as used in the item specifications, mean a metal joint continuously welded then all exposed parts ground smooth and polished to match adjoining surfaces.

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.



STANDARD EDGE DETAILS

NO SCALE

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 l". 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 l/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 l" 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. st. angles and l" x 3" st. 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 l/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 l" 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 l/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-l002 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 l" 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 an 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.

l2. 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 (l) year.

Manufacturers of standard items of equipment as supplied under this Contract are to provide a one (l) 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.

MAIN KITCHEN AND SERVERY ITEMS 1 THROUGH 76

ITEM # 1 WALK IN REFRIGERATOR/FREEZER

QTY: One (1)

MFG: AMERICAN PANEL

CONST:

Walk-In Refrigerator/Freezer provided under this portion of the specifications shall be prefabricated of modular design and construction. They shall be constructed to allow convenient and accurate field assembly. See Sheets FSE-9 & 10 for additional details.

Size of Refrigerator/Freezer to be 17' – 0" deep x 19' – 8" wide overall outside per plan with 8' - 4" clear inside height. **Nominal sizing is not permitted**.

Panel Construction - All panels shall consist of interior and exterior metal surfaces precision formed to exact dimensions with double 90° edges to enhance overall panel rigidity. The finished metal surfaces shall be fitted with a teardrop profile gasket and placed in precision tooled fixtures where they are injected with *Foamed-in-Place* urethane insulation. Curing of the insulating core shall take place at a controlled temperature within the foaming fixture to provide permanent adhesion to the metal surfaces, allowing for uniform foam expansion and to maximize finished panel strength. Panel edges shall have a molded urethane tongue and groove profile of insulation factor equal to core material to accurately align panels during installation and to assure an airtight seal. No structural wood, steel, straps, high density urethane or other non-insulating materials shall be used in panel construction.
Finished panels must be UL classified building units.

Finished panels will be 4" thick and will be provided in 11 ½", 23", 34 ½" and 46" widths to conform to project drawings. Corner panels shall be one piece 90° angled construction and shall measure 12" x 12" or 12" x 6 ¼" where required. For units with multiple compartments, specially designed "tee" panels shall be provided to form partition wall to outside wall junctures. "Tee" panels shall measure 23" x 12" or 23" x 6 ¼" where required. All panels shall be interchangeable with like panels or standard door frame sections for fast and easy assembly.

Floor Construction and Finish - Wall panels shall be set into a 7" deep depressed floor area arranged so that finished interior floor will be level with the finished building floor. After walls are set, building slab within each insulated area shall be covered with polyethylene film forming a vapor barrier. American Panel to provide two (2) layers of 2" board urethane and ethylene slip sheet. Quarry Tile, Concrete or epoxy finished wear surface and coved base to be provided by General Contractor.

Door Construction **-** Entrance doors are constructed similar to other panels and shall be flush mount, magnetic in-fitting type. Door sections shall be constructed to conform to Underwriters Laboratories Standards for electrical safety and shall bear all appropriate U.L. listing labels. The perimeter of the door and frame shall be built of a fiberglass reinforced plastic (FRP) pultrusion's weighing not less than 11 ounces per lineal foot. All pultrusion's shall be non-conductive, non-corrosive, rust proof and listed by the National Sanitation Foundation. Door jamb shall house a door frame heater circuit and a magnet attracting stainless steel trim strip. Door frame shall be equipped with flexible bellows type vinyl door gasket with magnetic core and flexible EPDM (ethylene propylene diene monomer) door sweep. Standard door frame sections 46", 57 ½" or 69" wide shall be equipped with a vapor proof light fixture and globe pre-wired to a pushbutton type light switch with pilot light and a 2 1/2" diameter dial-type thermometer. An aluminum braided heater wire with integral circuit closure providing activation while

refrigerated room is within operating temperature and a 16 gauge stainless steel threshold plate shall also be included in all door frames.

Door hardware shall be die cast zinc with brushed satin finish. Doors shall be mounted with two (2) heavy duty cam lift hinges. Pull handle assembly shall incorporate a keyed cylinder deadbolt style lock, provision for owner supplied padlock and an inside safety release to prevent personnel entrapment. Positive door closing and sealing shall be assisted by a hydraulic closer device.

Per code, provide clear vinyl strip curtains at door openings.

ACCESSORIES:

View-Through Window: To provide vision in the walk-in room, a 14” x 14” triple-pane window shall be used with a heated frame as standard. For freezer applications or humid conditions, heated glass shall be used. Window shall be neatly trimmed and designed for replacement in the field.

Cylinder Lock: A cylinder locking device shall be installed on reach-in doors as required. It shall consist of a cylinder lock and locking cam with a non-conductive housing.

Thru-Ceiling Electrical: A thru-ceiling electrical assembly shall be supplied at the entrance door to allow the door electrical components to be pre-wired through to the exterior ceiling. It shall consist of a flexible cord with plug on the door section and receptacle installed in the ceiling panel.

Kickplate: Provide 1/8” aluminum diamond kickplate on interior and exterior of all entrance doors. Kickplate to be 36” high x width of door.

Provide 48” long LED ceiling mounted light fixtures in each compartment. Exposed conduit on interior ceiling is not permitted. FSEC to be responsible for installation of light fixtures. Loose box of fixtures turned over to electrical trades is not acceptable. FSEC to mount lights and leave ready for interwiring and final connections to switch(s) and building power supply by electrical.

NOTE! Per code, The light intensity shall be at least 110 lux (10 foot candles) at a distance of 75 cm (30 inches) above the floor, in walk-in refrigeration units, dry food storage areas and in other areas during periods of cleaning. American Panel to provide fixture quantities to meet these requirements.

Wall Protectors: To prevent damage to Walk-Ins in heavy traffic areas, the following bumper rail shall be supplied on the exposed walls:

A 1-1/2” wide extruded aluminum rail with vinyl insert. Field mounted with unexposed with sheet metal screws/supplied with end caps.

Closure Panels: Furnish removable closure panels to enclose the area between the building and the walk-in ceilings. Panels to be fabricated of same material as walk-in exterior.

Trim Strips: Furnish trim strips between walk-in and building walls where shown. Constructed and finished of same material as exterior of walk-in.

Corner Guard: Provide 16 gauge stainless steel corner guards 6” x 6” x 60” high on exposed exterior corner of walk-in.

Base Cove: General Contractor to provide base cove, where specified, to seal walk-in to building floor and facilitate easy cleaning.

Two (2) Intelligent Controller Plus (IC+) (Wi-Fi, Dry Contacts, USB Interface, Battery Backup, Auto Lights)
One (1) Lot exterior wall bumpers where exposed
One (1) Lot of LED lights at doorway
One (1) Lot of 48" LED Tube Light Fixtures on ceiling
Two (2) Flex Strip Curtain
One (1) Heated Pressure Relief Vent Model 1825
Two (2) Vision Windows 14" x 14"

DETAILS:

Finishes - The interior and exterior finish on panel surfaces is to be manufactured from a combination of the following premium grade materials. The gauge or thickness of the metal material listed is rated prior to embossing.

- Interior walls shall be .032. Stucco Aluminum
- Interior ceilings shall be .032. White Stucco Aluminum
- Exposed Exterior walls shall be .032. Stucco Aluminum
- Exterior ceiling shall be .032. Stucco Aluminum
- Exposed Exterior Front shall be 032. Stucco Aluminum

Insulation - Insulation shall be 4" thick high pressure impingement mixed (HPIM) foamed-in-place urethane, minimum 2.4 lb. per cubic foot density, fully heat cured and bonded to metal finishes. The insulation shall be manufactured using an HFC 245fa expanding agent. The thermal conductivity ("K" factor) shall not exceed 0.133 BTU/Hour/Square Foot/Degree Fahrenheit/Inch of Thickness across the entire width of the panel. Overall coefficient of heat transfer ("U" factor) shall not exceed .033 and the resistance to heat penetration ("R" factor) shall not be less than 30. The insulation shall have a 97% closed cell structure to prevent absorption of liquids. The finished panel (not just the core material) shall be listed by Underwriters Laboratories as a Class 1 (UL-723) building unit and demonstrate a flame spread rating of 20 or less. The core material smoke developed Underwriters Laboratory rating shall be no greater than 300 as documented by and in accordance with ASTM Standards.

Panel Assembly - Assembly of walk-in shall be accomplished by the use of cam-action locking mechanisms precisely positioned along the outside tongue or groove edges of each panel to exactly correspond with a matching mechanism in the adjacent panel. Cam lock spacing on vertical joints shall not exceed 46" and at junction of vertical and horizontal joints by 23". Cam locks shall be foamed-in-place and anchored securely in the panel by steel "wings" integral to the lock housing. Cam locks shall be operated through access ports by the use of a hex wrench, thereby, pulling the panels together and establishing an airtight seal. All access ports shall be located on the walk-in interior to facilitate assembly when close to building structures and shall be covered by vinyl snap-in caps after final assembly. Complete step-by-step assembly instructions and erection drawings shall be supplied by the walk-in manufacturer and installing contractor must be factory authorized!

Walk-In Monitoring System IC+ System to have an LED display with high and low alarm set points with audible and visual alerts for alarm conditions. All functions shall be programmable and accessible from the face of the controller. System to display freeze and refrigerator temperatures in alternating pattern.

System shall have an integrated, push button light switch with on/off indicator light. System shall comply with Jan 1, 2009, federal energy requirements by incorporating an automatic lighting shut-off. System shall actively monitor and control door heater assembly for proper operation and lower energy

consumption by having programmable initiation temperature, termination temperature and percentage of operation time adjustability.

System to have 115V output for connection to external alarms, dialers, etc. that run on standard 115V input. Where specified, the system shall be supplied with a dry contact kit for connection to equipment that requires dry contacts.

Warranty - Insulated panel products are to be warranted for a period of ten (10) years after date of installation to the original user should the panels be installed properly and be used under normal service conditions. Installing contractor is to closely adhere to manufacturer's recommendations and guidelines for installation so as to ensure a quality operating product. All accessories and components shall have a one year warranty.

Refrigeration System **-** All system field connections shall be made by a licensed refrigeration contractor (as a subcontractor to the kitchen equipment contractor) that is certified in refrigerant recovery. Condensing units shall be preassembled remote, fully hermetic, air cooled units for outdoor installation as manufactured by Copeland or Tecumseh and shall be supplied with matching Russell evaporators. Condensing units shall be equipped with PSC fan motors and evaporator fans shall utilize the ECM type fan motors. Manufacturer is to calculate heat loads and provide systems with a minimum of 105% of needed capacity to maintain holding temperatures of 35° F in coolers and –10° F in freezers. Calculations shall take into consideration box ambient, refrigeration system ambient, air flow, exposure to sunlight and altitude. Interconnection of refrigeration lines, insulation and electrical wiring shall be accomplished by the appropriate trades and shall be a portion of the kitchen equipment contract.

Systems to consist of the following air cooled units.

2.60 HP hermetic air cooled refrigeration system -10° F Freezer 208/230/60/3 Includes an electric defrost evaporator coil Includes 5-Year Compressor Warranty Condensing Unit Model # FFAL-A26Z-TFC-075 (R-448A) and BEL0100BS6EE w/ E.C. Motors & I.R.C.

2.00 HP hermetic air cooled refrigeration system 35° F Cooler 208/230/60/3 Includes standard evaporator coil Includes 5-Year Compressor Warranty Condensing Unit Model # FFAP-A20Z-TFC-075 (R-448A) and BEL0115BS6AM w/ E.C. Motors & I.R.C.

Note! FSEC to verify makes and model numbers to insure proper operation and connection loads. Units to be installed on roof area in location as determined by architect. FSEC to verify distance at time of bidding to insure proper system sizing.

Refrigeration Warranty **-** All parts shall be warranted for one year from date of installation with an additional four (4) year compressor warranty added by the manufacturer. A one year labor warranty of the system is to be provided by the licensed installation contractor as a subcontractor to the kitchen equipment contractor.

NSF: All Walk-Ins shall be fabricated to comply with National Sanitation Foundation Standard No. 7. The NSF label shall be affixed to the interior door pan. Interior corners and floor shall be coved to meet NSF specifications.

Submit shop drawing for review and approval.

ITEM # 2 REMOTE REFRIGERATOR CONDENSER

One (1) Included with item # 1.

ITEM # 2.1 REFRIGERATOR BLOWER COIL

One (1) Included with item # 1.

ITEM # 3 REMOTE FREEZER CONDENSER

One (1) Included with item # 1.

ITEM # 3.1 FREEZER BLOWER COIL

One (1) Included with item # 1.

ITEM # 3.2 HEAT TAPE

One (1) Lot included with item # 1.

ITEM # 4 RACK, DUNNAGE

Four (4) CAMBRO model #DRS480 slotted top dunnage rack sized 21" deep x 12" high x 48” long per plan. Unit to have 3000 pound capacity. Provide units in speckled gray (480)

ITEM # 5 PORTABLE WALK IN FZR, SHELVING

QTY: One (1) Lot per plan.

MFG/MODEL: InterMetro Industries Corp SUPER ERECTA WITH METROSEAL3 SHELVING

CONST: Shelves to have # 10 gauge mat wires spaced 21/32" on centers with #6 gauge cross braces a maximum of 8" on centers and running perpendicular to crosswires. Additional center cross bracing is augmented with 1/4" snake wire support on shelves with depth 21" and greater. Side construction to consist of 1/4" diameter top and bottom support wires with 7 gauge snake wire welded between the top and bottom support wires. The top and bottom support wires are to be welded to round 1 1/4" i.d. collar to form corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. round tubes grooved at 1 " increments and numbered at 2" increments. Posts are double-grooved every 8" for easy identification. A round plastic post cap will be installed on the top of each post. A slip sleeve will be provided for each collar to stay at selected position on the post.

The finish will be Metroseal3, a proprietary applied electrostatic process over a self-sealing hydrated base layer. Metroseal3 contains Microban, which is an antimicrobial product which inhibits the growth of bacteria.

ACCESSORIES:

One (1) Set of 5” dia., swivel casters, 2 with locks to be provided with each section of shelving.

DETAILS:

Shelving to be furnished four (4) tiers high with One (1) set of 70UPK3 posts per unit. Post sized to allow mobile units to be rolled in and out of 75" doors while on 5" casters. FSEC to coordinate shelving length with walk in interior to insure proper fit.

ITEM # 6 PORTABLE WALK IN REF, SHELVING

QTY: One (1) Lot per plan.

MFG/MODEL: InterMetro Industries Corp SUPER ERECTA WITH METROSEAL3 SHELVING

CONST: Shelves to have # 10 gauge mat wires spaced 21/32" on centers with #6 gauge cross braces a maximum of 8" on centers and running perpendicular to crosswires. Additional center cross bracing is augmented with 1/4" snake wire support on shelves with depth 21" and greater. Side construction to consist of 1/4" diameter top and bottom support wires with 7 gauge snake wire welded between the top and bottom support wires. The top and bottom support wires are to be welded to round 1 1/4" i.d. collar to form corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. round tubes grooved at 1 " increments and numbered at 2" increments. Posts are double-grooved every 8" for easy identification. A round plastic post cap will be installed on the top of each post. A slip sleeve will be provided for each collar to stay at selected position on the post.

The finish will be Metroseal3, a proprietary applied electrostatic process over a self-sealing hydrated base layer. Metroseal3 contains Microban, which is an antimicrobial product which inhibits the growth of bacteria.

ACCESSORIES:

One (1) Set of 5” dia., swivel casters, 2 with locks to be provided with each section of shelving.

DETAILS:

Shelving to be furnished four (4) tiers high with One (1) set of 70UPK3 posts per unit. Post sized to allow mobile units to be rolled in and out of 75" doors while on 5" casters. FSEC to coordinate shelving length with walk in interior to insure proper fit.

ITEM # 7 STATIONARY STORE ROOM SHELVING

QTY: One (1) Lot per plan

MFG & MODEL: InterMetro Industries Corp Super Brite Super Erecta Shelving

CONST: All carbon steel construction. Shelves to have 10 ga. mat wires spaced 21/32" apart. Mat wires to be supported by 6 ga. support wire. Support wire spacing specific to shelf size. Shelf width greater than 18" include one to two 7 ga. snake wire supports running the length of the shelf. Shelf frame to be made up of 7 ga. snake wire with two 6 ga. snake support wire. A round 1 1/2" steel collar is welded at each corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. Round tubes notched every 1" of the post. A polypropylene post cap will be installed on the top of each post. The bottom of the post to have F04-004 hex head leveler and C03-002 post insert for the purpose of leveling the shelving.

Finish will be Super Brite, a zinc based chromate bath.

DETAILS: Each shelving to be furnished five (5) tiers high with four (4) 86" high posts. Shelving size and quantity to be sized per plan. Shared uprights will not be accepted.

ITEM # 8 CART, UTILITY

One (1) LAKESIDE model #511 st. st. portable utility cart.

ITEM # 9 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 # 10 DISPOSER, GARBAGE

QTY: One (1) Lot

MFG/MODEL: IN-SINK-ERATOR SS-200-18B-AS101 AQUA SAVER

CONSTRUCTION: Unit shall be a commercial, heavy-duty disposer with two (2) horsepower motor, stainless steel and chrome plated finish. Control Panel shall be 18 gauge st. st. NEMA 4, waterproof enclosure.

ACCESSORIES:

One (1) 18” cone w/ two fixed nozzles
One (1) St. St. Removable Cover and Scrap Block
One (1) Automatic Reversing Feature
One (1) Time Delay Relay set for 30 seconds
One (1) 24 volt line voltage transformer, controls operate on 24 volts
One (1) Line Disconnect Switch, Interlocks with front cover
One (1) Start/Stop Push Button
Two (2) Flow control valves and solenoids
One (1) St. st. support leg
One (1) 14 gauge st. st. mounting bracket
One (1) T&S B-2278 Pre-rinse unit w/ built in vacuum breaker & wall bracket
One (1) T&S B-0455 Vacuum Breaker Assembly w/ chrome plated pipe extension & elbows above backsplash area

DETAILS: Cone to be continuously welded to top with all welds ground and polished smooth. Control panel bracket welded to underside to top and set back so disconnect handle does not project beyond edge of table. Backsplash to be pre-drilled on exact centers to accommodate Vacuum Breaker Assembly.

FSEC shall tag all accessories with item numbers and locations of equipment. Accessories are then to be delivered to Plumbing and Electrical Contractors for their internal and final connections. FSEC shall furnish detailed drawings showing proper installation of loose accessories and piping details.

ITEM # 11 ST. ST. SOILED/CLEAN DISHTABLES

One (1) Lot Custom fabricated soiled and clean dishtables sized per with integral pitch to allow tables to drain towards dishwasher. See detail drawing for additional construction information.

TOP

Fabricated of 14 gauge stainless steel with front and exposed ends furnished with type "D" raised rim with apron type edge. Working surface to have integral pitch to drain surface area of any excess water. Top of rim to be parallel with floor. Reinforcing under and polish to be furnished in accordance with General Requirements and standard edge details. Provide table limit switch mounting location on soiled dishtable.

BACKSPLASH

Rear as shown on plan against wall to be furnished with 12" high integral backsplash. Top to be turned back at 45 degree angle with 1" return down parallel back of flight type

Provide clear silicone sealant to wall and equipment per Board of Health Requirements. See Edge Detail type "G" for construction requirements

LEGS

Top to be support with st. st. legs with flange feet. Feet to be secured to floor with st. st. screws and anchors.

SHELF UNDER

Under top as shown on plan or elevation, furnish 16 gauge stainless steel removable shelf. Shelf to be rolled over crossrails in front and sides. Rear to be turned up 3 against walls or side equipment. Shelf to have all coved corners at not less than 5/8 radius

.

DISPOSER CUTOUT - Where shown, top to be cut out to accommodate disposer cone specified under separate item. Cone to be continuously welded around full perimeter, then ground and polished smooth to a #4 satin finish. Under top furnish 14 ga. st. st. bracket to accommodate disposer control panel or switch. Rear backsplash to be punched out to accommodate vacuum breaker assembly specified under disposer item #10.

TABLE DRAINER - In top of soiled table, furnish integrally welded table drainer 6" wide x 3" deep x full width of dishtable. (Full width to mean from front vertical inside edge of rolled rim to back of vertical edge of backsplash). Inside edges both horizontally and vertically furnished with not less than ½" radius. Interior of drainer to be furnished with all coved cornered perforated strainer basket made of 16 gauge stainless steel.

Include 1/4" stainless steel rod guide handles to allow racks to slide over drainer area. Drainer pitched to drain and to have die stamped opening and furnished with basket drain, brass chrome plated with 1-1/2" tailpiece.

Submit shop drawing for review and approval

ITEM # 12 PORTABLE STORAGE SHELVING

QTY: One (1)

MFG/MODEL: InterMetro Industries Corp Super Brite Super Erecta Shelving

CONST:

All carbon steel construction. Shelves to have 10 ga. mat wires spaced 21/32" apart. Mat wires to be supported by 6 ga. support wire. Support wire spacing specific to shelf size. Shelf width greater than 18" include one to two 7 ga. snake wire supports running the length of the shelf. Shelf frame to be made up of 7 ga. snake wire with two 6 ga. snake support wire. A round 1 1/2" steel collar is welded at each corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. Round tubes notched every 1" of the post. A polypropylene post cap will be installed on the top of each post.

Finish will be Super Brite, a zinc based chromate bath.

ACCESSORIES:

The bottom of the post to have heavy duty casters, two with locks.

DETAILS:

Each shelving to be furnished four (4) tiers high with four (4) 72" high posts. Shelving size and quantity to be sized per plan.

ITEM # 13 SPARE – NOT USED

ITEM # 14 WAREWASHER, RACK CONVEYOR

One (1) HOBART MODEL CL44EN ADV 44” Conveyor Style dishmachine with electric tank heat and built in booster heater.

CONST: Tank, chamber, frame, legs, control box, doors and panels are constructed of stainless steel.

ACCESSORIES:

One (1) Lot Soil Recovery
Two (2) Stainless steel vent hoods w/ locking type damper
Three (3) Peg type dishracks
Three (3) Combination type dishracks
Two (2) Sheet Pan Rack
One (1) 30KW booster heater

One (1) Lot Single Point Connection for Tank Heat, Motors and Controls
One (1) Built In Booster Heater (Separate Electrical Connection)
One (1) Drain water tempering kit (included)
One (1) Table Limit Switch – Turned over to table fabricator for installation.

DETAILS: Provide as standard equipment; Power wash section and Opti-rinse final rinse system. Automatic fill, energy saving auto-timer, low temperature alert. Rapid return conveyor drive system with a ball detent clutch. Horizontally mounted stainless steel self draining pump and impeller. Horizontally mounted splash proof, ventilated, grease packed ball bearing motor with inherent motor overload protection. Scrap screen and deep basket system. Top mounted programmable controls. Door actuated drain closures. Insulated hinged double doors with interlock switches. Vent fan control. One electrical connection for motors and controls and tank heat and one connection for built in SST chamber booster heater.

Electrical Trades and Plumbing Trades to be responsible for final connections.

ITEM # 15 SOAP AND RINSE SYSTEM

One (1) Lot furnished and installed by owner's soap vendor. "NIC"

ITEM # 16 ST. ST. EXHAUST DUCTS

Two (2) Custom Fabricated or equal ADVANCE TABCO VR-1 4 x 16 Exhaust ducts fabricated of 18 ga. st.st. with all welded construction. Duct shall be extended from top of dishwasher to ceiling above approx., 9'-0 above finished floor line.

Include 18 ga. st.st. ceiling trim collar with feathered edges and welded corners. FSEC to coordinate ducts with operator provided dishwasher to insure proper fit.

Submit shop drawing for review and approval.

ITEM # 17 WIRE WALL SHELVING

One (1) Lot Metro Chrome wire wall shelving sized per plan. Unit to consist of two (2) 14" deep chrome shelves with two (2) 2WD14C chrome wire wall supports. Each chrome wire wall support consists of one shelf support and mount plate with two caps. FSEC to mount wire shelf supports to wall with heavy duty SST lag bolts.

ITEM # 18 PORTABLE STORAGE SHELVING

QTY: One (1)

MFG/MODEL: InterMetro Industries Corp Super Brite Super Erecta Shelving

CONST:

All carbon steel construction. Shelves to have 10 ga. mat wires spaced 21/32" apart. Mat wires to be supported by 6 ga. support wire. Support wire spacing specific to shelf size. Shelf width greater than 18" include one to two 7 ga. snake wire supports running the length of the shelf. Shelf frame to be made up of 7 ga. snake wire with two 6 ga. snake support wire. A round 1 1/2" steel collar is welded at each corner. All contact points are to be welded.

Posts are to be provided as 1" O.D. Round tubes notched every 1" of the post. A polypropylene post cap will be installed on the top of each post.

Finish will be Super Brite, a zinc based chromate bath.

ACCESSORIES:

The bottom of the post to have heavy duty casters, two with locks.

DETAILS:

Each shelving to be furnished four (4) tiers high with four (4) 72" high posts. Shelving size and quantity to be sized per plan.

ITEM # 19 ST. ST. WALL PANELING

One (1) Lot of Custom Fabricated 18 ga. st. st. 30" high rear and side wall paneling to extend from top of backsplash. Provide st. st. panel on wall behind dishwasher down to top of coved base.
Furnish paneling hair line butt joints. Paneling to be sealed on sides and top with clear silicone sealant.
Submit shop drawing for review and approval.

ITEM # 20 ST. ST. PREP SINK AND TABLE

One (1) Custom fabricated unit sized per plan x 34 high to working surface.

TOP: Fabricated of 14 ga. Stainless Steel with front and exposed end furnished with type A edges

BACKSPLASH: Rear and sides as shown on plan, against walls or equipment to be furnished with 8 high integral backsplash. Top to be turned back at 45 degree angle with 1 return down parallel to wall. Furnish 14 gauge stainless steel Z clips to hold backsplash tight to wall in neat and workmanlike manner. Provide clear silicone sealant to wall and equipment per Board of Health requirements. See Edge Detail type G for construction requirements.

SINKS: In top, furnish two Integrally welded sink 21 x 26 x 12 deep. Bottom of sink compartment to be pitched and furnished with die stamped opening to accommodate waste flange. Sink to be all coved cornered and fabricated per General Requirements.

SINK TRIM: Sink to be furnished with the following:

One (1) T&S B-0230-LN with 060X 8" swing nozzle
One (1) T&S B-0199-01 Aerator
One (1) T&S B-0230-K Nipple Assembly
Two (2) T&S B-3950-01 Lever waste with over flow assembly. twist drain handle furnished with 14 gauge stainless steel brackets welded to underside of sink.

Sink trim to be furnished with identification tags and signed over to the Plumbing Trades for their internal and final connections to rough in locations.

LEG SUPPORTS: Top and sink to be mounted on EFW all stainless steel one (1) leg support. Gusset, leg, crossbrace and wall flange fabricated in accordance with isometric detail drawing attached to contract drawings.

SHELF UNDER: Under top, per plan or elevation, furnish 16 gauge stainless steel removable shelves. Shelves to be rolled over crossrails in front and sides. Rear to be turned up 3 against walls or side equipment. Shelves to be all coved cornered fabricated at not less than 5/8 radius.

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. Top of shelf turn up to align with top edge of st. st. wall cap.

DRAWER: Under top as shown on plan furnish 18 gauge stainless steel drawers 20 x 20 x 5 deep. Drawer insert to be removable type with roller bearing extension slides, double pan construction drawer front and 18 gauge stainless steel cabinet enclosure constructed per General Requirements. Drawer to be furnished with cylinder lock installed per manufacturer's recommendations. All drawer locks to be keyed alike on entire job.

SHOP DRAWING: Submit shop drawing for review and approval.

ITEM # 21 ST. ST. WALL PANELING

One (1) Lot of Custom Fabricated 18 ga. st. st. 30” high rear wall paneling to extend from top of backsplash.
Furnish paneling hair line butt joints. Paneling to be sealed on sides and top with clear silicone sealant. Submit shop drawing for review and approval.

ITEM # 22 ST. ST. THREE COMP SINK

One (1) Custom fabricated unit sized per plan and elevation detail x 2'-9" wide x 34" high to working surface.

TOP: Fabricated of 14 ga. st. st. w/front & exposed end furnished with type "D" raised rolled edges. Working surface to have integral pitch towards sink with top of rim parallel with floor. **NOTE! Edge in front of sink area to be 1-1/2" lower than edge on drainboards**. Edges to be integrally tapered at both ends of sink as shown on elevation detail. Top reinforcing and No 4 edge finish furnished in accordance with general requirements and standard edge details.

BACKSPLASH: Rear and sides as shown on plan against walls or equipment to be furnished with 12" high integral backsplash. Top to be turned back at 45 degree angle with 1" return down parallel to wall. Furnish 14 ga. st. st. "Z" clips to hold backsplash tight to wall in neat and workmanlike manner. Provide clear silicone sealant to wall and equipment. Caulking to fill gap without any recessed areas which will allow for debris and water to sit on caulk. Caulking requirements to be typical of all areas.

See Edge Detail type "G" for construction requirements.

SINKS: In top, furnish three (3) integrally welded sink compartments per plan location. Sink Compartments to be 24 x 28" x 14" deep. Bottom of each sink compartment furnished with die-stamped opening to accommodate waste flange. Sink bottom all coved cornered, pitched to waste and fabricated per General Requirements.

SINK TRIM: Three (3) compartment unit to be furnished with the following:

Two (2) T&S Model B-0290-112X (3/4" I.P.S) to fit in rear of Backsplash to accommodate 3/4" water lines. Right faucet to have Pre-rinse w/ 10" "Add a Faucet" (1) T&S Model B-0287-427-B, Remove T&S Model 114X, 12" spout and provide T&S Model 112x 10" spout.

Furnish each faucet complete with T&S Model B-0427 Assembly to facilitate fastening to Backsplash

Three (3) T&S Model B-3950-01 Twist Handle Drains with connected rear overflow & 010387-45 removable basket strainers. Twist Handle Drains Furnished with 14 ga. st. st. bracket welded to underside of sink.

Sink trim to be furnished with identification tags and signed over to Plumbing Trades for their internal and final connections to rough-in locations.

LEG SUPPORTS: Top and sink to be mounted on all st. st. one (1) leg support. Gusset leg crossbrace and wall flange fabricated in accordance with isometric detail drawing attached to contract drawings.

SHELF UNDER: Over tops, per plan or elevation, furnish 16 ga. st. st. removable shelf. Shelf to be rolled over crossrails in front and sides. Rear to be turned up 3" against walls or side equipment. Shelf to have all coved corners at not less than 5/8" radius.

Submit shop drawing for review and approval.

ITEM # 23 ST. ST. WALL PANELING

One (1) Lot of Custom Fabricated 18 ga. st. st. rear wall paneling to extend from top of backsplash up to partial height wall & 30" high at full height wall.
Furnish paneling hair line butt joints. Paneling to be sealed on sides and top with clear silicone sealant.
Submit shop drawing for review and approval.

ITEM # 24 RACK, PAN

One (1) ADVANCE TABCO model #PR20-3W. Units to be front load all welded portable pan rack. Unit to be furnished per manufacturers standards. Include heavy duty casters, two with locks.

ITEM # 25 REFRIGERATOR, REACH-IN

QTY: One (1)

MFG/MODEL: Traulsen G10010

CONST: Per manufacturers standards.

ACCESSORIES:

One (1) Full height stainless steel door
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 door, cylinder lock & Microprocessor Control System with LED Temperature Readout. Door swing hinged per plan.

Elect: Per rough-in plan.

ITEM # 26 ST. ST. PREP TABLE

One (1) Custom fabricated unit sized per plan x 34 high to working surface.

TOP: Fabricated of 14 ga. Stainless Steel with front and exposed end furnished with type A edges

BACKSPLASH: Rear and sides as shown on plan, against walls or equipment to be furnished with 8 high integral backsplash. Top to be turned back at 45 degree angle with 1 return down parallel to wall. Furnish 14 gauge stainless steel Z clips to hold backsplash tight to wall in neat and workmanlike manner. Provide clear silicone sealant to wall and equipment per Board of Health requirements. See Edge Detail type G for construction requirements.

LEG SUPPORTS: Top and sink to be mounted on EFW all stainless steel one (1) leg support. Gusset, leg, crossbrace and wall flange fabricated in accordance with isometric detail drawing attached to contract drawings.

SHELF UNDER: Under top, per plan or elevation, furnish 16 gauge stainless steel removable shelves. Shelves to be rolled over crossrails in front and sides. Rear to be turned up 3 against walls or side equipment. Shelves to be all coved cornered fabricated at not less than 5/8 radius.

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. Top of shelf turn up to align with top edge of st. st. wall cap.

DRAWER: Under top as shown on plan furnish 18 gauge stainless steel drawers 20 x 20 x 5 deep. Drawer insert to be removable type with roller bearing extension slides, double pan construction drawer front and 18 gauge stainless steel cabinet enclosure constructed per General Requirements. Drawer to be furnished with cylinder lock installed per manufacturer's recommendations. All drawer locks to be keyed alike on entire job.

SHOP DRAWING: Submit shop drawing for review and approval.

ITEM # 27 ST. ST. WALL PANELING W/ CAP

One (1) Lot of Custom Fabricated 18 ga. st. st. rear wall paneling to extend from top of backsplash up to partial height wall. Provide single piece wall cap with 1.5” turn down with welded mitered corners. Furnish paneling hair line butt joints. Paneling to be sealed on sides and top with clear silicone sealant. Submit shop drawing for review and approval.

ITEM # 28 ST. ST. EXHAUST HOOD

One (1) CAPTIVEAIRE model # 6624-ND-2 PSP F exhaust only canopy rated for all types of cooking equipment. The hood shall have the size, shape and performance specified on drawings. Construction shall be type 430 stainless steel with a #4 polish where exposed. Individual component construction shall be determined by the manufacturer, ETL, and NSF. Construction shall be dependent on the structural

application to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96. Hood shall be wall type with a minimum of four connections for hanger rods. Connectors shall have 9/16" holes pre-punched in 1 ½" x 1 ½" angle iron at the factory to allow for hanger rod connection by FSEC.

Ventilator shall be furnished with U.L. classified high efficiency stainless steel baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6" in width.

The hood manufacturer shall supply complete computer generated submittal drawings including hood sections view and hood plan view. These drawings must be available to the engineer, architect and owner for their use in construction, operation and maintenance.

Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator.

The hood shall have:

A double wall insulated front to eliminate condensation and increase rigidity. The insulation shall have a flexural modulus of 475 EL, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.

An integral front baffle to direct grease laden vapors toward the exhaust filter bank.

Removable grease cup for easy cleaning.

The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper", NSF Listed and built in accordance with NFPA 96. The hood shall be listed for 450°F cooking surfaces at 150 CFM/ft, 600°F cooking surfaces at 200 CFM/ft, and 700°F cooking surfaces at 250 CFM/ft. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper".

Accessories to be included:

One (1) Utility Cabinet
One (1) PSP – F per detail drawing
One (1) Lot Recessed Round LED lights
Two (2) St. St. full end panels w/ legs
One (1) Lot Stainless filters Captrate Solo filter with hook, ETL Listed. Particulate capture efficiency: 93% efficient at 9 microns, 72% efficient at 5 microns
One (1) Lot Extra Tall Field Wrapper Panels – FSEC to verify ceiling heights
One (1) Lot Balance Damper
One (1) Lot DCV Smart Controls
One (1) Pre-piped fire system
One (1) Electronic Gas valve
One (1) Remote Touch pad

FSEC/CAPTIVEAIRE to coordinate DCV smart controls with PBA Engineering to insure proper function of HVAC System. See Detail drawings for additional information.

Submit shop drawing for review.

ITEM # 28.1 EXHAUST HOOD CONTROL

One (1) Unit included with item # 28.

ITEM # 29 ST. ST. WALL PANELING

One (1) Lot of CAPTIVEAIRE or custom fabricated 18 ga. Stainless steel rear wall paneling sized per plan. Provide wall panels from bottom edge of hood down to top of base cove on end risers, Provide panels with finish to match hood and in lengths to match hood(s) section(s) wherever possible. Panels to butt together with hairline joint and be installed with concealed fasteners.

FSEC to provide all necessary cut outs for utility lines. Submit shop drawing for review and approval.

ITEM # 30 SPARE - NOT USED

ITEM # 31 SPARE - NOT USED

ITEM # 32 FIRE EXTINGUISHER

One (1) K Type unit provided by CaptiveAire. Verify mounting location.

ITEM # 33 FIRE SUPPRESSION SYSTEM

One (1) CAPTIVEAIRE System included with exhaust hood item # 28. System to be installed per manufacturers standards. System to comply with all state and local authorities. Submit shop drawing of system for review.

ITEM # 33.1 ELECTRONIC GAS VALVE

One (1) Lot included with item # 33.

ITEM # 34 OVEN-STEAMER, COMBINATION, GAS

One (1) UNOX Model No. (2)XAVC-06FS-GPLM ChefTop MIND.Maps™ Plus Combi Oven, gas, countertop, (6) 18" x 26" full size sheet or (12) hotel size pan capacity, MIND.Maps™ technology, programmable menu, 2-11/16" shelf spacing, glass door, left-to-right door opening, stainless steel interior & exterior,WIFI/USB for data transfer to HACCP software, 1kW, 8 amps, 120v/60/1-ph, cETLus, NSF, ENERGY STAR® (cooking chamber built from 316L stainless steel)

(For safety and reliability purposes, CHEFTOP MIND.Maps™ Gas ovens (Free Standing and Countertop Models) must be equipped with only UNOX brand casters with safety chains),Gas lines is not included with the oven and must be purchased separately.

See plan for door swing.

Note: Double Stack.

1 ea INSTALL FORM End User Data & Installation Confirmation Form 2 ea 2 Year parts and 1 year labor warranty standard; In K-12 LongLife4 extends warranty to 4 Year parts and 2 year labor warranty with wifi connection.

1 ea LONG.LIFE4-B1 LONG.LIFE4-B1, extended warranty with certified installation (Pricing based on a 100 mile radius from installer, Additional charges may apply). UNOX Long.Life4 program includes the following, which remains subject to UNOX, Inc. Terms and conditions: 1.) Extended Warranty providing a 4yr/10,000 ON hours parts/1 yr labor warranty. Oven must be connected to the internet via Ethernet cable or WIFI and must remain accessible for remote login by UNOX. 2) Pre- installation site inspection by an UNOX Certified Service Agent of the site where the UNOX equipment will be installed; Follow-up instructions advising customer of any additional material needed for site preparation required prior to installation; Assembly, setting and leveling of the UNOX equipment & Final Hook-up by Certified UNOX Service Agent. (1st 1011, 06FS, 10FS)

1 ea LONG.LIFE4-B2 LONG.LIFE4-B2, extended warranty with certified installation for 2nd or more unit(s) installed at same time and location as 1st unit. (1011, 06FS, 10FS)(NET)
1 ea LONG.LIFE4-ST Stacked unit installation - must be purchased with corresponding unit LONG.Life4. (NET)
2 ea NOTE: Stacking kit must be purchased whenever units are stacked.
2 ea Natural gas
1 ea XAAQC-00E2-G Stacking Kit for ChefTop MIND.Maps™ Plus, includes installation kits and stacking parts for stacking two ovens, for gas ovens including floor stand (XWARC-00-EF-F) and casters (XUC012)

2 ea It is the sole responsibility of the owner/operator/purchaser of this equipment to verify that the incoming water supply is comprehensively tested (Free Chlorine, Chloramine, TDS (Total Dissolved Solids), Silica, pH, TH (Total Hardness), Chlorides & Alkalinity) & if required, provide a means of water treatmeant that would meet the minimum requirements of the manufacturer's water quality standards as outlined on the product spec sheet. Non- compliance with these minimum standards will potentially damage this equipment and/or components & VOID the original equipment manufacturer's warranty
2 ea XHC012 UNOX.Finest Filtering System, reduces carbonate hardness of water, ChefTouch™ monitors water consumption and notifies user to replace cartridge
2 ea LONG.LIFE4-WF Water Filter installation - must be purchased with corresponding unit LONG.Life4 and installation must take place at same time as unit installation (NOTE: Installation can only be purchased when the Water Filtration is also purchased from UNOX) (NET)
2 cs DB1015A0 UNOX Detergent & Rinse Plus, (10) 1 liter tanks, double concentrate, cleaning chemicals for Rotor. Klean™ (There is a hazardous shipping charge for detergents)
12 ea GRP560 CHROMO.GRID, 18"x26", stainless steel
One (1) Lot DORMONT gas and water hoses with quick disconnects
One (1) Set DORMONT caster positioning kit

ITEM # 35 OVEN-STEAMER, COMBINATION, GAS

One (1) Unit same as item # 34.

ITEM # 36 OVEN, CONVECTION, GAS

One (1) Vulcan Model VC44GD Dimensions: 70(h) x 40(w) x 42.25(d)

Convection Oven, gas, double-deck, standard depth, solid state controls, electronic spark igniters, 60 minute timer, (5) nickel plated racks per oven, 8" high legs, stainless steel front, top & sides, stainless steel doors with windows, (2) 50,000 BTU, NSF, CSA Star, CSA Flame, ENERGY STAR®

One (1) 1 year limited parts & labor warranty, standard
Two (2) 120v/60/1-ph, 15.4 amps total, (2) cords with plugs, standard

One (1) Gas manifold piping included with stacking kit to provide single point gas connection
One (1) Lot casters, set of (4) in lieu of standard legs
One (1) Lot DORMONT gas hose assembly with quick disconnects, wall restraint and caster positing kit.

ITEM # 37 RANGE, RESTAURANT, GAS

One (1) Vulcan Model No. 24S-4BN.Fully MIG welded aluminized steel frame for added durability. Stainless steel front, sides, back riser, high shelf. Extra deep crumb tray with welded corners. Four 30,000 BTU/hr. open top burners with lift-off burner heads. Energy saving flashtube open burner ignition system (one pilot for every two burners) shrouded for reliability. Heavy duty cast grates, easy lift-off 12" x 12½" in the front and 12" x 14½" in the back to better accommodate stock pots or large pans. Grates have a built in aeration bowl for greater efficiency.

Burner knobs are cool to the touch, high temperature material. One oven: 23,000 BTU/hr. standard bakers depth ovens with porcelain oven bottom and door panel, measures 26¼"d x 20¼"w x 14"h. Oven thermostat adjusts from 250°F to 500°F with a low setting. Oven is supplied with two racks, two rack guide sets, and four rack positions. Oven door is heavy duty with an integrated door hinge/spring mechanism requiring no adjustment. ¾" rear gas connection and pressure regulator. Total input 143,000 BTU/hr.

Include the following standard and optional accessories:

One (1) DORMONT Super Swivel gas hose with quick disconnect and wall restraints
One (1) Lot casters, two with locks
One (1) Extra oven rack
One (1) Rear gas connection
One (1) Set DORMONT Safety-set caster positioners

ITEM # 38 ST. ST. COOKS TABLE W/ SINK

One (1) Custom fabricated unit sized 13' - 0" long x 2'-6" 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. Provide 6” x 1” integral backsplash against wall as shown. Splash to have coved base at top.

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. Base of unit to be mounted on Standard-Keil #1072-0641-1755, 6" high st. st. adjustable legs.

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.

SINK: In top per plan furnish integrally welded sink 24" x 20" x 12" deep. Sink fabricated of 14 ga. st. st. with horizontal and vertical corners with not less than 5/8" integral radius. Sink bottom to be pitched to drain towards 3 1/2" dia., die stamped opening. Sink to be polished out in all corners to a #4 finish.

SINK TRIM: One (1) T&S Model B-0220-LN deck type faucet furnished with 060X, 8” swing spout with B-0199-01 aerator. Faucet caulked watertight to counter top. Faucet to be cast red brass, all chrome plated with color coded hot and cold water faucets.

One (1) One (1) T&S Model B-3950-01 Twist Handle Drains with connected rear overflow & 010387-45 removable basket strainers

SINK ENCLOSURE: Cabinet base under sink section furnished with 18 ga. st. st. louvered access door. Door to be double pan construction, sound deadened, with Standard Keil N.S.F. hinges and recessed st. st. handles per General Requirements. Bottom of sink enclosure, to be furnished with removable 16 ga. st. st. shelf, coved interior corners with rear and ends turned up 2" against cabinet interior. NOTE! shelf to be held back 8" from rear of cabinet to allow space for water and waste rough in connections.

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. Base of unit to be mounted on Standard-Keil #1072-0641-1755, 6" high st. st. adjustable legs.

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.

ELECTRICAL: Per rough in plan furnish duplex receptacle recessed as shown on electrical plan. Junction box to be located below drawer enclosure. See electrical plan for outlet locations.

Receptacle to be duplex unit Pass & Seymour model #6307 set in Standard-Keil #2773 stainless steel recessed receptacle holder. Include Pass & Seymour neoprene mat gasket and stainless steel faceplate. Receptacle to be three (3) prong grounded type installed to meet all safety and electrical codes.

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 to be open type accessible from both sides of work table.

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.

LEGS: Cabinet base to be mounted 6" high st. st. adjustable legs with flange feet on four corners. Bullet feet in middle.

Submit shop drawing for review and approval.

ITEM # 39 OVEN, MICROWAVE

One (1) PANASONIC model # NE-2180 microwave oven furnished per manufacturers standards.

ITEM # 40 SPARE - NOT USED

ITEM # 41 SPARE - NOT USED

ITEM # 42 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 # 43 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 # 44 FREEZER, REACH-IN

QTY: One (1)

MFG/MODEL: Traulsen G22010

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: Freezer 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 # 45 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 # 46 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 # 47 TABLE, WORK, 14 GAUGE, BACK SPLASH W/ UNDERSHELF

One (1) ADVANCE TABCO model #KSS-305 st. st. work table furnished with 5" integral backsplash, st. st. under shelf, heavy duty SS-2015 enclosed drawer and four st. st. legs with bullet feet

ITEM # 48 CABINET, HEATED, PASS-THRU

QTY: One (1)

MFG/MODEL: Traulsen G1431xP

CONST: Per manufacturers standards.

ACCESSORIES:

Two (2) Full height st. st. hinged doors Door swings hinged per plan.
One (1) Lot 6" High st. st. legs with adjustable feet
One (1) UL. approved grounded cord & plug
One (1) Automatic condensate evaporator
One (1) Lot of Universal angle slides for 12x20 , 14x18 & 18x26 trays on 3" Centers
Three (3) Year service/labor policy
One (1) Lot Lifetime warranty on door handles and hinges

Details: Warmer to have 25.6 cu. Ft. Capacity, size 29 7/8" w x 32" d x 83 1/4" high. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. Verify door swing per plan.

Elect: Per rough-in plan.

ITEM # 49 REFRIGERATED SELF-SERVICE CASE

One (1) Structural Concepts Model B3632

Oasis® Self-Service Refrigerated Merchandiser, high profile, open front, (4) non-lighted shelves, top light, Breeze-E (Type ll) with EnergyWise self-contained refrigeration system, Blue Fin coated coil, one piece formed ABS plastic tub, black interior, full end panels with mirror, cETLus, ETL-Sanitation

One (1) Lot 1 yr. parts & labor warranty, 5 yr. compressor warranty, standard
One (1) Lot Breeze-E (Type ll) with EnergyWise self-contained refrigeration, lower front air intake/upper front air discharge, standard
One (1) 6 ft straight blade power cord NEMA 6-20P (base exit), standard
One (1) Model CLEAN SWEEP Clean Sweep®, automatic condenser coil cleaner
One (1) Base Support: Casters, with levelers, standard
One (1) Lot Exterior: Wilsonart or Formica NON-PREMIUM laminate (Color chart available from factory rep or access color selections via www.wilsonart.com or www.formica.com)
One (1) Lower front panel: Black, standard
One (1) Lot left end panel: Full with mirrored interior, metal edging, standard
One (1) Right end panel: Full with mirrored interior, metal edging, standard
One (1) Exterior back panel: Solid back panel, black painted, standard
One (1) Digital Fahrenheit thermometer, standard
One (1) Lot Add Lights (LED) to standard shelves (4)
One (1) Lot Roll-down security cover, locking

One (1) Rear access door with lock.

FSEC to verify finishes with architect prior to ordering.

ITEM # 50 SPARE - NOT USED

ITEM # 51 SPARE - NOT USED

ITEM # 52 FLAT TOP UTILITY COUNTER

One (1) Duke Manufacturing Model No. TST-88SS Thurmaduke™ Solid Top Unit, mobile utility counter, 14ga stainless steel welded frame & supports, 20ga stainless steel body & undershelves, 5" dia. gray poly swivel casters & brakes, NSF. Uni to include the following:

Counter length: 88"L body, 89.5"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 9.75" on customer's side and 2.25" OP side, on stainless steel fixed brackets, 3-1/2" high eased edge profile all sides, 34" high counter, 42" deep top overall, length per drawing.
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
1 ea CUSTOM Stainless steel isolation trim ring, countertop cutout, and prep to accept drop-in unit
1 ea CUSTOM Stainless steel control panel, modify apron/rail, cutouts, touch screen switches mounted & wired
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-6P Veneer on customer's side
2 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit, * 34" high ADA Compliant Countertop *
1 ea TDST-X-1 For special length counter.
1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
1 ea MOD-2S-6CU Kick Plate, customer's side, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
2 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
1 ea CUSTOM Electric Inter-Connect, stainless steel box & cover, receptacles & breakers, mounted in base and wired 1 ea CORD-10 10 ft. cord & plug, NEMA 5-50P. This counter has a single cord/plug (HCF-5/LED under top extension/Heat with LED in PMG sneeze guard).
1 ea CUSTOM Installation of food guards (posts) supplied by dealer Installed by Duke including wiring. Note glass panels are field installed by FSEC. 1 ea LED-88 Lights under top extension/tray slide
1 ea ON & OFF switch for LED lights under top extension.
1 ea ON & OFF switch for LED lights for sneeze guard

Submit shop drawing for review

ITEM # 52.1 BUFFET/CAFETERIA, HOT/COLD CONVERTIBLE

One (1) Duke Manufacturing Model No. HCF-5 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 80" long, (5) 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 NEMA #14-30P, 208 volt, 60 hrz, 1 phase, 18 amps, UL, cULus, NSF #4 & 7

1 ea HCF-5-120 120v/60/1-ph, 28.0 amps
1 ea MOD-DRY No Drains, in lieu of standard drains. Each well comes with lift out silicone pan liner.

ITEM # 52.2 ADJ SNEEZE GUARD W/ LED & HEAT

One (1) Premier Metal & Glass Model No. TM2N-A
Tm2n-a-ext - 1" od gearless adjustable food shield with top Shelf and rear supports; 3/8" clear tempered glass with Polished edges and radius corners; both end panels included (fixed); surface mounting option with 2.5" round flange; Hatco grnm narrow max watt heat lamp and ultraslim led Lights (with external driver) in complimentary colored Housing; brushed stainless finish; approx 84.5" cl length; Approx 220 lbs ea (2 end supports), ext clear span. Note: 120V/1P and 2075W/10A for heat, 120V/1P and .25A for LED light fixture.

ITEM # 53 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing Model No. TST-88SS Thurmaduke™ Solid Top Unit, mobile utility counter, 14ga stainless steel welded frame & supports, 20ga stainless steel body & undershelves, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 78"L body, 79.5"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 9.75" on customer's side and 2.25" OP side, on stainless steel fixed brackets, 3-1/2" high eased edge profile all sides, 34" high counter, 42" deep top overall, length per drawing.
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
2 ea CUT-OP1-G Round cutout with grommet, in counter top for cord pass, * Locate on Operator's Side *
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-6P Veneer on customer's side
2 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *
1 ea TDST-X-1 For special length counter
1 ea CUSTOM Hinged doors on open side, stainless steel, lift-off hinges and

ADA compliant door pulls
1 ea MOD-2S-6CU Kick Plate, customer's side, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
2 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
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) simplex receptacle L14-20R for Hatco L14-20P plug
-- (1) duplex receptacle 120V/1P NEMA 5-20R for counter top equipment use and for LED light under top extension.
2 ea CORD 6 ft. cord & plug: (1) L14-20P and (1) 5-20P from counter base receptacles.
1 ea LED-88 Lights under top extension/tray slide
1 ea ON & OFF switch for duplex receptacle 120V (LED lights).

Submit shop drawing for review.

ITEM # 54 DISPLAY CASE, HEATED

One (1) HATCO model # GR2SDS-42D 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 – Coordinate with counter mounted receptacle.
Ten (10) Total stainless divider rods

ITEM # 55 SPARE – NOT USED

ITEM # 56 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing Model No. TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 14ga stainless steel welded frame & supports, 20ga stainless steel body & undershelves, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 68"L body, 69.5"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 9.75" on customer's side and 2.25" OP side, on stainless steel fixed brackets, 3-1/2" high eased edge profile all sides, 34" high counter, 42" deep top overall, length per drawing.
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
1 ea CUSTOM Stainless steel isolation trim ring, countertop cutout, and prep to accept drop-in unit
1 ea CUSTOM Stainless steel control panel, modify apron/rail, cutouts, touch screen switches mounted & wired

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-5P Veneer on customer's side
2 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *
1 ea TDST-X-1 For special length counter.
1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
1 ea MOD-2S-5CU Kick Plate, customer's side, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
2 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R duplex receptacle & stainless steel cover, wired to existing power source. This receptacle for LED light under the top extension and LED light in PMG sneeze guard.
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R simplex receptacle for Duke cold pan drop-in & stainless steel cover, wired to existing power source. Note Duke to wire together the simplex and duplex receptacles for a single cord/plug for counter.
1 ea CORD-10 10 ft. cord & plug, NEMA 5-15P.
1 ea CUSTOM Installation of food guards (posts) supplied by dealer Installed by Duke including wiring. Note glass panels are field installed by FSEC.
1 ea LED-74 Lights under top extension/tray slide
1 ea ON & OFF switch for duplex which controls LED lights under top extension and in sneeze guard.

Submit shop drawings for review.

ITEM # 56.1 DROP-IN, COLD PAN

One (1) Duke Manufacturing Model No. FCP4-SB Flush Mount Cold Pan Unit, drop-in unit, 60-13/16"W x 26"D x 24"H, (4) 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, 4.9 amps, NSF, CULus, UL EPH Classified

ITEM # 56.2 BUFFET/CAFETERIA, SNEEZE GUARD

One (1) 1Premier Metal & Glass TM2R-F fixed glass fusion self Serve 1" od post food shield with top shelf and rear supports; 3/8" clear tempered glass with polished edges and radius Corners; both end panels included (fixed); surface mounting Option 2.5" diam flange; ultraslim led lights (with external Driver) in complimentary colored housing; brushed stainless Finish; approx 64.75" cl length; approx 190 lbs ea (2 end Supports)

Note: 120V/1P and .15A for LED light fixture

ITEM # 57 CASHIERS STAND

One (1) Duke Manufacturing Model No. TCS-30SS Thurmaduke™ Cashier Stand, mobile, 14ga stainless welded frame, 20ga stainless steel body & bottom shelf, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 41"L body, 42.25"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 10" on customer's side, on stainless steel fixed brackets, 3-1/2" high eased edge profile, 34" high, 42" deep, and 42.25" long.
1 ea CS-DR-LK Stainless steel drawer, with lock and keys, for cashier stand
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
1 ea CUT-OP1-G Round cutout with grommet, in counter top for cord pass
1 ea P-LAM Veneer plastic laminate on body (NOTE: Manufacturer's standard colors ONLY, metallics, color-core & raised textures may incur additional cost)
2 ea MOD-3P Veneer on customer's side
1 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *
1 ea MOD-32 For special width body…per unit,
* 42" wide *
1 ea 329-SS-2L-LK Single door, with lock & keys, left hand hinge, stainless steel, magnetic catch, recessed stainless steel pull,
* Full bottom Shelf *
* Louvered Vents in door *
2 ea MOD-2S-3CU Kick Plate, both 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 E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R duplex receptacle & stainless steel cover, wired to existing power source.
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R simplex receptacle for LED light under top extension & stainless steel cover, wired to existing power source. Note Duke to wire together the simplex and duplex receptacles for a single cord/plug for counter.
1 ea CORD 6 ft. cord & plug, NEMA 5-15P
1 ea LED-30 Lights under top extension/tray slide
1 ea ON & OFF switch for LED lights under top extension.

Submit shop drawing for review

ITEM # 58 POS/CASH REGISTER SYSTEM

One (1) System provided by owner. “NIC”

ITEM # 59 CASHIERS STAND

One (1) Duke Manufacturing Model No. TCS-30SS Thurmaduke™ Cashier Stand, mobile, 14ga stainless welded frame, 20ga stainless steel body & bottom shelf, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 41"L body, 42.25"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 10" on customer's side, on stainless steel fixed brackets, 3-1/2" high eased edge profile, 34" high, 42" deep, and 42.25" long.
1 ea CS-DR-LK Stainless steel drawer, with lock and keys, for cashier stand
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
1 ea CUT-OP1-G Round cutout with grommet, in counter top for cord pass
1 ea P-LAM Veneer plastic laminate on body (NOTE: Manufacturer's standard colors ONLY, metallics, color-core & raised textures may incur additional cost)
2 ea MOD-3P Veneer on customer's side
1 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *
1 ea MOD-32 For special width body…per unit,
* 42" wide *
1 ea 329-SS-2L-LK Single door, with lock & keys, left hand hinge, stainless steel, magnetic catch, recessed stainless steel pull,
* Full bottom Shelf *
* Louvered Vents in door *
2 ea MOD-2S-3CU Kick Plate, both 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 E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R duplex receptacle & stainless steel cover, wired to existing power source.
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R simplex receptacle for LED light under top extension & stainless steel cover, wired to existing power source. Note Duke to wire together the simplex and duplex receptacles for a single cord/plug for counter.
1 ea CORD 6 ft. cord & plug, NEMA 5-15P
1 ea LED-30 Lights under top extension/tray slide
1 ea ON & OFF switch for LED lights under top extension.

Submit shop drawing for review

ITEM # 60 SPARE - NOT USED

ITEM # 61 SPARE - NOT USED

ITEM # 62 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing Model No. TST-74SS Thurmaduke™ Solid Top Unit, mobile utility counter, 14ga stainless steel welded frame & supports, 20ga stainless steel body & undershelves, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 68"L body, 69.5"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 9.75" on customer's side and 2.25" OP side, on stainless steel fixed brackets, 3-1/2" high eased edge profile all sides, 34" high counter, 42" deep top overall, length per drawing.
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
1 ea CUSTOM Stainless steel isolation trim ring, countertop cutout, and prep to accept drop-in unit
1 ea CUSTOM Stainless steel control panel, modify apron/rail, cutouts, touch screen switches mounted & wired
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-5P Veneer on customer's side
2 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *
1 ea TDST-X-1 For special length counter.
1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
1 ea MOD-2S-5CU Kick Plate, customer's side, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
2 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R duplex receptacle & stainless steel cover, wired to existing power source. This receptacle for LED light under the top extension and LED light in PMG sneeze guard.
1 ea E-OP2 Electric outlet, mounted in base, with galvanized junction box, NEMA 5-15R simplex receptacle for Duke cold pan drop-in & stainless steel cover, wired to existing power source. Note Duke to wire together the simplex and duplex receptacles for a single cord/plug for counter.
1 ea CORD-10 10 ft. cord & plug, NEMA 5-15P.
1 ea CUSTOM Installation of food guards (posts) supplied by dealer Installed by Duke including wiring. Note glass panels are field installed by FSEC.
1 ea LED-74 Lights under top extension/tray slide
1 ea ON & OFF switch for duplex which controls LED lights under top extension and in sneeze guard.

Submit shop drawings for review.

ITEM # 62.1 DROP-IN, COLD PAN

One (1) Duke Manufacturing Model No. FCP4-SB Flush Mount Cold Pan Unit, drop-in unit, 60-13/16"W x 26"D x 24"H, (4) 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, 4.9 amps, NSF, CULus, UL EPH Classified

ITEM # 62.2 BUFFET/CAFETERIA, SNEEZE GUARD

One (1) 1Premier Metal & Glass TM2R-F fixed glass fusion self Serve 1" od post food shield with top shelf and rear supports; 3/8" clear tempered glass with polished edges and radius Corners; both end panels included (fixed); surface mounting Option 2.5" diam flange; ultraslim led lights (with external Driver) in complimentary colored housing; brushed stainless Finish; approx 64.75" cl length; approx 190 lbs ea (2 end Supports)

Note: 120V/1P and .15A for LED light fixture

ITEM # 63 SPARE - NOT USED

ITEM # 64 DISPLAY CASE, HEATED

One (1) HATCO model # GR2SDS-42D 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 – Coordinate with counter mounted receptacle.
Ten (10) Total stainless divider rods

ITEM # 65 BUFFET/CAFETERIA, FLAT TOP

One (1) Duke Manufacturing Model No. TST-88SS Thurmaduke™ Solid Top Unit, mobile utility counter, 14ga stainless steel welded frame & supports, 20ga stainless steel body & undershelves, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 78"L body, 79.5"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 9.75" on customer's side and 2.25" OP side, on stainless steel fixed brackets, 3-1/2" high eased edge profile all sides, 34" high counter, 42" deep top overall, length per drawing.
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
2 ea CUT-OP1-G Round cutout with grommet, in counter top for cord pass, * Locate on Operator's Side *
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-6P Veneer on customer's side
2 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *

1 ea TDST-X-1 For special length counter.
1 ea CUSTOM Hinged doors on open side, stainless steel, lift-off hinges and ADA compliant door pulls
1 ea MOD-2S-6CU Kick Plate, customer's side, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
2 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
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) simplex receptacle L14-20R for Hatco L14-20P plug
-- (1) duplex receptacle NEMA 5-20R for counter top equipment use and for LED light under top extension.
2 ea CORD 6 ft. cord & plug: (1) L14-20P and (1) 5-20P from counter base receptacles.
1 ea LED-88 Lights under top extension/tray slide
1 ea ON & OFF switch for duplex receptacle 120V (LED lights).

Submit shop drawing for review.

ITEM # 66 FLAT TOP UTILITY COUNTER

One (1) Duke Manufacturing Model No. TST-88SS Thurmaduke™ Solid Top Unit, mobile utility counter, 14ga stainless steel welded frame & supports, 20ga stainless steel body & undershelves, 5" dia. gray poly swivel casters & brakes, NSF

Counter length: 88"L body, 89.5"L quartz top

1 ea CUSTOM Engineered Stone countertop, 3cm Silestone (or equal) quartz composite on 14ga stainless steel backer, stainless steel pin & latch line up device under countertop, extend 9.75" on customer's side and 2.25" OP side, on stainless steel fixed brackets, 3-1/2" high eased edge profile all sides, 34" high counter, 42" deep top overall, length per drawing.
1 ea ILD Internal Locking Device (on both ends), stainless steel pin & latch line up device under countertop, per unit price (Note: Units required to be portable)
1 ea CUSTOM Stainless steel isolation trim ring, countertop cutout, and prep to accept drop-in unit
1 ea CUSTOM Stainless steel control panel, modify apron/rail, cutouts, touch screen switches mounted & wired
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-6P Veneer on customer's side
2 ea MOD-P-END Veneer on end, each
1 ea MOD-31 For special height unit,
* 34" high ADA Compliant Countertop *
1 ea TDST-X-1 For special length counter.
1 ea CUSTOM Louvered hinged doors on open side, stainless steel grilles, lift-off hinges and ADA compliant door pulls
1 ea MOD-2S-6CU Kick Plate, customer's side, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling

2 ea MOD-2S-E Kick Plate, end, stainless steel, recessed, screw attached, 1/2" above floor for easy rolling
1 ea CUSTOM Electric Inter-Connect, stainless steel box & cover, receptacles & breakers, mounted in base and wired
1 ea CORD-10 10 ft. cord & plug, NEMA 5-50P. This counter has a single cord/plug (HCF-5/LED under top extension/Heat with LED in PMG sneeze guard).
1 ea CUSTOM Installation of food guards (posts) supplied by dealer Installed by Duke including wiring. Note glass panels are field installed by FSEC.
1 ea LED-88 Lights under top extension/tray slide
1 ea ON & OFF switch for LED lights under top extension.
1 ea ON & OFF switch for LED lights for sneeze guard.

Submit shop drawing for review.

ITEM # 66.1 BUFFET/CAFETERIA, HOT/COLD CONVERTIBLE

One (1) Duke Manufacturing Model No. HCF-5 Hot/Cold/Freeze Drop-In Food Well Unit, heated & refrigerated, 80" long, (5) 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 NEMA #14-30P, 208 volt, 60 hrz, 1 phase, 18 amps, UL, cULus, NSF #4 & 7

1 ea HCF-5-120 120v/60/1-ph
1 ea MOD-DRY No Drains, in lieu of standard drains. Each well comes with lift out silicone pan liner.

Submit shop drawing for review.

ITEM # 66.2 ADJ SNEEZE GUARD W/ LED & HEAT

One (1) Premier Metal & Glass Model No. TM2N-A Tm2n-a-ext - 1" od gearless adjustable food shield with top Shelf and rear supports; 3/8" clear tempered glass with Polished edges and radius corners; both end panels included (fixed); surface mounting option with 2.5" round flange; Hatco grnm narrow max watt heat lamp and ultraslim led Lights (with external driver) in complimentary colored Housing; brushed stainless finish; approx 84.25" cl length; Approx 220 lbs ea (2 end supports), ext clear span.
Note: 120v/1p and 2075w/10a for heat, 120v/1p and .25a for led light Fixture.

ITEM # 67 REFRIGERATED SELF-SERVICE CASE

One (1) Structural Concepts Model B3632

Oasis® Self-Service Refrigerated Merchandiser, high profile, open front, (4) non-lighted shelves, top light, Breeze-E (Type ll) with EnergyWise self-contained refrigeration system, Blue Fin coated coil, one piece formed ABS plastic tub, black interior, full end panels with mirror, cETLus, ETL-Sanitation

One (1) Lot 1 yr. parts & labor warranty, 5 yr. compressor warranty, standard
One (1) Lot Breeze-E (Type II) with EnergyWise self-contained refrigeration, lower front air intake/upper front air discharge, standard

One (1) 6 ft straight blade power cord NEMA 6-20P (base exit), standard
One (1) Model CLEAN SWEEP Clean Sweep®, automatic condenser coil cleaner
One (1) Base Support: Casters, with levelers, standard
One (1) Lot Exterior: Wilsonart or Formica NON-PREMIUM laminate (Color chart available from factory rep or access color selections via www.wilsonart.com or www.formica.com)
One (1) Lower front panel: Black, standard
One (1) Lot left end panel: Full with mirrored interior, metal edging, standard
One (1) Right end panel: Full with mirrored interior, metal edging, standard
One (1) Exterior back panel: Solid back panel, black painted, standard
One (1) Digital Fahrenheit thermometer, standard
One (1) Lot Add Lights (LED) to standard shelves (4)
One (1) Lot Roll-down security cover, locking
One (1) Rear access door with lock.

FSEC to verify finishes with architect prior to ordering.

ITEM # 68 REFRIGERATOR, REACH-IN

QTY: One (1)

MFG/MODEL: Traulsen G20013

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 # 69 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 # 70 CART, UTILITY

Two (2) LAKESIDE model #511 st. st. portable utility carts.

ITEM # 71 SPARE - NOT USED

ITEM # 72 TABLE, WORK, 14 GAUGE, BACK SPLASH W/ UNDERSHELF

One (1) ADVANCE TABCO model #KSS-305 st. st. work table furnished with 5” integral backsplash, st. st. under shelf, heavy duty SS-2015 enclosed drawer and four st. st. legs with bullet feet

ITEM # 73 CABINET, HEATED, PASS-THRU

QTY: One (1)

MFG/MODEL: Traulsen G14312P

CONST: Per manufacturers standards.

ACCESSORIES:

Two (2) Full height st. st. hinged doors - Door swings hinged per plan.
One (1) Lot 6” High st. st. legs with adjustable feet
One (1) UL. approved grounded cord & plug
One (1) Automatic condensate evaporator
One (1) Lot of Universal angle slides for 12x20 , 14x18 & 18x26 trays on 3” Centers
Three (3) Year service/labor policy
One (1) Lot Lifetime warranty on door handles and hinges

Details: Warmer to have 25.6 cu. Ft. Capacity, size 29 7/8” w x 32” d x 83 1/4" high. Include self-closing doors, cylinder locks & Microprocessor Control System with LED Temperature Readout. Verify door swing per plan.

Elect: Per rough-in plan.

ITEM # 74 HEATED HOLDING CABINET

One (1) FWE model #MTU-10 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 # 75 PORTABLE KIOSK CART

One (1) Multiteria Model # RXT 72 to be constructed with heavy duty 1" welded stainless steel tubular frame and laminated front and side panels made from 3/4" laminated medium density fiberboard. Counter top to be manufactured 3 cm quartz in material and color as selected by architect.

Unit in closed position is 32" x 72" x 77"H (designed to fit through common doorways). Locking mechanism holds the 48" expansion section in closed position when moving. Unit in extended position increases length by 48" to O.A. size 32" x 120" x 77"H. Casters (6 ea.) are 5" heavy-duty, all swivel. Unit is UL listed.

Electrical
Provide power management system with single 50 amp 120 volt supply cord for tower lighting and counter top equipment as shown. Provide switch for tower lighting.

Body Frame
Counter to have 4' expandable section equipped with locking mechanism to secure expanding section within main counter body during transport. Include locking hinged doors on main and expanded section. POS shelf to be included on pull out end.

Tower With LED Lighting All-stainless steel tower construction includes stainless steel structural supports for rigidity and removable access panels for service and maintenance. Tower to include vertical backlit plexiglass signage plate with laser cut stainless steel cover. Lettering to be verified with owner. Tower supports a cantilevered U-shaped LED light fixture over
main counter.

Submit shop drawing for review and approval.

ITEM # 76 COUNTER TOP REFRIGERATOR

One (1) TRUE model # GDM-06-34-HC-TSLO1 counter top refrigerator furnished per manufacturer standards.

ITEM #77 HEATED DISPLAY CHUTES

One (1) HATCO model # GRSDS-24D 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 #78 HEATED DISPLAY CHUTES

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

One (1) Designer Color
One (1) Front sneeze guard only for single side use.
One (1) UL Cord and plug

ITEM # 79 POS/CASH REGISTER SYSTEM

One (1) System provided by owner. "NIC"

ITEM # 80 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.

LIFE SKILLS AND SPECIAL ED ITEMS 1 THROUGH 9

ITEM # 1 ST. ST. EXHAUST HOOD W/ CABINET & FIRE SYSTEM

One (1) CAPTIVEAIRE model # 4824-ND-2 exhaust only canopy rated for all types of cooking equipment. The hood shall have the size, shape and performance specified on drawings. Construction shall be type 430 stainless steel with a #4 polish where exposed. Individual component construction shall be determined by the manufacturer, ETL, and NSF. Construction shall be dependent on the structural application to minimize distortion and other defects. All seams, joints and penetrations of the hood enclosure to the lower outermost perimeter that directs and captures grease-laden vapor and exhaust gases shall have a liquid-tight continuous external weld in accordance with NFPA 96. Hood shall be wall type with a minimum of four connections for hanger rods. Connectors shall have 9/16" holes pre-punched in 1 ½" x 1 ½" angle iron at the factory to allow for hanger rod connection by FSEC.

Ventilator shall be furnished with U.L. classified high efficiency stainless steel baffle filters, supplied in size and quantity as required by ventilator. The filters shall extend the full length of the hood and the filler panels shall not be more than 6" in width.

The hood manufacturer shall supply complete computer generated submittal drawings including hood sections view and hood plan view. These drawings must be available to the engineer, architect and owner for their use in construction, operation and maintenance.

Exhaust duct collar to be 4" high with 1" flange. Duct sizes, CFM and static pressure requirements shall be as shown on drawings. Static pressure requirements shall be precise and accurate; air velocity and volume information shall be accurate within 1-ft increments along the length of the ventilator.

The hood shall have:

A double wall insulated front and sides to eliminate condensation and increase rigidity. The insulation shall have a flexural modulus of 475 EL, meet UL 181 requirements and be in accordance with NFPA 90A and 90B.

An integral front baffle to direct grease laden vapors toward the exhaust filter bank.

Removable grease cup for easy cleaning.

The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper", NSF Listed and built in accordance with NFPA 96. The hood shall be listed for 450°F cooking surfaces at 150 CFM/ft, 600°F cooking surfaces at 200 CFM/ft, and 700°F cooking surfaces at 250 CFM/ft. The hood shall be ETL Listed as "Exhaust Hood Without Exhaust Damper".

Accessories to be included:

One (1) Utility Cabinet
One (1) Lot Recessed Round LED lights
One (1) Lot Stainless filters Captrate Solo filter with hook, ETL Listed. Particulate capture efficiency: 93% efficient at 9 microns, 72% efficient at 5 microns
One (1) Lot Extra Tall Field Wrapper Panels – FSEC to verify ceiling heights
One (1) Lot Balance Damper
One (1) Lot DCV Smart Controls
One (1) Pre-piped fire system
One (1) Remote Touch pad

FSEC/CAPTIVEAIRE to coordinate DCV smart controls with PBA Engineering to insure proper function of HVAC System. See Detail drawings for additional information.

Submit shop drawing for review.

ITEM # 1.1 EXHAUST HOOD TOUCH PAD

Two (2) Units included with item # 1 and 7

ITEM # 2 ST. ST. EXHAUST HOOD W/ CABINET & FIRE SYSTEM

One (1) Unit same as item # 1.

ITEM # 3 ST. ST. EXHAUST HOOD

One (1) Unit same as item # 1, except omit utility cabinet. St. St. wall panel to run from of coved base to bottom of quartz sill cap.

ITEM # 4 ST. ST. EXHAUST HOOD

One (1) Unit same as item # 1, except omit utility cabinet. St. St. wall panel to run from of coved base to bottom of quartz sill cap.

ITEM # 5 ST. ST. ISLAND EXHAUST HOOD

One (1) Unit with similar construction as item 1, except provide model # 6024-ND-WI island style hood. Without utility cabinet. St. St. wall panel to run from of coved base to bottom of quartz sill cap.

ITEM # 6 ST. ST. EXHAUST HOOD W/ CABINET & FIRE SYSTEM

One (1) Unit same as item # 1.

ITEM # 7 ST. ST. EXHAUST HOOD W/ CABINET & FIRE SYSTEM

One (1) Unit same as item # 1.

ITEM # 8 30" ST. ST. EXHAUST HOOD W/ FIRE SYSTEM

One (1) CAPTIVEAIRE model 2424WRH exhaust hood with built in fire suppression system furnished and installed per manufacturers standard. See detail drawings for construction and installation requirements.

ITEM # 8.1 FIRE SYSTEM PULL STATION

One (1) Unit included with item # 8.

ITEM # 9 FIRE EXTINGUISHERS

One (1) K Type unit provided by CaptiveAire. Verify mounting location.

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	Walk In Refrigerator/Freezer	_____	_____	_____
2	Remote Refrigerator Condenser	_____	_____	_____
2.1	Refrigerator Blower Coil	_____	_____	_____
3	Remote Freezer Condenser	_____	_____	_____
3.1	Freezer Blower Coil	_____	_____	_____
3.2	Heat Tape	_____	_____	_____
4	Rack, Dunnage	_____	_____	_____
5	Portable Walk In Fzr, Shelving	_____	_____	_____
6	Portable Walk In Ref, Shelving	_____	_____	_____
7	Stationary Store Room Shelving	_____	_____	_____
8	Cart, Utility	_____	_____	_____
9	Hand Sink, Wall Mount	_____	_____	_____
10	Disposer, Garbage	_____	_____	_____
11	St. St. Soiled/Clean Dishtables	_____	_____	_____
12	Portable Storage Shelving	_____	_____	_____
13	Spare – Not Used			
14	Warewasher, Rack Conveyor	_____	_____	_____
15	Soap And Rinse System	_____	_____	_____
16	St. St. Exhaust Ducts	_____	_____	_____
17	Wire Wall Shelving	_____	_____	_____
18	Portable Storage Shelving	_____	_____	_____
19	St. St. Wall Paneling	_____	_____	_____
20	St. St. Prep Sink And Table	_____	_____	_____

21 St. St. Wall Paneling	_____	_____	_____
22 St. St. Three Comp Sink	_____	_____	_____
23 St. St. Wall Paneling	_____	_____	_____
24 Rack, Pan	_____	_____	_____
25 Refrigerator, Reach-In	_____	_____	_____
26 St. St. Prep Sink And Table	_____	_____	_____
27 St. St. Wall Paneling W/ Cap	_____	_____	_____
28 St. St. Exhaust Hood	_____	_____	_____
28.1 Exhaust Hood Control	_____	_____	_____
29 St. St. Wall Paneling	_____	_____	_____
30 Spare - Not Used			
31 Spare - Not Used			
32 Fire Extinguisher	_____	_____	_____
33 Fire Suppression System	_____	_____	_____
34 Oven-Steamer, Combination, Gas	_____	_____	_____
35 Oven-Steamer, Combination, Gas	_____	_____	_____
36 Oven, Convection, Gas	_____	_____	_____
37 Range, Restaurant, Gas	_____	_____	_____
38 St. St. Cooks Table W/ Sink	_____	_____	_____
39 Oven, Microwave	_____	_____	_____
40 Spare - Not Used			
41 Spare - Not Used			
42 Hand Sink, Wall Mount	_____	_____	_____
43 Refrigerator, Reach-In	_____	_____	_____
44 Freezer, Reach-In	_____	_____	_____
45 Refrigerator, Reach-In	_____	_____	_____

46 Hand Sink, Wall Mount	_____	_____	_____
47 Table, Work	_____	_____	_____
48 Cabinet, Heated, Pass-Thru	_____	_____	_____
49 Refrigerated Self-Service Case	_____	_____	_____
50 Spare - Not Used			
51 Spare - Not Used			
52 Flat Top Utility Counter	_____	_____	_____
52.1 Hot/Cold Convertible	_____	_____	_____
52.2 Adj Sneeze Guard	_____	_____	_____
53 Buffet/Cafeteria, Flat Top	_____	_____	_____
54 Display Case, Heated	_____	_____	_____
55 Spare – Not Used			
56 Buffet/Cafeteria, Flat Top	_____	_____	_____
56.1 Drop-In, Cold Pan			
56.2 Buffet/Cafeteria, Sneeze Guard	_____	_____	_____
57 Cashiers Stand	_____	_____	_____
58 Pos/Cash Register System	_____	_____	_____
59 Cashiers Stand	_____	_____	_____
60 Spare - Not Used			
61 Spare - Not Used			
62 Buffet/Cafeteria, Flat Top	_____	_____	_____
62.1 Drop-In, Cold Pan			
62.2 Buffet/Cafeteria, Sneeze Guard	_____	_____	_____
63 Spare - Not Used			
64 Display Case, Heated	_____	_____	_____
65 Buffet/Cafeteria, Flat Top	_____	_____	_____

66 Flat Top Utility Counter	_____	_____	_____
66.1 Hot/Cold Convertible	_____	_____	_____
66.2 Adj Sneeze Guard	_____	_____	_____
67 Refrigerated Self-Service Case	_____	_____	_____
68 Refrigerator, Reach-In	_____	_____	_____
69 Hand Sink, Wall Mount	_____	_____	_____
70 Cart, Utility	_____	_____	_____
71 Spare - Not Used			
72 Table, Work	_____	_____	_____
73 Cabinet, Heated, Pass-Thru	_____	_____	_____
80 Field Erection Labor	_____	_____	_____

LIFE SKILLS AND SPECIAL ED

1 St. St. Exhaust Hood/FS Cabinet	_____	_____	_____
1.1 Exhaust Hood Controls	_____	_____	_____
1.2 Fire Pull Station	_____	_____	_____
2 St. St. Exhaust Hood/FS Cabinet	_____	_____	_____
3 St. St. Exhaust Hood	_____	_____	_____
4 St. St. Exhaust Hood	_____	_____	_____
5 St. St. Exhaust Hood	_____	_____	_____
6 St. St. Exhaust Hood/FS Cabinet	_____	_____	_____
7 St. St. Exhaust Hood/FS Cabinet	_____	_____	_____
8 St. St. Exhaust Hood/FS	_____	_____	_____
8.1 Fire Pull Station	_____	_____	_____

Sales Tax _____

Total base bid _____

ALTERNATE #2

74 Heated Holding Cabinet	_____	_____	_____
75 Portable Cart	_____	_____	_____
76 Counter Top Refrigerator	_____	_____	_____
77 Heated Chutes	_____	_____	_____
78 Heated Shelf w/ Protecto	_____	_____	_____
79 POS Register System	_____	_____	_____
		Sales Tax	_____
		Alternate #2 Total	_____

END OF SECTION

SECTION 11 5213 - PROJECTION SCREENS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Front projection screen assemblies.
B. Rear projection screen assemblies.
C. Section 26 0583 - Wiring Connections: Electrical supply, conduit, and wiring for electric motor operated projection screens.

1.02 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's catalog cuts and descriptive information on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Wiring diagrams for motor operators and actuators, and controls and switches.
C. Shop Drawings: Indicate dimensions, verified field measurements, mounting details, and interface with adjacent construction.
D. Samples:
   1. Case and Frame Finishes: Submit 3 samples {CH#126110} in size for each color selected.
   2. Screen Fabrics: Submit 3 samples, 4 by 4 inches in size, for each type, color, and finish.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Operation and Maintenance Data: Provide manufacturer's operation and maintenance instructions.
I. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
B. Installer Qualifications: Company specializing in performing work of the type specified and with at least {CH#125659} years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver projection screens to project site in manufacturer's original unopened packaging, and inspect for damage and proper size before accepting delivery.
B. Store in a protected, clean, dry area with temperature maintained above 50 degrees F, and stack in accordance with manufacturer's recommendations.
C. Acclimate screens to building temperatures for 24 hours prior to installation, in accordance with manufacturer's recommendations.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide 1 year manufacturer warranty for projection screen assembly.
   1. Additionally provide 5 year tab separation warranty for tab-tentioned screens.

PART 2 PRODUCTS

2.01 FRONT PROJECTION SCREENS

A. PS-AFront Projection Screen, Motorized.

1. Basis of Design: Draper, Inc.; Paragon V: www.draperinc.com.
   a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      1) Legrand AV Inc., Da-Lite Brand; Professional Electrol: www.legrandav.com.
      2) Substitutions: See Section 01 6000 - Product Requirements.
2. Factory assembled unless otherwise indicated.
3. Screen Size: 16:10 Format.
   a. Diagonal: 335 inches.
   b. Height: 177 inches.
   c. Width: 284 inches.
4. Electrically-Operated Screens:
   a. Roller: Manufacturer's standard roller, steel.
   b. Vertical Tensioning: Screen fabric weighted at bottom with steel or aluminum bar and plastic end caps.
   c. Tab-Tensioning: Screen fabric to have tab-guided vertical cable system on each side of screen to provide even lateral tension and a flat screen surface.
5. Concealed-in-Ceiling Screen Cases: Steel, case fully enclosed except for slot allowing viewing screen passage.
   a. Bottom closure panel detachable or hinged to allow accessiblilty for service and maintenance.
   b. Metal Thickness: 0.0478 inch (18 gage), minimum.
   c. Finish: Powder coat.
   d. Color: White.
   e. End Caps: Steel; finished to match case.
   f. Provide manufacturer's standard supports for suspension from ceiling.
      1) Includes minimum 3/8 inch threaded rods and case mounting brackets.
6. Screen Material: Matte light diffusing fabric.
7. Masking Borders: Black, on four sides.
8. Extra Drops: Black; 120 inch wide.
   a. Location: Top of screen.
9. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

B. PS-BFront Projection Screen Fixed, Wall Mounted.
1. Basis of Design: Draper, Inc.; Profile Plus: www.draperinc.com.
   a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      1) Legrand AV Inc., Da-Lite Brand; Cinema Contour: www.legrandav.com.
      2) Substitutions: See Section 01 6000 - Product Requirements.
2. Factory assembled unless otherwise indicated.
3. Screen Size: 16:10 Format.
   a. Diagonal: 137 inches.
   b. Height: 72.5 inches.
   c. Width: 116 inches.
4. Screen Material: Matte light diffusing fabric.
5. Masking Borders: Black, on four sides.
6. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

C. PS-C Rear Projection Screen, Motorized.
1. Basis of Design: Draper, Inc.; Paragon V: www.draperinc.com.
   a. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
      1) Legrand AV Inc., Da-Lite Brand; Professional Electrol: www.legrandav.com.

2) Substitutions: See Section 01 6000 - Product Requirements.
2. Factory assembled unless otherwise indicated.
3. Screen Size: 16:10 Format.
   a. Diagonal: 234 inches.
   b. Height: 124 inches.
   c. Width: 198 inches.
4. Electrically-Operated Screens:
   a. Vertical Tensioning: Screen fabric weighted at bottom with steel or aluminum bar and plastic end caps.
   b. Tab-Tensioning: Screen fabric to have tab-guided vertical cable system on each side of screen to provide even lateral tension and a flat screen surface.
5. Concealed-in-Ceiling Screen Cases: Steel, case fully enclosed except for slot allowing viewing screen passage.
   a. Bottom closure panel detachable or hinged to allow accessiblilty for service and maintenance.
   b. Metal Thickness: 0.0478 inch (18 gage), minimum.
   c. Finish: Powder coat.
   d. Color: White.
   e. End Caps: Steel; finished to match case.
   f. Provide manufacturer's standard supports for suspension from ceiling.
      1) Includes minimum 3/8 inch threaded rods and case mounting brackets.
6. Screen Material: Matte light diffusing fabric.
7. Masking Borders: Black, on four sides.
8. Extra Drops: Black; 120 inch wide.
   a. Location: Top of screen.
9. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

D. Provide mounting hardware, brackets, supports, fasteners, and other mounting accessories required for a complete installation, in accordance with manufacturer's recommendations for specified substrates and mountings.

2.02 FABRIC FRONT PROJECTION SCREEN MATERIALS

1. Matte Light Diffusing Fabric: Light diffusing screen fabric; washable, flame retardant and mildew resistant.
   a. Basis of Design: Draper, Inc.; TecVision XH900X ALR: www.draperinc.com.
      1) Provide either the product identified as "Basis of Design" or one of the following equivalent products:
         (a) Legrand AV Inc., Da-Lite Brand; : www.legrandav.com.
         (b) Substitutions: See Section 01 6000 - Product Requirements.
   b. Material: Matte white vinyl on fiberglass backing, with nominal gain of 1.0 over viewing angle not less than 70 degrees from axis, horizontally and vertically.
   c. Seams: Seamless unless height exceeds 120 inches.

2.03 FABRIC REAR PROJECTION SCREENS

A. Manufacturers:
   1. Da-Lite Screen Company; HD Progressive ReView 0.9: www.da-lite.com/#sle.
   2. Draper, Inc; CineFlex White XT700V: www.draperinc.com/#sle.
   3. Substitutions: See Section 01 6000 - Product Requirements.

B. Rear Projection Screen Fabric: Translucent; washable; flame retardant and mildew resistant.
   1. Material: Vinyl fabric without backing, with 0 degree gain: 0.7, viewing cone 180 degrees.
   2. Seams: No seams permitted in fabric up to 144 inch high.
   3. Color: White.

2.04 ELECTRICAL COMPONENTS

A. Electrical Components: Listed and classified by UL as suitable for the purpose specified and indicated.

B. Motors: Direct drive, 110 V, 60 Hz.

1. Screen Motor: Mounted inside roller or at end of roller as standard with manufacturer; three wire with ground; quick reverse type and lifetime lubricated; equipped with thermal overload cut-off, internal junction box, electric brake, and pre-set accessible limit switches.
   a. Electrical Characteristics: 1.2 amps.
   b. Motor mounted on sound absorber or vibration dampener.

C. Controls: Three (3) position control switch with plate.

1. Security: Provide key operated switch; provide 2 keys.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate is finished and ready to accept screen installation.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that openings for recessed screens are correctly sized.

D. Verify type and location of electrical connections.

E. Do not install projection screens until climate control systems are in place and interior painting and other finishes are completed.

3.02 PREPARATION

A. Coordinate screen installation with installation of projection systems.

B. Coordinate installation with adjacent construction and fixtures, including ceilings, walls, lighting, fire suppression, and registers and grilles.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, using manufacturer's recommended hardware for relevant substrates.

B. Do not field cut screens.

C. Install screens in mountings as specified and as indicated on drawings.

D. Install plumb and level.

E. Install electrically operated screens ready for connection to power and control systems by others.

F. Adjust projection screens and related hardware in accordance with manufacturer's instructions for proper placement and operation.

G. Test electrical screens for proper working condition. Adjust as needed.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 11 6050 THEATRICAL RIGGING AND DRAPERY

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 WORK INCLUDED

A. Theatrical Rigging Contractor, as part of the work of this section, shall provide, install and test a complete Theatrical Rigging and Drapery System as specified herein and shown on Drawing TR1.1 and TR1.2.

B. Theatrical Rigging Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to:

1. General Conditions
2. Electrical Contractor
3. Theatrical Dimming Contractor
4. Theatrical Lighting Fixture Dealer
5. Theatrical Sound Contractor

1.03 SYSTEM DESCRIPTION

A. The system shall be designed as a fully functional theatrical rigging and drapery system, to provide rigging pipe battens for scenic and theatrical electrical systems and provide sight and sound barriers for the stage and audience seating areas.

B. Location of the projects are in the New Smith Middle School, Troy, Mi..

1.04 GENERAL REQUIREMENTS

A. All bidders will be responsible to inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or material item the bidder could have been informed of prior to the bid date.

B. Prior to commencement of work the Theatrical Rigging Contractor will fully coordinated with all parties the proposed length of time to complete the project and the availability of the jobsite. Start date will have to be sensitive to the usage of the facility by the School District.

C. It is the responsibility of the Theatrical Rigging Contractor to verify all dimensions in the field. Dimensions listed in this document are approximate and should not be considered final.

D. The system shall conform to all applicable code and industry standards, requirements and / or standard operations and practice. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the user to arrange andoperate a safe assembly and working environment for audience and user personnel.

E. Upon completion of the project a set of as built drawings and / or any pertinentequipment manufacturer's operations manuals will be made available to the Architect and / or the end user.

F. The Theatrical Rigging Contractor will be responsible for providing a reasonable level of training to End User's designated staff on the practical and safe operations of the new Theatrical Rigging and System.

G. The Theatrical Rigging Contractor will employ an ETC Certified Rigging installer for the portion of the project involving ETC Rigging equipment including installation, turnon, and end user training

1.05 SUBMITTALS

A. Theatrical Rigging Contractor shall provide electronic copies of full system submittals. Submittals shall include:

1. Component and installation drawings showing a full description and understanding of the scope and detail of the project. These drawing will be subject to the approval of the Architect prior to the beginning of any aspect of the project. Such approval does not relieve the Theatrical Rigging Contractor of the responsibility for providing equipment in accordance

with the specification.
2. Catalog cut sheets for standard equipment items. They must contain full dimensional and standard application information. If any modification of construction or use are intended, they must be clearly outlined.
3. Theatrical Rigging Contractor or manufacturer shall provide any additional frmation,including equipment demonstration, as required by the Theatre Consultant

1.06 ACCEPTABLE MANUFACTURERS AND QUALITY ASSURANCE

A. The equipment in this section shall be installed by reputable and reliable Theatrical Rigging Contractor with equipment supplied by a Theatrical Fabric and / or Rigging Equipment Manufacturer. The Manufacturer must have been involved continuously in the supply and installation of Theatrical Drapery and Rigging equipment for at least 10 years, or can demonstrate an equal level of qualification. They shall have a permanent warehouse and sales facility staffed with sales and service personal on a permanent basis. The following lists of Dealers and Manufacturers shall be considered pre-qualified.

B. Any other interested company is subject to the approval of the Theatrical Consultant.
   1. Specific manufacturer's descriptions are intended to establish recognizable parameters for equipment function and in no way preclude the substitution of other manufacturer's competitive and equal equipment.
   2. Other alternative Dealers or Manufacturers must submit a full pre-approval package ten days prior to bid date, showing at least 10 completed projects of similar scope completed in the past 5 years.
   3. Approval of alternate Dealers or Manufacturers shall be at the discretion of the Architect and the Theatrical Consultant.
   4. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the Theatrical Rigging Contractor to ensure that any price quotations received and submittals made are for systems that meet or exceed the specifications.

C. Pre-approved Dealers and Manufacturers
   1. Dealers:
      a. Tobins Lake Sales Ypsilanti, MI
      b. John Hyatt and Assoc. Grand Rapids, MI
      c. Northcoast Studios Roseville, Mi
   2. Manufacturers:
      a. Fabric
         1) KM Fabrics
         2) Rose Brand
         3) I. Weiss
      b. Hardware
         1) Automatic Devices
         2) I. Weiss
         3) Wenger / Clancy
         4) SSRC

D. Specific manufactures descriptions are intended to establish recognizable parameters for equipment function and in no way preclude the substitution of other manufacturers competitive and equal equipment.

1.07 FLAMEPROOFING

A. All Fabric shall be fully Flame Proofed to meet current industry standards or be made from nonflammable materials (IFR)

PART 2 PRODUCT SPECIFICATIONS

2.01 DRAPERY

A. All drapery shall be made from first quality fabrics with no less than full height panels. The drapes will be made flat or with fullness as per the Drapery Schedule to follow.

B. Cotton thread shall be used for the assembly of all Drapes using Cotton Fabric. Nylon or Polyester thread will be substituted when the base fabric will be synthetic.

C. The top of the drapes shall have a jute or synthetic webbing sewn onto the rear as a header. The Header shall have #4 Brass grommets on 12” centers or in every pleat unless specifically stated otherwise in the drapery schedule. Either #10 S hooks or 24” tielines shall be provided depending on the hanging mechanism to be used.
D. The bottom hem shall be no less than 5” deep. If weighting chain is called for, a separate enclosed canvas pocket shall be sewn into the bottom hem so that the chain is hung 2” above the bottom of the hem, so as not to allow the chain to drag on the floor. If called for the chain weight will be #10 jack chain or lead tape.
E. The side edges of all drapery panels will be finished with a single turn with a salvage edge and a double turned with a cut edge. The turn will be at least 2” wide.
F. If a turnback is called for, then the leading edge of each panel will have at least 12” of face fabric turn backed on the rear of the drape and tacked.
G. The colors shall be selected from the manufactures stock selection of colors. If the color is not called out in the Drapery Schedule it shall be the responsibility of the Owner to choose colors from samples provided by the Theatrical Rigging Contractor. All dyed fabrics will be first quality. NO re-dyes will be accepted.
H. All drapes will be tagged with a Certification of flame proofing from the Drapery Manufacturer, Date of Construction, Type of Drapery, and Size clearly marked on the upper offstage header.
I. All Drapes will be delivered in a clean and undamaged condition. It will be the responsibility of the Theatrical Rigging Contractor to assure that they are kept clean until the point of delivery to the Owner. Timing of the installation of the Drapes should be considered to ensure that they are kept clean after hanging in regards to the other trades on the job site.

2.02 TRACK

A. ADC 280:
1. The track (#2800) shall be of 14 gauge galvanized steel construction, entirely enclosed except for a slot in the bottom, each half to be one continuous piece except where splicing clamps are required. Each curtain carrier (#2801) shall be spaced on 12” centers and shall be nylon or steel construction supported from a ball-bearing by two polyethylene wheels held to the ball-bearing by a rustproof nickel plated rivet, such wheels rolling on separate parallel treads. Each curtain carrier shall consist of a free-moving plated swivel and sufficient trim chain to accommodate curtain snap hooks or S-hooks. The manufacturer will furnish to end stops (#2809) for placement at the end of each track. When used as a traveler, Live-end pulley (#2803) and Dead-end pulley (#2804) blocks shall be adjustable and shall be equipped with 3” diameter sleeve-bearing wheels adequately guarded. A tension floor block (#2805) will be provided toincrease cord tension. A stretch resistant operating cord (#2828) shall be provided for hand operation.
2. Approved equal: I. Weiss Align Channel Curtain Track

B. ADC 142:
1. The track (#1400) shall be 11 gauge extruded aluminum, painted black, I-Beam construction consisting of a center rib and top, intermediate and bottom flanges. Each curtain carrier (#4201) shall be spaced on 12” centers and shall be of steel construction to include two solid nylon ball-bearing wheels rolling on two separate parallel treads. Each curtain carrier shall consist of a free-moving plated swivel to accommodate curtain snap hooks or S-hooks. Nylon spacers shall be attached to wheel supports of curtain carriers. Track shall be rigidly supported by hanging clamps (#4208BL). Curves shall be formed on-the-job or at the factory. This model track system is for walk-along operation only and does not include pulleys, rope, or other operating hardware. Where track suspension points exceed 6’ on centers a 1 ¼” pipe stiffener shall be used.
2 Approved equal: I. Weiss Align Light Duty I-Beam Curtain Track

2.03 PIPE BATTENS

A. Pipe Battens will be 1 1/2:” Schedule 40 steel pipe painted black.
B. Any splicing will be made with 18” Internal pipe sleeves bolted or screwed together on both sides of the splice.

2.04 LIGHTING FIXTURE CAGE

A. SSRC ASL-6-L
   1. For use in gymnasiums to protect light fixture from damage.
   2. Welded angle iron frame with ½" expanded metal sides
   3. 2" x 4" wire mesh on hinged door
   4. 1 ½" Sch 40 steel pipe included for fixture hanging
   5. To be hung directly from the building structure with threaded rod or chain
   6. Size: 96" L x 42" H

PART 3 EQUIPMENT LISTS

3.01 DRAPERY

A. Valance: 1 pc 4' H x 32' W / 25 oz Charisma / IFR Velour / Color: TBD / 50% fullness / Tielines
B. Act Curtain: 2 pcs 21' H x 17' W / 25 oz Charisma / IFR Velour / Color: TBD / 50% fullness / 12" turn back onstage edges / Chain in enclosed pocket / S Hooks
C. Legs: 4 pcs 20' H x 15' W / 20oz Crescent / IFR Velour / Color: Black / 50% fullness / Chain in enclosed pocket / S hooks

3.02 RIGGING HARDWARE

A. Drapery Track Hardware
   1 - 36' - ADC #282 Black Track complete for rope pull / Act Curtain
   1 - 60' - ADC #142 Black Curved Track complete for walk-along / Upstage and Side Legs
B. Pipe:
   1 - 32' - 1 ½" Sch 40 Black Pipe / Painted Black / Valance
   1 - 28' - 1 ½" Sch 40 Black Pipe / Painted Black / 1st Electric
   1 - 24' - 1 ½" Sch 40 Black Pipe / Painted Black / 2nd Electric Electrics
C. 2 - SSRC ASL-6-L Lighting Cages / FOH Lighting Positions
D. Hardware: As Needed
   1. 3/16" Proof Coil Chain
   2. 3/16" Screw Pin Shackles w/ mouse as needed
   3 Beam Clamps
   4 Full Pipe Clamps
   5 1 ½" Splice Pipes

PART 4 EXECUTION

4.01 INSTALLATION

A. It shall be the responsibility of the Theatrical Rigging Contractor to receive and store the necessary materials and equipment for installation of the Theatrical Rigging and Drapery System.
B. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the Theatrical Rigging and Drapery System, even though every item may not be specifically mentioned.
C. The Theatrical Rigging Contractor shall be responsible for field measurements and coordinating physical size of all equipment with the architectural requirements of the spaces into which they are to be installed.
D. The Theatrical Rigging Contractor shall install the Theatrical Rigging and Drapery System in accordance with manufacturer's approved shop drawings and the best applicable industry standards and practices.
E. The contractor shall deliver on a timely basis to other trades any equipment that must be installed by them during construction
F. During the installation of equipment, the Theatrical Rigging Contractor shall arrange for access as necessary for inspection of equipment by the Architect or Owners Representative.
G. If specifications, the Architects Instructions, laws, ordinances, or any public authority requires any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for inspection, and the dates of inspections.
H. Upon completion of the Theatrical Drapery System installation, the Theatrical Rigging

Contractor will notify the Architect. The Architect will them schedule a date for inspection. The Theatrical Rigging Contractor will provide personnel on that date to fully operate the system and to facilitate any tests as may be required by the Architect or Owners Representative. It will be the responsibility of the Theatrical Rigging Contractor to correct any equipment failures at their expense and in a timely manner and to re-schedule a follow up inspection with the Architect.

4.02 THEATRICAL RIGGING CONTRACTORS SERVICES

A. Upon completion of the installation, the Theatrical Rigging Contractor shall demonstrate operation and maintenance of the systems to the owner's representatives. Training shall not exceed four working hours. Additional training shall be available upon request.

4.03 WARRANTY

A Manufacturer:

1. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of one (1) year from date of delivery.
2. Warranty shall cover repair or replacement of such parts determined defective upon inspection.
3. Warranty does not cover any product or part of a product subject to accident negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.
4. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer's prior written authorization.

B. Theatrical Rigging Contractor

1. The Theatrical Rigging Contractor will provide a one (1) year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner's Representative.
2. They will also warranty any equipment or materials they provide in addition to those by the manufacturer.
3. The guarantee shall not cover damage due to normal wear and tear, acts of God, or improper use of equipment.
4. Any required maintenance or replacement shall be provided by the Theatrical Rigging Contractor within thirty (30) days of notification by the owner except for safety related items, which shall be corrected or addressed within 48 hours of notification.

END OF SECTION

SECTION 11 6143 - STAGE CURTAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stage curtain fabrics.
B. Linings.
C. Stage curtain track support systems.

1.02 REFERENCE STANDARDS

A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
C. ASTM A391/A391M - Standard Specification for Grade 80 Alloy Steel Chain; 2021.
D. ASTM A413/A413M - Standard Specification for Carbon Steel Chain; 2021.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
H. FM (AG) - FM Approval Guide; Current Edition.
I. ITS (DIR) - Directory of Listed Products; Current Edition.
J. NEMA MG 1 - Motors and Generators; 2017.
K. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
L. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
M. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide for each type of product as follows:
   1. Stage Curtains: Provide information on type of curtain, weight, location for use on project, and type of flame retardancy.
   2. Draw-Curtain and Fly-Curtain Operators: Provide rated capacities, and operating and electrical characteristics.
   3. Tracks: Provide capacity of each curtain track to support curtain weight and control curtain operation.
C. Shop Drawings: Indicate installation information for components not dimensioned or detailed in product data.
   1. Submit floor plans, elevations, sections, attachment details of curtains and operating clearances.
   2. Submit fabric assembly and support details.
   3. Submit documentation indicating load capacity of each batten, track, attachment, and rigging components.
   4. Submit attachment locations for grand drape, backdrop curtain, and proscenium curtain, and corresponding loads imposed on structure.

D. Selection Samples: Submit color chart for each type of stage curtain indicated that includes full range of colors, textures, and patterns available, along with 12 inch square fabric sample, in any color, of each fabric type and seam.
E. Verification Samples: Submit fabric full width by at least 12 inch long section of each selected fabric from dye lot to be used for this work, with specified treatments applied and showing repeat of patterns; mark top and face of fabric.
F. Certificate: Certify that products of this section meet or exceed specified requirements.
G. Delegated Design Data: Indicate stage curtain system structural attachments, including analysis data signed and sealed by qualified designer responsible for their preparation.
H. Designer's Qualification Statement.
I. Manufacturer's Qualification Statement.
J. Installer's Qualification Statement.
K. Operation and Maintenance Data: For stage curtains and rigging operations.
L. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
M. 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 Stock Materials: ___ square yards of each kind of fabric provided for project.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Perform design of track support system under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
C. Installer Qualifications: Company specializing in performing work of the type specified and with minimum five years of documented experience.

1.06 FIELD CONDITIONS

A. Ambient Conditions: Do not install stage curtains until spaces are fully enclosed and watertight, and the following:
    1. Wet work in adjacent areas is complete and surfaces are dry.
    2. Work at and above ceiling level has been completed.
    3. Ambient temperatures and humidity of adjacent areas are maintained at levels when occupied for intended use.
B. Field Measurements: Confirm supporting structural element locations and adjacent construction for stage curtains and rigging, and complete field measurements prior to fabrication and include these dimensions on shop drawings.

1.07 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Correct defective Work within a two year period after Date of Substantial Completion.
    1. Defective Work includes, but is not limited to, stage curtain support and rigging that is not operating properly.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Stage Curtain Fabrics:
    1. Beck Studios Inc; _____: www.beckstudios.net/#sle.
    2. Fred Krieger & Company; _____: www.fredkriegerfabrics.com/#sle.
    3. LuXout Stage Curtains; _____: www.luxout.com/#sle.
    4. Substitutions: See Section 01 6000 - Product Requirements.
B. Stage Curtain Track Systems:

1. Beck Studios Inc; _____: www.beckstudios.net/#sle.
2. Fred Krieger & Company; _____: www.fredkriegerfabrics.com/#sle.
3. LuXout Stage Curtains; _____: www.luxout.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Stage Curtain Systems Design: Engage qualified designer to develop design of stage curtain system, including comprehensive project specific analysis of necessary structural system attachments in compliance with performance requirements.

B. Structural Performance: Ensure attachment of stage curtain system to structure withstands material weight and operational loads applicable for this project and in compliance with local building codes and authorities having jurisdiction.
   1. Design Loads: Weight of stage curtains and track system.

C. Fire-Test Characteristics: Stage curtain fabrics in compliance with NFPA 701 flame propagation fire test requirements conducted by authorized testing agency, listed by UL (DIR), ITS (DIR), or FM (AG) and acceptable to authorities having jurisdiction.
   1. Permanently attach label to fabric of each curtain assembly indicating fabric treatment as follows:
      a. Inherently Flame Retardant (IFR), fibers/yarns that are non-combustible for life of fabric.
      b. Durable Flame Retardant (DFR), fibers/yarns that are non-combustible for life of fabric.
      c. Flame Retardant (FR), fabric has been topically treated in an immersion process with chemical fire retardant.
         1) Indicate retreatment requirements after cleaning or after designated period of time.
   2. Permanently attach swatch of matching fabric from same dye lot, at least 12 inch square, to backside of curtain assembly for use as fire-resistance test strip.

D. Electrical Components: Devices that are listed and labeled in compliance with NFPA 70, by a qualified testing agency, and marked for designated application.

2.03 STAGE CURTAIN FABRICS

A. Provide curtains of matching fabric and color from single dye lot, and when size and quantity of curtains exceeds maximum dye lot size, provide curtain or adjacent pair of curtains from only one dye lot, and arrange curtain dye lots to minimize exposure of any differences.

B. Type A - Polyester Velour: Weighing at least 25 ounces/linear yard, napped fabric of 100 percent polyester with minimum pile height of 75 mils, 0.075 inch and minimum width of 54 inch.
   1. Application: Main Traveler, Main Valance, Olio Traveler, Olio Legs, Olio Valance, Cyclorama Traveler, Cyclorama Legs, Cyclorama Border, and _____ curtains
   2. Color: Black.
   3. Texture: As selected by Architect from manufacturer's full range.
   4. Pattern: As selected by Architect from manufacturer's full range.
   5. Products:
      a. Fred Krieger & Company; IFR Epic Velour 25 oz: www.fredkriegerfabrics.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.04 LININGS

A. Type LA - Light-Weight Polyester Lining: Weighing at least 10 ounces/linear yard, 100 percent polyester fabric; 72 inch minimum width.
   1. Color: Black.
   2. Products:
      a. Fred Krieger & Company; IFR Poplin Cyc Cloth: www.fredkriegerfabrics.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

2.05 CURTAIN TRACK

A. Steel Track: Commercial quality, roll-formed, galvanized steel sheet, ASTM A653/A653M, with G60 coating designation; with continuous bottom slot and each half of track in single continuous piece; black paint finish; including support and operation accessories.
   1. Thickness: As recommended by manufacturer for curtain loads and operation.
      a. Heavy-Duty: 14 gauge, 0.0747 inch minimum thickness.
   2. Products:
      a. Fred Krieger & Company; 100 Straight Track, Heavy-Duty: www.fredkriegerfabrics.com/#sle.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Curved Track: Shop fabricate curved portions of curtain track.
   1. Curved Track Cable Guides: Provide outside idlers, mule pulleys, spindles, and guides as required for curve configuration and track length.

C. Curtain Rails: Provide single or double curtain capacity as indicated on drawings, and end stops.

D. Curved-Suspended-Track Stiffener: Steel pipe, 1-1/2 inch nominal diameter, Grade A, Schedule 40 in accordance with ASTM A53/A53M; support both sections of curved suspended tracks, with curve to match track.

E. Clamp and Bracket Hangers: Steel clamps and brackets of required strength to support loads for attaching track to overhead support.

F. Track-Lap Clamp: Clamp that matches track channel finish as necessary for attaching two tracks at center overlap.

G. Folding Guide: Carriers, as indicated on drawings, with rear-fold or backpack guide and rubber spacers to fold curtain from offstage end of curtain; size for use with operating line as required.

H. Operation:
   1. Manual Cord Operation: Curtain track with cord, pulleys, and floor pulley; must manually open and close the curtain.
      a. Operating Line: 3/8 inch diameter, stretch-resistant operating cord with braided synthetic-fiber cover over solid, synthetic-fiber, linear filaments.
      b. End Pulleys: One single dead-end and one double live-end pulley, with sheaves having shielded ball bearings housed in plated-steel covers that match track finish, and provide with bracket for securing off-stage end of curtain.
      c. Floor Pulleys: Sheave, adjustable type with 3 inch (76 mm) diameter wheels, and having shielded ball bearings housed in plated-steel covers, painted black.

I. Track System: Provide heavy-duty curtain track with components as recommended by manufacturer for loads and operation, including track end stops.
   1. Carriers: Standard plated-steel carriers with a pair of nylon tired ball-bearing wheels riveted parallel to body, and equip carriers with rubber or neoprene bumpers to reduce noise and plated-steel swivel eye and trim chain for attaching curtain snap or S-hook, and required number of curtain carriers for track length and curtain fabrication.
      a. Master Curtain Carriers: One plated-steel master carrier for each leading curtain edge, with two pairs of nylon tired ball-bearing wheels and with two line guides per carrier.
   2. Pulleys: One dead-end, single-wheel pulley; one live-end, double-wheel pulley; and one adjustable pulley to maintain proper tension on operating line; each with molded-nylon-tired ball-bearing sheaves enclosed in steel housings; pulleys with steel housing finished to match track and with bracket for securing off-stage end of curtain.

2.06 FABRICATION - CURTAINS

A. General: Provide vertical seams unless otherwise indicated, locate vertical seams so they do not fall on faces of pleats, and only use fabric that is cut greater than half the width of fabric.
   1. Facing the full width of material at center meeting edges.

2. Curtains that are tabled square, and hems that don't pucker.
3. 1-1/2 inch clearance from floor at bottom of curtain.
4. Curtains are 24 inch longer than clear height of valance opening.
5. Curtains that overlap 36 inch at the center.
6. Curtains that extend 24 inch on each side beyond full width of proscenium opening.

B. Vertical and Top Hems: Machine sew hems as follows, unless otherwise indicated:
1. Vertical Hems: Fabricate at least 2 inch wide, and at least 4 inch wide at borders, valances, teasers, and tormentors with at least 1 inch tuck and without visible selvedge material from front of curtain; sew open ends of hems closed.
2. Turnbacks: Fabricate leading-edge and trailing-edge turnbacks for traveler curtains by folding back at least 12 inch of face fabric, with at least 1 inch tuck, and vertically secured by sewing.
3. Top Hems: Fabricate by double-stitching 3-1/2 inch wide, heavy jute or laminated synthetic webbing to top edge at back side of curtain with at least 2 inch of face fabric turned under.

C. Fullness:
1. 50 Percent Fullness: Provide this fullness, exclusive of turnbacks and hems, and spaced at 12 inch on center along top hem reinforcement as follows:
a. Sewing additional material into 3 inch double-stitched, flat, box pleats.
b. Tying or hooking together adjacent grommets into round pleats.

D. Grommets:
1. Black Colored Curtains: No. 3 brass, No, 4 brass, or aluminum grommets with black finish.
2. Flat Curtains: No. 3 brass grommets at 12 inch on center and 1 inch from corner of curtain; for ties, snap hooks, or S-hooks.
3. Flat Curtains: No. 3 brass blind grommet top finish to mask battens using hidden pairs of grommets at 12 inch on center and 1 inch from corner of curtain; for ties.
4. Pleated Curtains: Provide grommets centered on each box pleat and placed 1 inch from corner of curtain; for snap hooks or S-hooks.

E. Bottom Hems: Machine sew hems as follows, unless otherwise indicated:
1. For Curtains With Fullness:
a. Curtains That Don't Hang to Floor: Hems at least 3 inch deep, with weight tape, 3/4 inch, and open ends of hems sewn closed.
2. Lining: Provide lining for curtain with matching fullness of face fabric and finished 2 inch shorter than face fabric, and sew or otherwise securely fasten lining to top hem of face fabric.
a. Attach lining to face fabric along bottom and side seams with 4 inch long strips of heavy woven cotton tape.
b. Sew lining to bottom edge of curtain to provide sufficient lining fabric for tucking and to accommodate for shrinkage.

2.07 ACCESSORIES

A. S-Hooks: Manufacturer's standard heavy-duty plated wire hooks, at least 2 inch long.

B. Snap Hooks: Manufacturer's standard heavy-duty snap hooks, sewn into top edge of curtain.

C. Tie Lines: No. 4 or No. 4-1/2 cord or braided soft cotton tape, colored to best match curtain; at least 5/8 inch wide by 36 inch long and threaded through grommets.

D. Battens: Fabricate using steel pipe and minimize the number of joints; connect pipe at joints using 18 inch long internal splice sleeve secured with four flush rivets, plug welds, threaded couplings, or equally strong method.
1. Steel Pipe: 1-1/4 inch nominal diameter, Grade A, Schedule 40 in accordance with ASTM A53/A53M.
2. Finish: Matte black with 1 inch wide yellow colored stripe along center of each batten.

E. Support, Clamps, and Anchors: Galvanized after fabrication sheet steel, Class B in accordance with ASTM A153/A153M; manufacturer's standard thickness.
F. Trim and Support Cable: 1/4 inch diameter, 7x19 galvanized steel cable with minimum breaking load (MBL) of 7,000 lbs.
   1. Provide fittings in accordance with cable manufacturer's written instructions for size, number, and method of installation, including a drop-forged galvanized turnbuckle to allow for leveling.
G. Trim and Support Chain: Hardened alloy steel chain rated for overhead lifting, Grade 80 in accordance with ASTM A391/A391M.
H. Inserts, Bolts, Rivets, and Fasteners: Manufacturer's standard and corrosion-resistant.
I. Individual Curtain Bottom Weights: Curtain manufacturer's standard segmented weights in compliance with requirements for curtain type and location.
J. Proof Coil Chain, Curtain-Bottom Weight: No. 8, zinc plated, 3/16 inch diameter, Grade 30 in accordance with ASTM A413/A413M.
K. Weight Tape: Curtain manufacturer's standard continuous weight tape to suit each curtain fabric type and location.
L. Pipe/Conduit Weight and Stiffener: Curtain manufacturer's recommended stiffening pipe/conduit that slides into bottom hem of curtain, as suitable for curtain fabric type and location.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with installer present, for compliance with requirements for supporting structural members, blocking, clearances, installation tolerances, and other conditions that may impact performance of stage curtain assembly.
B. Examine placement and condition of inserts, clips, blocking, or other supports installed by others and for use in supporting track and battens of stage curtain assembly.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Install stage curtain assembly in accordance with curtain and track manufacturers written instructions.

3.03 INSTALLATION - CURTAIN

A. Track Hung: Secure curtains to track carriers with S-hooks.
B. Batten Hung: Secure curtains to pipe battens with S-hooks.

3.04 INSTALLATION - BATTENS

A. Install battens by suspending at heights as indicated with trim and supports spaced as required to support loads; do not exceed 10 feet between supports.
   1. Cable Trim and Support:
      a. Fasten cables securely to either structure or to inserts, eye screws, or other applicable devices that are appropriate for substrate and not subject to deterioration or failure with time or elevated temperatures.
      b. Attach other end of cable to pipe clamps with turnbuckles, housed or fixed securely after adjustment to prevent loosening.
   2. Chain Support: Secure chain as required for application with load-rated terminations.

3.05 INSTALLATION - TRACK

A. Mounting of Track Assembly:
   1. Ceiling Mounted: Provide ceiling supports for mounting track direct to ceiling structure and within intervals indicated in manufacturer's written instructions for on center spacing.

2. Beam Mounted: Install track by suspending from beam clamps securely mounted to structural I-beam and within intervals indicated in manufacturer's written instructions for on center spacing.
3. Wall Mounted: Install track by suspending from brackets securely mounted to wall construction and within intervals indicated in manufacturer's written instructions for on center spacing.
4. Batten Mounted: Install track by suspending from pipe batten with manufacturer's acceptable track clamp hangers securely attached to batten pipe clamps and within intervals indicated in manufacturer's written instructions for on center spacing.

B. Track Support Spacing: Comply with manufacturer's recommendations for applied loads, and not to exceed the following dimensions between track supports:
1. Heavy-Duty Track: 6 feet, maximum.
2. Medium-Duty Track: 4 feet, maximum.
3. Curved Walk-Along Track: 4 feet, maximum, with additional supports at curves and splices.

C. Install track for center-parting curtains with at least 24 inch overlap of track sections at center-line, and supported with track lap clamps.

3.06 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
B. See Section 01 7900 - Demonstration and Training, for additional requirements.
C. Demonstrate proper operation of equipment to Owner's designated representative.
D. Demonstration: Demonstrate operation of system to Owner's personnel.
1. Use operation and maintenance data as reference during demonstration.
2. Conduct walking tour of project.
3. Briefly describe function, operation, and maintenance of each component.

E. Training: Train Owner's personnel on operation and maintenance of system.
1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
2. Provide minimum of two hours of training.
3. Instructor: Manufacturer's training personnel.
4. Location: At project site.
5. Location: Owner's offsite classroom facilities may be used.
6. Location: At manufacturer's training facility; include travel expenses for one member of Owner's staff.

3.07 PROTECTION

A. Protect installed stage curtain assembly from subsequent construction operations until Date of Substantial Completion.

END OF SECTION

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SECTION 11 6623 - GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basketball equipment.
B. Wall safety pads.
C. Divider curtains.
D. Volleyball equipment.

1.02 DEFINITIONS

A. NFHS: National Federation of State High School Associations.

1.03 REFERENCE STANDARDS

A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
B. ANSI A208.1 - American National Standard for Particleboard; 2022.
C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
D. ASTM A391/A391M - Standard Specification for Grade 80 Alloy Steel Chain; 2021.
E. ASTM A413/A413M - Standard Specification for Carbon Steel Chain; 2021.
F. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2022).
G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
J. ASTM F2440 - Standard Specification for Indoor Wall/Feature Padding - 2018.
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
L. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).
M. NFHS (Guide) - Court and Field Diagram Guide; current edition.
N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
O. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
P. PS 1 - Structural Plywood; 2023.
Q. PS 2 - Performance Standard for Wood Structural Panels; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Large Components: Ensure that large components can be moved into final position without damage to other construction.
C. Electrically Operated Equipment: Coordinate location and electrical characteristics of service connection.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
   1. Electrical characteristics and connection locations.
C. Shop Drawings:

1. Include plans, elevations, sections, and attachment details.
2. Include point loads and locations for attachment of gymnasium equipment to structure.
3. Indicate operational clearances.
4. Include diagrams for power, signal, and control wiring
5. For divider curtains:
   a. Include plans showing alignment of curtains in relation to court layout and overhead structural supports.
   b. Include system clearances, stacking requirements, and limits for fitting into adjacent construction.

D. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, divider curtains, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which overhead-supported gymnasium equipment will be attached.
   2. Suspended ceiling components, if any.
   3. Items supported from building structure above the courts, including, but not limited to, the following:
      a. Luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Smoke detectors.
      f. Acoustical treatments or panels.
      g. Access panels.

E. Samples: Submit 3 samples 3 by 3 inches in size showing each color and finish selected.

F. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

G. Operating and maintenance data for each operating equipment item.

H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing 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 with minimum 5 years of documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.

B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.

C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.08 FIELD CONDITIONS

A. Environmental Limitations: Do not install equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

1.09 WARRANTY

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

B. Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Basketball backboard failures, including glass breakage.
      b. Faulty operation of divider curtains and basketball backstops.
      c. Faulty operation of volleyball standards and winches.
   2. Warranty Periods:
      a. 1 year from date of Substantial Completion for volleyball nets, volleyball referee stand, volleyball equipment cart, safety pads, volleyball antennas, volleyball sideline markers, and volleyball cable covers.
      b. 3 years from date of Substantial Completion volleyball winch assembly, volleyball floor sleeves, and volleyball cover plates.
      c. 4 years from date of Substantial Completion for basketball goals.
      d. 5 years from date of Substantial Completion for divider curtains.
      e. 10 years from date of Substantial Completion for basketball backboard safety pads and volleyball standards.
      f. 25 years from date of Substantial Completion for ceiling mounted basketball backstops.
      g. Lifetime for basketball backboards.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

A. Basis-of-Design Product: The design for each item specified is based on the product named.
   1. Provide either the product identified as "Basis of Design" or an equivalent product from one of the following:
      a. ADP Lemco, Inc: www.adplemco.com/#sle.
      b. Draper, Inc.; www.draperinc.com.
      c. Bison/IPI; www.ipibybison.com.
      d. JayPro Sports, LLC; www.jayprosports.com.
      e. Porter Athletic Equipment Company; www.porterathletic.com.
      f. Spalding Sports Equipment; www.spaldingequipment.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

2.02 GENERAL REQUIREMENTS

A. See drawings for sizes and locations, unless noted otherwise.
B. Where mounting dimensions or sizes are not indicated, comply with applicable requirements of the following:
   1. National Federation of State High School Associations (NFHS) sports rules; NFHS (Guide).
C. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of Contract Documents.
D. Hardware: Heavy duty steel hardware, as recommended by manufacturer.
E. Electrical Wiring and Components: Comply with NFPA 70; provide UL-listed equipment.
F. Structural Steel Fabrications: Welded in accordance with AWS D1.1/D1.1M, using certified welders.

2.03 GYMNASIUM DIVIDER CURTAINS

A. Divider-Curtain System: Electrically operated.
   1. Operation: Vertical lift roll-up, curtain coils on top rail
   2. Outer Edge Hems: Double turned and welded.
   3. Supports and Fittings: Corrosion-resistant steel clamps and hangers.
   4. Drive Pipe: 3-1/8-inch nominal diameter, fabricated from steel or aluminum, with minimum number of joints for required lengths. Black finish.
   5. Curtain Battens: 1-1/2-inch nominal diameter, fabricated from steel pipe or tubing, with minimum number of joints for required lengths. Black finish.

B. Divider Curtains:
1. Upper Curtain, Mesh: Woven mesh of polyester yarn coated with vinyl, weighing not less than 9 oz./sq. yd.
a. Color: Standard color as selected by Architect.
2. Lower Curtain, Solid: Woven polyester fabric coated with vinyl, 22 oz./sq. yd.
a. Height Above Floor: 8 feet.
b. Color: Standard color as selected by Architect.
3. Hems: Folded and electronically welded.
4. Seams: Electronically welded.
5. Overall Curtain Height: Floor to ceiling, within installation clearances required.
6. Bottom of Curtain: Approximately 2 inches above finished floor.
7. Flame-Resistance Rating: Passes NFPA 701 Test 2.

C. Curtain Operators:
1. Electric motors of size and capacity recommended by divider curtain manufacturer for proper operation.
a. Include wiring from control stations to motors and between synchronizer and dual motors for long curtains.
b. Coordinate operator wiring requirements and electrical characteristics with building electrical system.
2. Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70 and marked for intended location and application.
3. Motor Electrical Characteristics:
a. Horsepower: 1 hp.
b. Voltage: 120 V AC, single phase, 60 hertz.
4. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop divider curtain at fully extended and fully retracted positions.
5. Safety Lock: Locks drive system when speed exceeds 1-1/2 fps or manufacturer's recommended speed; whichever is more restrictive.
6. Controls: Controlled by a remote control station.

D. Locations: As indicated.

E. Basis of Design: Performance Sports Systems; Model 4040XL: www.perfsports.com .

2.04 BASKETBALL EQUIPMENT

A. General:
1. Standard Rules: Provide equipment according to the requirements of NFHS's "Basketball Rules Book."
2. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.
3. Connections: Manufacturer's standard connections of size and type required to transfer loads to building structure.
4. Overhead-Supported Backstops:
a. Folding Type.
1) Manufacturer's standard assembly for forward-folding, front-braced backstop, with associated hardware and fittings.
b. Framing: Steel pipe, tubing, and shapes designed to minimize vibration during play.
1) Center-mast Frame: Welded and bolted or clamped with side-sway bracing.
2) Finish: Polyester powder-coat finish.
(a) Color: Standard color as selected by Architect.
c. Locations: As indicated.
d. Basis-of-Design: Performance Sports Systems; Model 3107.
5. Backstop Electric Operator: Electric motors of size and capacity recommended by basketball equipment manufacturer for proper operation of folding backstops. .
a. Operator Mounting: Overhead mounted.
b. Operator Type: Cable drum with grooved drum and cable tension device to automatically take up cable slack and retain cable in grooves.

c. Electrical:
   1) Electrical Components, Devices, and Accessories: Listed and labeled according to NFPA 70 and marked for intended location and application.
   2) Motor Electrical Characteristics:
      (a) Horsepower: 3/4 hp.
      (b) Voltage: 120 V AC, single phase, 60 hertz.
   3) Include wiring from control stations to motors.
   4) Coordinate operator wiring requirements and electrical characteristics with building electrical system.
d. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop backstop at fully retracted and fully lowered positions.
e. Controls: Controlled by a remote control station.
f. Locations: One per folding backstop
g. Basis-of-Design: Performance Sports Systems; Model 1194.

6. Backstop Safety Device: Designed to limit free fall if support cable, chains, pulleys, fittings, winch, or related components fail; includes mechanical automatic reset. 6000 lb load capacity.
   a. Locations: One per folding backstop.
   b. Basis-of-Design: Performance Sports Systems; Model 1100.
7. Basketball Backboards:
   a. Shape and Size:
      1) Rectangular, 72 by 42 inches (width by height).
   b. Backboard Material: Provide with predrilled holes or preset inserts for mounting goals.
      1) Glass: Minimum 1/2 inch thick, transparent tempered glass; ASTM C1048 Kind FT (fully tempered) complying with 16 CFR 1201 Category II or ANSI Z97.1 Class A for safety glazing.
      2) Frame: Fully welded, painted steel frame, with steel subframe, reinforcement, bracing, and mounting slots for mounting backboard frame to backstop.
         (a) Provide impact-absorbing resilient rubber or PVC gasket for glass mounting.
         (b) Provide for direct mounting of backboard frame to center mast of backstop.
         (c) Provide rim-restraining device that ensures goal remains attached if glass backboard breaks; complies with NCAA and NFHS rules.
   c. Target Area and Border Markings: Permanently etched in white color, marked in pattern and stripe width per manufacturer's standard design.
   d. Quantity: One backboard per backstop.
   e. Basis-of-Design: Performance Sports Systems; Model LXP4200.
8. Basketball Goals: Basket ring complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
   a. Single-Rim Basket Ring Competition Goal: Materials, dimensions, and fabrication per manufacturer's standard design and complying with NFHS guidelines.
   b. Type:
      1) Movable: Pressure-release design with manufacturer's standard breakaway mechanism and rebound characteristics identical to those of fixed, nonmovable ring.
   c. Pressure-Release Characteristics: Positive-lock movable breakaway design, with manufacturer's standard mechanism, including preset pressure release, set to release at more than 100 lb load, and automatic reset. Provide movable ring with rebound characteristics identical to those of fixed, nonmovable ring.
   d. Mount: Front.
   e. Net Attachment: No-tie loops for attaching net to ring without tying.
   f. Finish: Polyester powder-coat finish.

g. Goal-Mounting Assembly: Compatible with goal, backboard, and backstop; with 5-inch o.c. horizontally and vertically or 5-inch o.c. horizontally and 4-inch o.c. vertically hole pattern for goal attachment.
   1) Goal shall mount directly and independently to center mast of backstop; no force shall be transmitted directly to backboard.
h. Quantity: One goal per backboard.
i. Basis-of-Design: Performance Sports Systems; Model 2000+

9. Basketball Nets: 12-loop-mesh net, between 15 and 18 inches long, sized to fit ring diameter.
   a. Competition Cord: Antiwhip, made from white nylon cord; minimum120-gm thread, maximum 144-gm thread.
   b. Quantity: One net per basketball goal.
   c. Basis-of-Design: Performance Sports Systems; Model GAW
10. Backboard Safety Pads: Extend continuously along bottom and up sides of backboard and over backstop according to manufacturer's standard design.
   a. Attachment: Bolt-on.
   b. Color: Standard color as selected by Architect.
   c. Locations: All backboards.
   d. Basis-of-Design: Performance Sports Systems; Model PMCE.

2.05 VOLLEYBALL EQUIPMENT

A. General:
   1. Standard Rules: Provide equipment according to the requirements of NFHS's "Volleyball Rules Book."
B. Floor Inserts: Solid-brass floor cover plate and steel pipe sleeve with capped bottom.
   1. Size pipe sleeve to fit volleyball post standards.
   2. Sleeve Depth: 12 inches, minimum.
   3. Floor Cover Plate: Lockable swivel access cover designed for use with floating wood floors.
      a. Cover to be flush with adjacent flooring when in closed position.
      b. For each gymnasium, provide two tools for unlocking cover plates.
   4. Design floor insert for secure anchorage to flooring substrates indicated.
   5. Locations: As indicated.
   6. Basis-of-Design: Performance Sports Systems; Model 6405 floor sleeve with Model 6430 cover plate.
C. Post Standards: Removable, adjustable-height, telescoping, paired single-court and two-court volleyball post standards.
   1. Materials: Extruded-aluminum pipe or tubing with nonmarking plastic or rubber end caps.
   2. Post Size: 4 inch outside diameter at base.
   3. Design standards for easy installation and removal from floor inserts
   4. Finish: Manufacturer's standard factory-applied, polyester powder-coat finish.
   5. Net Height Adjuster: Manufacturer's standard telescoping system with lock mechanism and all related fittings.
      a. Net Height Range: Between tennis net height and boys'/men's volleyball net height, 42 and 95-5/8 inches or more.
      b. Height Markers: Net height adjuster shall be clearly marked for regulation play heights for girls/women volleyball, boys/men volleyball, badminton, and tennis.
   6. Net-Tensioning System: Manufacturer's standard system for adjusting and holding net tension.
      a. Provide manufacturer's standard fully enclosed, nonslip, winch with cable length and fittings for connecting to net lines; include positive-release mechanism and permanently fixed handle.
      b. Mount net tensioner on post standard at side away from court and on one side of center post standard.

c. Provide end post with post top pulley. Provide opposing post with post top grooved line guide and welded-steel loops, hooks, pins, or other devices for net attachment. Center post shall have one side similar to end post and opposite side similar to single-court opposing post.

7. Bottom Net Lock Tightener: Manufacturer's standard quick-release-type tension strap.
   a. Provide spring-loaded, self-locking tensioner; turnbuckle; pulley; or other device, and linkage fittings that quickly and easily tighten bottom line or net.
8. Quantity: One standard for each floor insert.
9. Basis-of-Design: Performance Sports Systems; Model 7200 Libero Collegiate

D. Net: Competition volleyball net.
1. Length: 32 feet.
2. Width/Height:, 39 inches.
3. Nylon Mesh: 4-inch square knotless mesh made of black nylon string.
4. Hemmed Edges/Band/Binding:
   a. Width: 2 inches, minimum.
   b. Provide at top, bottom, and sides of net.
   c. Color: White.
5. Provide end sleeves for dowels.
6. Provide lines with linkage fittings threaded through top and bottom hems of binding.
   a. Provide lengths of lines and linkage fittings as required to properly connect to posts.
7. Top Line: Minimum 1/8 inch diameter, galvanized or coated-steel cable.
8. Bottom Line: Minimum 1/8 inch diameter, galvanized or coated-steel cable.
9. Dowels: Minimum 1/2 inch diameter fiberglass or 1 inch diameter wood.
   a. Provide two dowels per net threaded through each side hem sleeve for straightening net side edges.
10. Quantity: One net per pair of post standards.
11. Basis-of-Design: Performance Sports Systems; Model 7600.

E. Net Antennas:
1. 3/8 inch diameter, high-tensile-strength, extruded-fiberglass or plastic rods, 72 inches long.
2. Antennas shall extend above top hem band of net, with alternating white and red bands according to referenced standard rules.
3. Clamps: Secures antenna to top and bottom of net.
4. Quantity: Two antennas per net.
5. Basis-of-Design: Performance Sports Systems; Model 6412.

F. Boundary Tape Sideline Markers:
1. 2 inch wide white strip with sleeve for securing net antenna.
2. Secure to net top and bottom with hook-and-loop attachments.
3. Quantity: Two markers per net.
4. Basis-of-Design: Performance Sports Systems; Model 6413.

G. Judges' Stands:
1. Manufacturer's standard folding freestanding unit.
2. Fabricated of welded-steel tubing units.
3. Provide wheels for easy transporting.
4. Finish: Manufacturer's standard factory-applied, polyester powder-coat finish.
   a. Color to match post standards.
5. Quantity: One judges' stand per volleyball court.
6. Basis-of-Design: Performance Sports Systems; Model 6448.

H. Safety Pads:
1. Material: 1 1/4 inch thick, minimum, multiple-impact-resistant polyurethane foam covered by puncture and tear resistant fabric cover.
   a. Fabric:
      1) Weight: 14 oz./sq. yd., minimum.

2) Treated with fungicide for mildew resistance.
3) Fire-resistance: Complies with NFPA 701.

2. Provide pads with hook-and-loop closure or attachments for the following components:
   a. Post Standards: Wraparound style pads, designed to totally enclose each standard to a minimum height of 72 inches.
      1) Quantity: One per post.
      2) Basis-of-Design: Performance Sports Systems; Model 6010.
   b. Net Lines:
      1) Quantity: 4 per net.
      2) Basis-of-Design: Performance Sports Systems; Model 6251.
   c. Judges' Stands: Pads designed to totally enclose each framing member.
      1) Quantity: One per judges' stand.
      2) Basis-of-Design: Performance Sports Systems; Model 6040.
3. Fabric Covering Colors:
   a. Two standard colors as selected by Architect.

I. Storage Cart: Manufacturer's standard wheeled unit for transporting and storing volleyball equipment.
1. Capable of passing through 36 inch wide door openings.
2. Fabricated of welded-steel tubing with heavy-duty casters; provide two swivel casters, minimum.
   a. Wheels shall not damage or mark floors.
3. Finish: Manufacturer's standard factory-applied, polyester powder-coat finish
4. Quantity: As required to provide transport and storage for all volleyball equipment provided.
5. Basis-of-Design: Performance Sports Systems; Model 6295

2.06 WALL SAFETY PADS

A. Wall Safety Pads: Padded wall panels attached in a continuous row.
1. Construction: Fabric covered fill material laminated to backer board,
   a. Backer Board: Minimum 1/2 inch thick plywood or oriented strand board.
   b. Fill: Fire-resistive, high impact-resistant, neoprene foam.
      1) Thickness: 2 inches, minimum.
      2) Density: 6 lb per cu. ft.
   c. Fabric: Puncture and tear resistant, PVC-coated polyester or nylon-reinforced PVC fabric.
      1) Weight: 14-oz./sq. yd., minimum.
      2) Secure fabric to back of backer board.
      3) Fabric shall be free of sags and wrinkles.
      4) Treat with fungicide for mildew resistance.
      5) Colors: Two standard colors as selected by Architect.
2. Performance Requirements:
   a. Complies with ASTM F2440 for impact protection.
   b. Surface-Burning Characteristics: ASTM E84, Class A.
      1) Flame-Spread Index: 25 or less.
      2) Smoke-Developed Index: 450 or less.
3. Sizes:
   a. Standard Padding:
      1) Width: 24 inches.
      2) Length: 72 inches.
   b. L and C Shaped Padding:
      1) Manufacturer's standard L and C shapes for corners. Length to match standard padding.
   c. Specially Shaped Padding: Custom fabricate special shapes and sizes to fit irregularly shaped members, areas, and protrusions in walls.

4. Cutout Trim: Provide manufacturer's standard flanged cutout trim kits for fitting pads around switches, receptacles, and other obstructions.
5. Mounting Method: Concealed Z-clips.
6. Locations: As indicated.
7. Basis-of-Design: Performance Sports Systems; Model 4130 Wall Pads with Model 4196 z-clips.

2.07 REMOTE CONTRTOL SYSTEM

A. Remote Control System:
1. General: All gymnasium operable equipment within each gymnasium space shall be controlled from a single system located within full view of all the operable gymnasium equipment.
a. System shall be capable of controlling all the operable equipment within the space including, but not limited to, the following:
1) Backstops.
2) Goal height adjusters.
3) Divider curtains.
2. Remote-Control Stations: NEMA ICS 6, Type 1 enclosure for flush mounting. Key-pad controlled, with constant pressure on the key pad to control gymnasium equipment.
a. Control station shall be capable of controlling gymnasium equipment individually or in multiple pre-programmed groups.
b. Control station shall require a four digit password to operate and shall go inactive after 30 seconds of non-use.
c. Control station shall use LED lights and buzzer, or similar method, to provide information to user as follows:
1) Green LED and buzzer activation occurs after correct password has been entered, and system is activated.
2) Yellow LED indicates standby mode.
3) Red LED indicates activation and operation of selected gymnasium equipment.
d. Locations: As indicated.
3. Include all associated relay boards and wiring as required for a complete remote control system.
4. Basis-of-Design: Performance Sports Systems; Model TSC1500.

2.08 MISCELLANEOUS MATERIALS

A. Equipment-Mounting Boards: Wood; size and quantity as required to mount gymnasium equipment according to manufacturer's instructions.
1. Finish: Gymnasium equipment manufacturer's standard transparent finish.
B. Associated Hardware, Support, and Fasteners:
1. Support Cable: Manufacturer's standard galvanized-stranded-steel wire rope with a breaking strength of 7000 lbs.
a. Provide fittings according to the wire rope manufacturer's instructions for size, number, and installation method.
2. Support Chain and Fittings: ASTM A391/A391M, Grade 80, heat-treated alloy-steel chains.
a. Provide hot-dip galvanized or zinc-plated steel connectors and hangers.
3. General Purpose Chain: For chains not used for overhead lifting, ASTM A413/A413M carbon steel chain, Grade 30 proof coil chain or higher as recommended by gymnasium equipment manufacturer.
a. Provide coating type, chain size, number, and installation method according to manufacturer's instructions.
4. Castings and Hangers: ASTM A47/A47M malleable iron; grade as required for structural loading.
5. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard corrosion-resistant units; concealed; tamperproof, vandal-resistant design.

C. Plywood: PS 1, Exterior Exposure.
D. Oriented Strand Board (OSB): PS 2.
E. Particle Board: ANSI A208.1.
F. Grout: Nonshrink, nonmetallic, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, ASTM C1107/C1107M; with minimum strength recommended by gymnasium equipment manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Take field measurements to ensure proper fitting of work. If taking field measurements before fabrication will delay work, allow for adjustments within recommended tolerances.
B. Inspect areas and conditions before installation, and notify Architect in writing of unsatisfactory or detrimental conditions.
   1. Verify that supporting structure, subfloors, and other substrates are properly prepared to receive and support work of this section.
C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.
D. Verify that electrical services are correctly located and have proper characteristics.

3.02 INSTALLATION - GENERAL

A. Install gymnasium equipment in accordance with Contract Documents and manufacturer's instructions.
B. Install gymnasium equipment after other finishing operations, including painting, have been completed unless otherwise indicated.
C. Coordinate installation of inserts and anchors that must be built in to flooring or subflooring.
D. Install equipment rigid, straight, plumb, and level.
E. Secure equipment with manufacturer's recommended anchoring devices.
   1. Fasteners and anchors shall properly transfer gymnasium equipment loads to structural supports.
F. Separate dissimilar metals to prevent electrolytic corrosion.
G. Electric Installation: Connect wiring to building electrical system.

3.03 OPERATIONAL GYMNASIUM EQUIPMENT

A. Operating Gymnasium Equipment: Verify clearances of movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

3.04 FLOOR INSERTS

A. Floor Inserts:
   1. Coordinate locations with application of game lines and markers.
   2. Coordinate installed elevation heights of floor inserts with installation and field finishing of finish flooring; ensure that installed cover plates are flush with adjacent flooring.
   3. Installation:
      a. Clean oversized, recessed voids in concrete substrate of debris.
      b. Position each sleeve, and fill void around sleeve with grout, mixed and placed according to grout manufacturer's written instructions.
      c. Hold sleeve in proper position until grout is sufficiently cured.

3.05 WALL SAFETY PADS

A. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.
B. Bottom of pads shall be 4 inches above finish floor unless otherwise indicated.
C. Limit cuts in face of wall padding so that cuts are securely and fully concealed behind cutout trim.

3.06 ADJUSTING

A. Verify proper placement of equipment.

B. Verify proper placement of floor inserts; install volleyball standard posts and equipment and verify installation is proper and all equipment functions correctly.
C. Perform operational tests of all operable equipment.
   1. Adjust operating equipment for proper operation; remove and replace equipment causing noise or vibration; lubricate equipment as recommended by manufacturer.
   2. Verify that limit switches are properly set.

3.07 CLEANING

A. Remove masking or protective covering from finished surfaces.
B. Clean equipment in accordance with manufacturer's recommendations.

3.08 PROTECTION

A. Protect installed products until Date of Substantial Completion.
B. Replace damaged products before Date of Substantial Completion.

3.09 DEMONSTRATION

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

END OF SECTION

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SECTION 11 6643 - INTERIOR SCOREBOARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basketball scoreboards and controllers.

1.02 REFERENCE STANDARDS

A. 47 CFR 15 - Radio Frequency Devices; current edition
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements
C. UL 48 - Standard for Electric Signs; 2011.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Verify scoreboard locations.
C. Coordinate location and electrical characteristics of service connection.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each type of product.
C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Include diagrams for power, signal, and control wiring.
D. Samples: Submit 3 samples 2 by 3 inches in size showing each color and finish selected.
E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
F. Operation and Maintenance Data: For scoreboard equipment to include in operation, and maintenance manuals.

1.05 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 experienced in installing the products specified in this section with minimum 5 years documented experience.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not install scoreboard until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
B. Field Measurements: Verify position of scoreboard with Owner and Architect prior to installation.

1.07 COORDINATION

A. Coordinate installation of scoreboard equipment with other construction and items mounted on the wall.

1.08 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of scoreboard equipment that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 5 years from date of Substantial Completion:

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain scoreboards and associated equipment from single source from single manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. Scoreboards and equipment shall comply with the following:
   1. Standard for Electric Signs, UL 48.
   2. NFPA 70.
   3. 47 CFR 15.

2.03 BASKETBALL SCOREBOARDS

A. Basis of Design: Daktronics, Inc.; Model BB-2155: www.daktronics.com.
   1. Provide either the product identified as "Basis of Design" or an equivalent product from one of the following:
      a. Nevco, Inc.; www.nevco.com.
      b. Substitutions: See Section 01 6000 - Product Requirements.

B. Locations: As indicated. Verify locations with Owner prior to installation.

C. Single Sided Basketball Scoreboard: Single-sided scoreboard capable of scoring basketball, volleyball and wrestling. It shall score home and guest to 199, period to 9, player fouls to 9, team fouls to 19, time outs left to 9, indicate possession and bonus, display period time to 99:59 and during the last minute of the period, it shall display time to 1/10 of a second.
   1. General information:
      a. Dimensions: 6 feet high by 10 feet wide by 6 inches deep.
      b. Weight: 275 lbs.
      c. Power: 120V AC, 270W, 2.3 Amps.
         1) Cord plugs into a standard grounded outlet.
      d. Color: Standard color, as selected by the Architect.
      e. Scoreboard Striping: Standard color, as selected by the Architect.
         1) Apply around scoreboard perimeter and clock perimeter.
   2. Construction: Aluminum.
      a. Scoreboard face, back and perimeter: 0.063" thick
      b. Cabinet shall be capable of withstanding high-velocity impacts from indoor sports balls without the need for protective screens.
   3. Digits:
      a. LED Technology:
         1) Seven bar segments per digit.
         2) Daktronics Pana View (PV); discrete LEDs that protrude through scoreboard face, or equal.
      b. Digit Heights:
         1) 13 inches: Clock and Score digits.
         2) 10 inches: All other digits.
         3) 4 inches: Bonus Indicators.
         4) 3 inches: Possession Arrows/Indicators.
      c. LED Digit Colors:
         1) Amber: For Clock, Bonus Indicators, Period, Player/Fouls, and Time Outs Left.
         2) Red: For Score, Possession Arrows/Indicators, and Foul Digits.
   4. Electronic Captions:
      a. LED Technology:
         1) Through-Hole LEDs: Equal to Daktronics PanaView digits; discrete LEDs that protrude through scoreboard face.
      b. Players and Fouls Captions:
         1) Caption Heights: 6 inches.
      c. LED Digit Colors: Amber.
   5. Horn: Vibrating horn mounted behind scoreboard face.
      a. Sounds automatically when period clock counts down to zero.
      b. Sounds manually as directed by operator.

2.04 WIRELESS CONTROL CONSOLES

A. Basis of Design: Daktronics, Inc.; All Sport 5000 Controller: www.daktronics.com.

1. Provide either the product identified as "Basis of Design" or one of the following equivalent products:
   a. Nevco, Inc.; www.nevco.com.
   b. Substitutions: See Section 01 6000 - Product Requirements.

B. Quantity: Provide one control console for each gymnasium, including battery kit, power cord, and carrying case.

C. Control Console: Wireless control console.

D. Construction:
1. Size: 4.25 inches high by 16.25 inches wide by 9 inches deep.
2. Weight: 7 lbs.
3. Case: Rugged aluminum enclosure.
4. Keyboard: A sealed membrane water-resistant keyboard.
5. Display: A 32-character backlit LCD.

E. Features:
1. Console recalls clock, score, and period information if power is lost.
2. Capable of scoring basketball, volleyball, and wrestling.
3. Capable of controlling multiple scoreboards.

F. Power and Control:
1. Power: Console has a maximum power requirement of 6 W. Console shall be capable of being powered from either a cord plugged into the wall or by an external battery.
   a. Plug-in: Provide 6 foot power cord to plug into a standard grounded 120 V AC outlet.
   b. External Battery: Provide a battery pack kit that includes the following:
      1) AC wall-pack adapter.
      2) Battery charger.
      3) Cloth carrying case and carrying strap.
      4) Battery; capable of powering console for 24 hours.
2. Wireless Control:
   a. 2.4 GHz spread spectrum radio system with frequency hopping technology and 64 non-interfering channels.
   b. System includes a transmitter installed inside the console and receivers that shall be installed inside each scoreboard.

G. Provide the following additional equipment:
1. Wireless control console hard carrying case.

2.05 MISCELLANEOUS MATERIALS

A. General: Fasteners shall be of size and type required for substrates indicated.
1. Provide manufacturer's standard corrosion-resistant fasteners and related hardware for a complete and secure installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with scoreboard manufacturer's requirements, including the following:
1. Installation tolerances.
2. Operational clearances.
3. Locations of connections to building electrical system.
4. And other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions.

B. Install scoreboards after other finishing operations, including painting, have been completed unless otherwise indicated.

C. Install score board rigid, level, plumb, square, and true; anchored securely to wall; positioned at locations and elevations indicated; in proper relation to adjacent construction.
   1. Anchors and fasteners shall secure scoreboard equipment to supporting wall and properly transfer load to in-place construction.
D. Electric Installation: Connect wiring to building electrical system.
E. Verify proper operation of scoreboards and controllers.

3.03 CLEANING

A. After installation, inspect components. Remove dirt and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.
B. Replace scoreboard equipment and finishes that cannot be cleaned and repaired.

3.04 DEMONSTRATION

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

END OF SECTION

SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manual roller shades.
B. Motorized roller shades.

1.02 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
D. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
C. Sequencing:
   1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
   2. Do not install shades until final surface finishes and painting are complete.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
   1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.
C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
   1. For schedule, use same designations as indicated on Drawings.
   2. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
F. Samples:
   1. Roller Shade Finishes: Submit 3 samples 2 by 3 inches in size for each color selected.
   2. Shade Material: Submit 3 samples, 4 by 4 inches in size, for each type, color, and finish.
G. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.
H. Window Shade Samples: Representative of types in the project.
   1. Complete, full-size operating unit not less than 16 inches wide for each type of roller shade indicated. Include all related accessories such as valances.

I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
K. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Drive Chain: Quantity equal to 2 percent of total installed, but not less than 100 lineal feet.
3. Clutch Operator: Quantity equal to 2 percent of total installed, but not less than 2 units.
4. Mounting Brackets: Quantity equal to 2 percent of total installed, but not less than 2 pair.
L. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
B. Installer Qualifications: Company specializing in performing work of this type with minimum 5 years of documented experience with shading systems of similar size and type.

1.06 MOCK-UP

A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.
1. Full-sized mock-up may become part of the final installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
1. Shade Hardware: 10 years, excluding drive chains.
2. Electric Motors: 5 years.
3. Electronic Control Equipment: 5 years.
4. Fabric: 10 years.
5. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roller Shades:
1. Draper, Inc.: www.draperinc.com.
2. Hunter Douglas Architectural: www.hunterdouglasarchitectural.com.
3. Legrand North America, LLC/Solarfective: www.legrand.us/solarfective.aspx.
4. Levolor: https://commercial.levolor.com.
5. Lutron Electronics Co. Inc./Contract Roller Shades: www.lutron.com
6. MechoShade Systems, LLC: www.mechoshade.com.
7. Silent Gliss Inc.: www.silentglissamerica.com.
8. Substitutions: See Section 01 6000 - Product Requirements.
B. Provide roller shades by one manufacturer from a single source

2.02 ROLLER SHADES

A. General:
1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.

2. Provide shade system that operates smoothly when shades are raised or lowered.
3. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
   a. Comply with NFPA 70.
   b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
   c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.
   d. Electrical Characteristics: 120 volts, single phase, 60 Hz, unless otherwise indicated.

B. Roller Shades Type A: Manual, single roller, light-filtering.
1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
   a. Drop Position: Regular roll.
   b. Roll Direction: Roll down, closed position is at window sill.
   c. Mounting: As indicated.
   d. Size: As indicated on drawings.
   e. Fabric: RSF- 1
   f. Finishes:
      1) For metal components exposed to view provide manufacturer's standard baked enamel finish.
      2) Colors of Metal and Plastic Components Exposed to View: Standard color as selected by Architect.
2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge or double sided adhesive tape.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Exposed aluminum bottom bar, flat profile with closed ends.
5. Manual Operation:
   a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
   b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
      1) Chain Material: Provide nickel-plated metal or stainless steel.
   c. Chain Retainer:
      1) Manufacturer's standard clip.
6. Accessories:
   a. Headbox: Extruded aluminum, size as required to conceal shade mounting with back/top cover, attachable to brackets without exposed fasteners.
      1) Profile: Square.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

C. Roller Shades Type C: Manual, single roller, blackout/room-darkening.
1. Description - Interior Roller Shades: Single roller, manually operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.

a. Drop Position: Regular roll.
b. Roll Direction: Roll down, closed position is at window sill.
c. Mounting: As indicated.
d. Size: As indicated on drawings.
e. Fabric: RSF- 2
f. Finishes:
1) For metal components exposed to view provide manufacturer's standard baked enamel finish.
2) Colors of Metal and Plastic Components Exposed to View: Standard color as selected by Architect.

2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
a. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
a. Material: Extruded aluminum.
b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge or double sided adhesive tape.
4. Hembars: Designed to maintain bottom of shade straight and flat.
a. Style: Exposed aluminum bottom bar, flat profile with closed ends.
b. Room-Darkening Shades: Provide a slot in bottom bar with wool-pile light seal.
5. Manual Operation:
a. Clutch Operator: Manufacturer's standard material and design, permanently lubricated.
b. Drive Chain: Continuous loop beaded ball chain, 95 pounds minimum breaking strength. Provide upper and lower limit stops.
1) Chain Material: Provide nickel-plated metal or stainless steel.
c. Chain Retainer:
1) Manufacturer's standard clip.
6. Accessories:
a. Headbox: Extruded aluminum, size as required to conceal shade mounting with back/top cover, attachable to brackets without exposed fasteners.
1) Profile: Square.
b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
c. Interior Side Channels: As required for light sealing room-darkening shade applications.
d. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

D. Roller Shades Type B: Motorized, single roller, light-filtering.
1. Description - Interior Roller Shades: Single roller, motor operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
a. Drop Position: Regular roll.
b. Roll Direction: Roll down, closed position is at window sill.
c. Mounting: As indicated.
d. Size: As indicated on drawings.
e. Fabric: RSF- 1
f. Finishes:
1) For metal components exposed to view provide manufacturer's standard baked enamel finish.
2) Colors of Metal and Plastic Components Exposed to View: Standard color as selected by Architect.

2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
   a. Material: Stamped steel.
3. Roller Tubes: As required for type of shade operation.
   a. Material: Extruded aluminum.
   b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
   c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge or double sided adhesive tape.
4. Hembars: Designed to maintain bottom of shade straight and flat.
   a. Style: Exposed aluminum bottom bar, flat profile with closed ends.
5. Accessories:
   a. Headbox: Extruded aluminum, size as required to conceal shade mounting with back/top cover, attachable to brackets without exposed fasteners.
      1) Profile: Square.
   b. End Caps: Provide manufacturer's standard end caps to cover exposed ends of brackets.
   c. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.03 SHADE FABRIC

A. Fabric RSF- 1: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Products: Provide one of the following:
      a. Mermet Corporation: E Screen: www.mermetusa.com
      b. Phifer, Inc.: SheerWeave 2410: www.phifer.com
      c. Substitutions: Not permitted
   2. Material: Vinyl coated polyester.
   3. Performance Requirements:
      a. UV Blockage: 95 percent, minimum.
      b. Flammability: Pass NFPA 701 large and small tests.
      c. Fungal Resistance: No growth when tested according to ASTM G21.
   4. Openness Factor: 3 percent.
   5. Roll Width: 63 inches, minimum.
   6. Color: Standard color as selected by Architect.

B. Fabric RSF- 2: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
   1. Manufacturers:
      a. Mermet Corporation; E-Screen - 3%: www.mermetusa.com.
      b. Phifer, Inc; Style 2410 3%: www.phifer.com.
      c. Substitutions: Not permitted.
   2. Products: Provide one of the following:
      a. Mermet Corporation: Avila Twilight: www.mermetusa.com.
      b. Phifer, Inc.:SheerWeave 7000 Blackout: www.phifer.com.
      c. Substitutions: Not permitted
   3. Material: Vinyl coated polyester.
   4. Performance Requirements:
      a. UV Blockage: 95 percent, minimum.
      b. Flammability: Pass NFPA 701 large and small tests.
      c. Fungal Resistance: No growth when tested according to ASTM G21.
   5. Openness Factor: 0 percent (Blackout).
   6. Roll Width: 63 inches, minimum.
   7. Color: Standard color as selected by Architect.

2.04 MOTOR CONTROLS

A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.

B. Provide all components and connections necessary to interface with other systems as indicated.

C. Manual Motor Controls:

1. Control Functions:
   a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
   b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
   c. Raise: Raise controlled shade(s) only while button is pressed.
   d. Lower: Lower controlled shade(s) only while button is pressed.
   e. Presets: For selection of predetermined shade positions.
   f. Multiple Shade Groups: Provide individual controls for each shade group as indicated.

2.05 ROLLER SHADE FABRICATION

A. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.

1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
2. Horizontal Dimensions - Inside Mounting: Provide symmetrical light gaps on both sides of shade not to exceed 3/4 inch total.
3. Horizontal Dimensions - Outside Mounting: Extend shades 2 inches beyond jambs on each side.

B. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine finished openings for deficiencies that may preclude satisfactory installation.

B. Electrical Connections: For motorized roller shades, verify proper electrical characteristics and connection locations.

C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

A. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.

B. Electrical Connections: Connect motorized roller shades to building electrical system.

C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

A. Clean soiled shades and exposed components as recommended by manufacturer.

B. Replace shades that cannot be cleaned to "like new" condition.

3.05 CLOSEOUT ACTIVITIES

A. Demonstration: Demonstrate operation and maintenance of window shade system to Owner's personnel.

3.06 PROTECTION

A. Protect installed products from subsequent construction operations.

B. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 3216 - MANUFACTURED PLASTIC LAMINATE-CLAD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured plastic laminate casework.
B. Countertops.- In Section 12 3600 Countertops

1.02 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation, and bottoms of cabinets less than 30 inches above finished floor.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI A208.1 - American National Standard for Particleboard; 2022.
C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
D. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
H. BHMA A156.18 - Materials and Finishes; 2020.
I. BHMA A156.9 - Cabinet Hardware; 2020.
J. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
K. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
L. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.
C. Coordinate the work with placement of concealed framing, blocking, and reinforcements that support casework.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each product. Include component dimensions, configurations, construction details, joint details, attachments.
C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include filler panels, rough-in and anchors, reinforcements, and blocking, placement dimensions and tolerances, clearances required, and keying information.
    1. Indicate manufacturer's catalog number for each unit of casework.
    2. Indicate plumbing locations and electrical service locations.

D. Samples:
   1. Plastic Laminate: Submit 3 samples 3 by 6 inches in size showing each color, texture, and finish selected.
   2. Edge Banding: Submit 3 samples 6 inches in length showing each color and finish selected.
   3. Solid Surfacing:Submit 3 samples 4 by 4 inches in size, for each type, color, pattern, and finish.
E. Casework Samples: Representative of types in the project.
   1. To be provided only upon request of Architect.
      a. Base Cabinet: Cabinet with drawer and door and specified hardware.
      b. Wall Cabinet: Cabinet with shelves and supports, door and specified hardware.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Maintenance Data: Manufacturer's recommendations for care and cleaning.
I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Door Hinges: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
   3. Door Catches: Quantity equal to 2 percent of total installed, but not less than 5, includes fasteners.
   4. Door Pulls: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
   5. Shelf Supports: Quantity equal to 2 percent of total installed, but not less than 10.
   6. Drawer Slides: For each size and type, quantity equal to 2 percent of total installed, but not less than 2 paris; includes fasteners.
   7. Locks: For each type, quantity equal to 2 percent of total installed, but not less than 2; includes fasteners.
   8. Grommets: Quantity equal to 2 percent of total installed, but not less than 5.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years of documented experience.
   1. Licensed under Architectural Woodwork Institute (AWI) Quality Certification Program (QCP).
B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than 5 years of documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation.
B. Environmental Requirements: Do not deliver casework until the following conditions have been met:
   1. Building has been enclosed (windows and doors sealed and weather-tight).
   2. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place and will remain operating.
   3. Painting and other “wet work” construction is complete in the casework areas.
C. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.
D. Storage:
   1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the above environmental requirements.

1.08 WARRANTY

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

B. Correct defective Work within a five year period after Date of Substantial Completion. Defects include, but are not limited to:

1. Delamination of components.
2. Failure of adhesives.
3. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: Catalog numbers indicated on Drawings are for products manufactured by TMI Systems Design Corporation: www.tmisystems.com.

1. Provide either the indicated "Basis of Design" products or equivalent products from one of the following:
   a. Advanced Cabinet Systems: www.advancedcabinetsystems.com.
   b. Case Systems: www.casesystems.com.
   c. Stevens Industries, Inc.: www.stevensind.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

B. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 PERFROMANCE REQUIREMENTS

A. Accessibility: Comply with ICC A117.1 and ADA Standards.

2.03 MATERIALS

A. Casework Adhesives: As recommended by casework manufacturer.

B. Laminate Adhesive: Type recommended by casework manufacturer to suit application.

C. Wood-based Materials - General:

1. Maximum Moisture Content: 7 percent.

D. Hardwood Plywood: HPVA HP-1, particleboard core.

E. Particleboard: ANSI A208.1, Grade M-2.

1. Moisture resistant where indicated.

F. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.

1. Moisture resistant where indicated.

G. Laminates:

1. High-Pressure Decorative Laminate (HPDL); NEMA LD 3; Grades as indicated.
2. Thermally Fused Laminate (TFL) : Melamine resin; NEMA LD 3, Grade VGL.

H. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness.

1. 0.118 inch (3 mm) thick at doors, drawer fronts, and countertops.
2. 0.039 inch (1 mm) thick elsewhere, including exposed exterior cabinet members, top edges of drawer boxes, adjustable shelves, and interior panels.

I. Tempered Glass: Annealed float glass ASTM C1036, Type 1 (Transparent Flat), Class 1 (Clear), Quality Q3; fully tempered per ASTM C1048, Kind FT. Complying with ANSI Z97.1.

1. Glass Thickness: 1/4 inch, minimum.
2. Exposed Edges: Ground smooth.

2.04 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, General:

1. Cabinet Hardware: Comply with BHMA A156.9, types as indicated for quality grade specified.
   a. Finishes:

1) Exposed Hardware: Provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finishes:
   (a) Satin Stainless Steel: BHMA 630.
   (b) Satin Chromium Plated: BHMA 626.
2) Concealed Hardware: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2. Provide all fasteners, hardware and accessories for a complete installation including:
   a. Undercounter plastic laminate support panels or metal support brackets.
   b. Free-standing table hardware.

B. Hinges: Semiconcealed type, 5 knuckle, institutional grade, hospital tip, 2-3/4 inch overlay, 270 degree opening, 3 way adjustment, 0.095 inch gage, steel with satin finish, Grade 1.
   1. Provide two (2) hinges for doors less than 36 inches high.
   2. Provide three (3) hinges for doors 37 inches to 54 inches high.
   3. Provide four (4) hinges for tall cabinet doors 55 inches to 84 inches high.

C. Door Catches: Heavy-duty magnetic or roller type catch and strike plate.
   1. Doors up to 48 inches high shall have single catch mounted at bottom door edge.
   2. Doors over 48 inches high shall have catch at both the top and bottom edges of door.

D. Pulls:
   1. Type: Back-mounted wire pulls, standard U-shape style.
      a. Material: Solid aluminum, stainless steel, or chrome-plated brass.
      b. Overall Size: 4-1/2 inches wide by 1 inch deep.
   2. Provide as follows:
      a. Doors: Single pull.
      b. Drawers up to 24 inches Wide: Single pull.
      c. Drawers over 24 inches Wide: Two pulls.

E. Drawer Slides: Epoxy coated with nylon rollers or zinc plated with steel ball-bearings; self-closing with positive stop both directions. Load rating at full extension as follows:
   1. Drawers less than 2 inches deep: 50 lbs.
   2. All Drawers 2 to 4 inches deep: 100 lbs.
   3. File Drawer and Drawers over 4 inches deep: 150 lbs.

F. Adjustable Shelf Supports: Double-pin clear polycarbonate shelf rests with shelf anti-tipping feature complying with BHMA A156.9, Type B04013. Designed to mount into pre-drilled holes in casework sides. Each shelf rest shall support 200 lbs, minimum.

G. Locks: Removable core, disc tumbler, cam style lock with strike for drawers and doors. At other locations, use lock style to suit application.
   1. Door Locks: BHMA A156.11, E07121.
   2. Drawer Locks: BHMA A156.11, E07041.
   3. Provide locks on every doors and drawers per room.
      a. All locks within a room shall be keyed alike and different than adjacent rooms. All locks on the Project shall be master keyed.
         1) Provide 2 keys for each room and three 3 master keys.

H. Sliding Door Track: Manufacturer's standard anodized aluminum double channel assembly with track/door rollers; type and size to suit sliding-doors.

I. Grommets: 2 inch outside diameter, molded-plastic grommets and matching plastic caps with wire passage slot.
   1. Color: Black.

J. Coat Rods:
   1. Rod: Minimum 1 inch diameter steel tube; minimum wall thickness 0.075 inch (14 gage).
   2. Brackets: Steel mounting brackets.

K. Casters: Non-marking, soft, rubber wheels with ball bearing assembly.

1. Brakes: Provide 2 brakes, minimum, per mobile unit.
2. Load Capacity: 200 pounds, minimum, per caster.

2.05 MANUFACTURED PLASTIC LAMINATE CASEWORK

A. Cabinet Construction - General:
   1. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
      a. Laminate-clad panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels.
      b. Provide cabinet sizes and configurations as indicated on Drawings.
   2. Quality Standard: AWI/AWMAC/WI (AWS), unless noted otherwise.
      a. Grade: Premium.
   3. Design Style: Flush overlay, frameless construction.
B. Core Material: Particleboard or MDF, unless otherwise indicated.
C. Component Thicknesses: Not less than the following.
   1. General component thicknesses unless otherwise indicated:
      a. Base Cabinets: 3/4 inch.
      b. Wall Cabinets: 3/4 inch.
      c. Tall Cabinets: 3/4 inch.
   2. Cabinet Backs:
      a. 1/4 inch thick.
   3. Shelves:
      a. 36 inches or less in length: 3/4 inch thick, unless otherwise indicated.
      b. Over 36 inches in length: 1 inch thick.
   4. Doors:
      a. Height 48 inches or less: 3/4 inch thick.
      b. Height over 48 inches: 1 inch thick
   5. Drawer Subfronts, Sides and Backs: 1/2 inch thick.
   6. Drawer Bottoms:
      a. 24 inches or less in width: 1/4 inch thick.
      b. Over 24 inches in width: 1/2 inch thick.
D. Exposed Materials:
   1. Laminates: High-Pressure Decorative Laminate (HPDL), Grade VGS.
   2. Edgebanding: Provide specified edgebanding unless noted otherwise.
E. Semi-Exposed Materials:
   1. Laminates: Thermally Fused Laminate (TFL).
   2. Edgebanding: Provide specified edgebanding unless noted otherwise.
F. Concealed Materials:
   1. Laminates: High-Pressure Decorative Laminate (HPDL), Grade BKM, BKV, BKL, or CLS as appropriate for conditions.
G. Joints doweled, glued and screwed.
H. Drawer Materials and Construction: Hardwood veneer plywood. Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Drawer Construction Method: Multiple dovetailed or doweled; with captured bottoms.
I. All cabinets shall be manufactured with balance construction; apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
J. Laminates: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
K. Edgebanding: Do not use more than one piece for any single length.
L. Glazing for Doors: Clear tempered glass.
M. Aprons and Modesty Panels: Provide panels matching construction and finish of casework.

N. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
O. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
P. Provide cutouts for electrical receptacles and other utility, mechanical, and electrical components as indicated.
Q. Access Panels: Provide as required for maintenance of utility service and mechanical and electrical components.

2.06 COUNTERTOPS

A. Countertops: As specified in Section 12 3600.

2.07 ACCESSORIES

A. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
B. Countertop Adhesives: As recommended by solid surfacing manufacturer.

2.08 COLORS AND FINISHES

A. Laminate Colors, Patterns, and Finishes:
   1. High-Pressure Decorative Laminates:
      a. PL1Wilsonart, Landmark Wood, 7981K-12, Soft Grain Finish, AEON Scratch Resistance.
      b. PL4Formica, Color Core 2, Matte Finish, White, 949C-58.
   2. Thermally Fused Laminates:
      a. Color: White or Almond.
B. PVC Edgebanding Colors:
   1. Color(s): Matching adjacent laminate.

PART 3 EXECUTION

3.01 PREPARATION

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

A. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment.
B. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:
   1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
   2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.
C. Verify adequacy of support framing and anchors.
D. Verify that service connections are correctly located and of proper characteristics.

3.03 CASEWORK INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.
B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.
C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.
E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
   1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
   2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
   3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
   4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
   5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.
G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.
   1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches on center, and at sides of cabinets with not less than two fasteners per side.
H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.
I. Install hardware uniformly and precisely.
J. Replace units that are damaged, including those that have damaged finishes.

3.04 COUNTERTOP INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install countertops in one true plane, with ends abutting at hairline joints, and no raised edges.
   1. Variation From Level/Horizontal: 1/8 inch in 10 feet, maximum.
   2. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
   3. Field Joints: 1/16 inch wide, maximum.
   4. Do not exceed 1/64 inch difference between planes of adjacent units.
C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
D. Attach plastic laminate countertops using concealed screws with minimum penetration into substrate of 5/8 inch.
   1. Secure back/end splashes to countertop and vertical substrates with waterproof adhesive.
E. Attach solid surfacing countertops to subtops using compatible adhesive.
   1. Secure back/end splashes to countertop and vertical substrates with waterproof adhesive.
F. Attach stainless steel countertops using concealed stainless steel fasteners and clips.

3.05 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.06 CLEANING

A. Clean casework and other installed surfaces thoroughly.

3.07 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.
B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.
C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

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SECTION 12 3583 - PERFORMING ARTS CASEWORK - MUSIC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured music casework.
B. Stringed instrument mobile storage rack.

1.02 DEFINITIONS

A. Exposed: Portions of casework visible when drawers and cabinet doors are closed, including end panels, bottoms of cases more than 42 inches above finished floor, tops of cases less than 72 inches above finished floor and all members visible in open cases or behind glass doors.
B. Semi-Exposed: Portions of casework and surfaces behind solid doors, tops of cases more than 72 inches above finished floor and bottoms of cabinets more than 30 inches but less than 42 inches above finished floor.
C. Concealed: Sleepers, web frames, dust panels and other surfaces not generally visible after installation, and bottoms of cabinets less than 30 inches above finished floor.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ANSI A208.1 - American National Standard for Particleboard; 2022.
C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
E. BHMA A156.18 - Materials and Finishes; 2020.
F. BHMA A156.9 - Cabinet Hardware; 2020.
G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
H. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
I. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
J. PS 1 - Structural Plywood; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
B. Keying Conference: Conduct conference prior to ordering keys. Incorporate conference decisions into keying submittal.
C. Coordinate the work with placement of concealed framing, blocking, and reinforcements that support casework.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: For each product. Include component dimensions, configurations, construction details, joint details, attachments.
C. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include filler panels, rough-in and anchors, reinforcements, and blocking, placement dimensions and tolerances, clearances required, and keying information.
    1. Indicate manufacturer's catalog number for each unit of casework.
    2. Indicate electrical service locations.
D. Samples:
    1. Laminate: Submit 3 samples 3 by 6 inches in size showing each color, texture, and finish selected.
    2. Edge Banding: Submit 3 samples 6 inches in length showing each color and finish selected.

3. Polyethylene Shelving: Submit 3 samples 3 by 6 inches in size showing each color, texture, and finish selected.

E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

F. Casework Samples: Representative of types in the project.
1. To be provided only upon request of Architect.
   a. Base Cabinet: Cabinet with drawer and door and specified hardware.
   b. Wall Cabinet: Cabinet with shelves and supports, door and specified hardware.

G. Manufacturer's Qualification Statement.

H. Installer's Qualification Statement.

I. Maintenance Data: Manufacturer's recommendations for care and cleaning.

J. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Door Hinges: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
3. Door Catches: Quantity equal to 2 percent of total installed, but not less than 5, includes fasteners.
4. Door Pulls: For each type, quantity equal to 2 percent of total installed, but not less than 5; includes fasteners.
5. Shelf Supports: Quantity equal to 2 percent of total installed, but not less than 10.
6. Drawer Slides: For each size and type, quantity equal to 2 percent of total installed, but not less than 2 paris; includes fasteners.
7. Locks: For each type, quantity equal to 2 percent of total installed, but not less than 2; includes fasteners.

1.06 QUALITY ASSURANCE

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

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than 5 years of documented experience and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation.

B. Environmental Requirements: Do not deliver casework until the following conditions have been met:
1. Building has been enclosed (windows and doors sealed and weather-tight).
2. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place and will remain operating.
3. Painting and other “wet work” construction is complete in the casework areas.

C. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.

D. Storage:
1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the above environmental requirements.

1.08 WARRANTY

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

B. Correct defective Work within a ten year period after Date of Substantial Completion. Defects include, but are not limited to:
1. Fracturing or breaking of casework components including doors, panels, shelves, or hardware resulting from normal wear and tear and normal use other than vandalism.

2. Warping of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
3. Delamination of components.
4. Failure of adhesives.
5. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: UltraStor Acoustic Storage Cabinets; Wenger Corporation; www.wengercorp.com. Catalog numbers are indicated on Drawings.
   1. Provide either the indicated "Basis of Design" products or equivalent products from one of the following:
      a. Case Systems: www.casesystems.com.
      b. Stevens Industries, Inc.: www.stevensind.com.
      c. TMI Systems Design Corporation: www.tmisystems.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
B. Obtain casework from single source and manufacturer, unless otherwise indicated.

2.02 PERFROMANCE REQUIREMENTS

A. Accessibility: Comply with ICC A117.1 and ADA Standards.

2.03 MATERIALS

A. Casework Adhesives: As recommended by casework manufacturer.
B. Laminate Adhesive: Type recommended by casework manufacturer to suit application.
C. Wood-based Materials - General:
   1. Maximum Moisture Content: 7 percent.
D. Hardwood Plywood: HPVA HP-1, particleboard core.
E. Softwood Plywood: PS 1.
F. Particleboard: ANSI A208.1, Grade M-2.
G. Medium Density Fiberboard (MDF): ANSI A208.2, Grade 130.
H. Laminates:
   1. Provide one of the following:
      a. High-Pressure Decorative Laminate (HPDL); NEMA LD 3; Grade VGS.
      b. Thermally Fused Laminate (TFL-P) : Polyester resin; NEMA LD 3, Grade VGS.
   2. Where indicated provide Thermally Fused Laminate (TFL-M) : Melamine resin; NEMA LD 3, Grade VGL.
I. Edgebanding: Rigid PVC extrusions, flat shaped, smooth texture, through color with satin finish. Width to match component thickness.
   1. Thickness: 0.118 inch (3 mm) unless otherwise indicated.

2.04 HARDWARE AND ACCESSORIES

A. Hardware and Accessories, General:
   1. Cabinet Hardware: Comply with BHMA A156.9, types as indicated for quality grade specified.
      a. Finishes:
         1) Exposed Hardware: Provide finish that complies with BHMA A156.18 for BHMA finish number indicated. Unless otherwise indicated, provide the following finishes:
            (a) Satin Stainless Steel: BHMA 630.
            (b) Satin Chromium Plated: BHMA 626.
         2) Concealed Hardware: Provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
   2. Epoxy or Powder-Coat Finish Hardware:
      a. Color(s): Standard color as selected by Architect.
   3. Provide all fasteners, hardware and accessories for a complete installation including:

a. Undercounter plastic laminate support panels or metal support brackets.
b. Free-standing table hardware.

B. Grille Doors: Welded steel grille construction. Minimum wire size 5/16 inch and 3/16 inch diameter.
1. Finish: Epoxy or powder-coat finish.
2. Provide at instrument storage unless otherwise indicated.

C. Butt Hinges: 5-knuckle butt hinge, overlay type, Grade 1 (institutional), with hospital tip and non-removable pin. 0.090 inch thick, minimum.
1. Provide two hinges for doors less than 48 inches high, and provide three hinges for doors more than 48 inches high.
2. Provide four hinges for tall cabinet doors.
3. Finish: Epoxy or powder-coat finish.

D. Door Latches:
1. Slide Latch: 0.105 inch thick, minimum, steel sliding latch with padlock hasp.
a. Door shall securely latch without padlock.
b. Provide permanently fixed label holder.
c. Finish: Epoxy or powder-coat finish.

E. Solid Door Catches: Heavy-duty magnetic or roller type catch and strike plate.
1. Doors up to 48 inches high shall have single catch mounted at bottom door edge.
2. Doors over 48 inches high shall have catch at both the top and bottom edges of door.
3. Exclude catches from solid doors with door latches.

F. Pulls - Solid Doors Without Latches:
1. Type: Back-mounted wire pulls, standard U-shape style.
a. Material: Solid aluminum, stainless steel, or chrome-plated brass.
b. Overall Size: 4-1/2 inches wide by 1 inch deep.
2. Provide as follows:
a. Doors: Single pull.
b. Drawers up to 24 inches Wide: Single pull.
c. Drawers over 24 inches Wide: Two pulls.
d. Exclude pulls from solid doors with door latches.

G. Instrument Shelves: Provide one of the following:
1. Plastic Shelves:
a. Shelves up to 27 inches wide:
1) Impact resistant, molded polyethylene shelf with radiused front edge.
b. Shelves over 27 inches wide:
1) Impact resistant, formed polyethylene ribbed shelf with radiused front edge.
c. Shelf Support:
1) Shelves up to 19 inches wide:
(a) Mount to cabinet side panels with self-locking clip; shelf shall be removable.
2) Shelves over 19 inches wide:
(a) Supported by steel tube frame assembly; shelf shall be removable.
3) Finish: As standard with manufacturer.
2. Plastic-Clad Wood-Core Shelves:
a. Core: 3/4 inch thick plywood or 1 inch thick particleboard.
b. Top Surface: Molded heavy-duty polyethylene or other thermoplastic with textured abrasion-resistant finish permanently bonded to shelf; water resistant.
c. Bottom Surface: Thermally Fused Laminate (TFL-M).
d. Mounting: Permanently doweled to cabinet sides.
3. Plastic Color: Standard color as selected by Architect.

H. Drawer Slides: Epoxy coated with nylon rollers or zinc plated with steel ball-bearings; self-closing with positive stop both directions. Load rating at full extension as follows:
1. Drawers less than 2 inches deep: 50 lbs.
2. All Drawers 2 to 4 inches deep: 100 lbs.

3. File Drawer and Drawers over 4 inches deep: 150 lbs.

I. Non-instrumental, Adjustable Shelf Supports: Double-pin clear polycarbonate shelf rests with shelf anti-tipping feature complying with BHMA A156.9, Type B04013. Designed to mount into pre-drilled holes in casework sides. Each shelf rest shall support 200 lbs, minimum.

J. Locks: Removable core, disc tumbler, cam style lock with strike for drawers and doors. At other locations, use lock style to suit application.
   1. Door Locks: BHMA A156.11, E07121.
   2. Drawer Locks: BHMA A156.11, E07041.
   3. Provide locks where indicated but not less than 2 doors and 2 drawers per room.
      a. Coordinate lock locations with the Architect.
      b. All locks within a room shall be keyed alike and different than adjacent rooms. All locks on the Project shall be master keyed.
         1) Provide 2 keys for each room and three 3 master keys.

2.05 MANUFACTURED MUSIC CASEWORK

A. Cabinet Construction - General:
   1. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.
      a. Laminate-clad panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels.
      b. Provide cabinet sizes and configurations as indicated on Drawings.
   2. Quality Standard: AWI/AWMAC/WI (AWS), unless noted otherwise.
      a. Grade: Premium.
   3. Design Style: Flush overlay, frameless construction.

B. Component Thicknesses: Not less than the following.
   1. General cabinet component thicknesses unless otherwise indicated:
      a. Thickness: 3/4 inch.
   2. Cabinet Backs:
      a. 1/4 inch thick.
   3. Instrument Shelves: Provide as specified.
   4. Non-Instrument Shelves:
      a. 36 inches or less in length: 3/4 inch thick, unless otherwise indicated.
      b. Over 36 inches in length: 1 inch thick.
   5. Solid Doors:
      a. Height 48 inches or less: 3/4 inch thick.
      b. Height over 48 inches: 1 inch thick
   6. Drawer Subfronts, Sides and Backs: 1/2 inch thick.
   7. Drawer Bottoms:
      a. 24 inches or less in width: 1/4 inch thick.
      b. Over 24 inches in width: 1/2 inch thick.

C. Exposed and semi-exposed materials shall be laminates as specified.
   1. Edgebanding: Provide specified edgebanding unless noted otherwise.

D. Cabinet Doors:
   1. Grille Doors: Provide at instrument storage unless otherwise indicated.
   2. Solid Doors: Provide at non-instrument storage unless otherwise indicated.

E. Construction: Joints doweled, glued and screwed.

F. Drawer Materials and Construction: Hardwood veneer plywood. Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Drawer Construction Method: Multiple dovetailed or doweled; with captured bottoms.

G. All cabinets shall be manufactured with balance construction; apply laminate backing sheet to reverse side of laminate finished surfaces.

H. Laminates: Apply laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
I. Edgebanding: Do not use more than one piece for any single length.
J. Scribes and Fillers: Panels of matching construction and finish, for locations where cabinets do not fit tight to adjacent construction.
K. Hardware Application: Factory-machine casework members for hardware that is not surface applied.
   1. Hinges: Through-bolt hinges to solid doors and side panels; weld hinges to grille doors.
   2. Latches: Through-bolt latches to solid doors and side panels; weld latches to grille doors.
L. Provide cutouts for electrical receptacles and other utility, mechanical, and electrical components as indicated.
M. Access Panels: Provide as required for maintenance of utility service and mechanical and electrical components.

2.06 STRINGED INSTRUMENT MOBILE STORAGE RACKS

A. Construction
   1. End panels are 3/4" (19 mm) thick industrial grade composite wood with no added formaldehyde and polyester laminate finish in Wenger standard colors.
   2. Edging is 1/8" (3mm) radiused PVC.
   3. Racks have 2-1/2" (64 mm) swivel casters in yellow zinc finish for easy transport.
      a. Front casters are locking.
   4. UL GREENGUARD Certified - Product certified for low chemical emissions: ul.com/gg - UL 2818.
   5. Environmental attributes and LEED compliance for this product can be found at www.wengercorp.com/GREEN or by contacting your Wenger representative.
   6. Five-year warranty.
B. String Bass and Cello Racks
   1. Four-unit String Bass Rack: 148J004._ 83 lbs (38 kg).
   2. Six-unit Cello Rack: 148J002._ 66 lbs (30 kg).
   3. Lower cross supports are plywood core laminated panels with flexible soft PVC edging to protect instruments.
C. Upper cross supports are plywood core laminated panels with
   1. PVC bonded edging to protect instruments.
   2. All racks include brass bow pegs.
   3. Holds uncased instruments 1/2 sized and up.
D. Holds cased instruments 1/2 size and up.

2.07 ACCESSORIES

A. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.

2.08 COLORS AND FINISHES

A. Laminate Colors, Patterns, and Finishes:
   1. PL-5To match Wenger Color : www.wengercorp.com.
B. PVC Edgebanding Colors:
   1. Color(s): Matching adjacent laminate.

PART 3 EXECUTION

3.01 PREPARATION

A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

3.02 EXAMINATION

A. For Base Cabinets Installation: Examine floor levelness and flatness of installation space. Do not proceed with installation if encountered floor conditions required more than 1/2 inch leveling adjustment.

B. For Wall Cabinets Installation: Examine wall surfaces in installation space. Do not proceed with installation if the following conditions are encountered:

1. Maximum variation from plane of masonry wall exceeds 1/4 inch in 10 ft and 1/2 inch in 20 ft or more, and/or maximum variation from plumb exceeds 1/4 inch per story.
2. Maximum Variation of finished gypsum board surface from true flatness: 1/8 inch in 10 feet in any direction.

C. Verify adequacy of support framing and anchors.

D. Verify that service connections are correctly located and of proper characteristics.

3.03 CASEWORK INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:

1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Bottoms of Wall Cabinets from Level: 1/8 inch in 10 feet.
3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

F. Secure wall and floor cabinets to concealed reinforcement at gypsum board assemblies.

G. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.

1. Where base cabinets are installed away from walls or service space framing, anchor to floor at toe space at not more than 24 inches on center, and at sides of cabinets with not less than two fasteners per side.

H. Wall Cabinets: Fasten to hanging strips, and/or wall substrates. Fasten each cabinet through back, near top, at not less than 16 inches on center.

I. Install hardware uniformly and precisely.

J. Replace units that are damaged, including those that have damaged finishes.

3.04 ADJUSTING

A. Adjust operating parts, including doors, drawers, hardware, and fixtures to function smoothly.

3.05 CLEANING

A. Clean casework and other installed surfaces thoroughly.

3.06 PROTECTION

A. Do not permit finished casework to be exposed to continued construction activity.

B. Protect casework and countertops from ongoing construction activities. Prevent workmen from standing on, or storing tools and materials on casework or countertops.

C. Repair damage, including to finishes, that occurs prior to Date of Substantial Completion, using methods prescribed by manufacturer; replace units that cannot be repaired to like-new condition.

END OF SECTION

SECTION 12 3600 - COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops for architectural cabinet work.
B. Countertops for manufactured casework.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
F. AWI (QCP) - Quality Certification Program; Current Edition.
G. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
H. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
J. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
K. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
L. NSF 51 - Food Equipment Materials; 2023.
M. NSI (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
N. PS 1 - Structural Plywood; 2023.
O. SEFA 2 - Installations; 2010.
P. SEFA 3 - Laboratory Work Surfaces; 2020.
Q. WI (CCP) - Certified Compliance Program (CCP); Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.
C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
G. Installation Instructions: Manufacturer's installation instructions and recommendations.
H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
B. Quality Certification:

1. Comply with AWI (QCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.awiqcp.org/#sle.
2. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section: www.woodworkinstitute.com/#sle.
3. Provide labels or certificates indicating that the installed work complies with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade or grades specified.
4. Provide designated labels on shop drawings as required by certification program.
5. Provide designated labels on installed products as required by certification program.
6. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Quality Standard: SEFA 3 for laboratory worksurfaces.

C. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.

1. Laminate Sheet, Type ___: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
   a. Manufacturers:
      1) Formica Corporation: www.formica.com/#sle.
      2) Panolam Industries International, Inc: www.panolam.com/#sle.
      3) Wilsonart: www.wilsonart.com/#sle.
      4) Substitutions: See Section 01 6000 - Product Requirements.
   b. Finish: Matte or suede, gloss rating of 5 to 20.
   c. Surface Color and Pattern:
      1) PL3: Wilsonart, Classic Linen, 4943-38
2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
3. Back and End Splashes: Same material, same construction.
4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Custom Grade.

D. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.

1. Flat Sheet Thickness: 1/2 inch, minimum.
2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
   a. Manufacturers:
      1) Dupont; Corian: www.corian.com/#sle.
   b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
   c. Color and Pattern: SS1, Corian Ash Aggregate

3. Other Components Thickness: 1/2 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

E. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
1. Flat Sheet Thickness: 1-1/4 inch, minimum.
2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
a. Manufacturers:
1) Cambria Company LLC; ____: www.cambriausa.com/#sle.
2) Corian Design; Quartz: https://www.corianquartz.com/-commercial-projects-
3) Wilsonart; ____: www.wilsonart.com/#sle.
4) Substitutions: Not permitted.
b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with NSI (DSDM).
c. Finish on Exposed Surfaces: Polished.
d. Color and Pattern: QTZ1, Corian Design, Quartz, Concrete Carrara.
3. Other Components Thickness: 3/4 inch, minimum.
4. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.

2.02 MATERIALS

A. Extruded Aluminum: ASTM B211/B211M, 6463 alloy, T5 temper.
B. Wood-Based Components:
1. Wood fabricated from old growth timber is not permitted.
C. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
D. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.
E. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
F. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
G. Joint Sealant: Mildew-resistant silicone sealant, white.
H. Polyester Laminate Protective Film: Scratch-, heat-, and acid-resistant optically clear removable polyester film for bonding to stone counters.
1. Thickness: 4 mil, 0.004 inch, minimum.
2. Finish: Satin.
3. Adhesive Type: Pressure sensitive acrylic.
4. NSF approved for food contact per NSF 51.
I. Sealer: Stain and acid protection for natural stone counters.
1. NSF approved for food contact per NSF 51.
2. Products:
a. Custom Building Products; _____: www.custombuildingproducts.com/#sle.
b. Rockstar Sealing, a division of TuffSkin Surface Protection LLC; Natural Finish Stone Sealer: www.rockstarsealing.com/#sle.
c. STONETECH, a division of LATICRETE International, Inc; _____: www.laticrete.com/#sle.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.03 FABRICATION

A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.

1. Join lengths of tops using best method recommended by manufacturer.
2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

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

C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
C. Apply sealer products in accordance with manufacturer's written instructions.
D. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

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

END OF SECTION

SECTION 12 6613 - TELESCOPING BLEACHERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Telescoping bleachers.

1.02 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
C. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
D. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
E. NFPA 102 - Standard for Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures; 2021.
F. ICC 300 - ICC Standards for Bleachers, Folding and Telscopic Seating and Grandstands; 2017.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Manufacturer's data sheets on each product.
C. Shop Drawings: Complete layout with dimensions, seat heights, row spacing and rise, aisle widths and locations, points of connection to substrate, assembly dimensions, and material types and finishes.
    1. Provide drawings customized to this project.
    2. Include the following:
        a. Plans, elevations, sections, and attachment details.
        b. Indicate wheelchair accessibility provisions.
        c. Include Professional Engineer's seal on each sheet.
        d. Wiring Diagrams: Show locations of motors, electrical wiring, and rough-in connections.
        e. Graphics Layout Drawings: Indicate pattern of contrasting seat colors, if any.
D. Samples:
    1. Submit 3 samples 4 by 4 inches in size, for each color and finish selected.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.
G. Operation and Maintenance Data: Manufacturer's operation and maintenance instructions.
H. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store, in original packaging, under cover and elevated above grade.

1.06 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Manufacturer agrees to repair or replace components of telescoping bleachers that fail in materials or workmanship within specified warranty period as follows:
    1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Telescoping Bleachers:
   1. Interkal LLC: www.interkal.com.
   2. Irwin Seating Company: www.irwinseating.com.
   3. Hussey Seating Company: www.husseyseating.com.
   4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 TELESCOPING BLEACHERS

A. Telescoping Bleachers: Factory assembled tiered benches that retract horizontally into depth approximately the same as a single row depth, with fixed seats mounted on leading edge of platforms.
   1. Provide a design certified by a licensed Professional Engineer licensed in the State in which the Project is located.
   2. Design to comply with applicable requirements of NFPA 102 and requirements of code authorities having jurisdiction; where conflicts between requirements occur, comply with whichever is more stringent.
   3. Design with solid fascia (riser) or seat fronts that conceal interior mechanisms when fully retracted, fitting tightly enough to prevent climbing up face; at front row provide key locked, hinged fascia (skirt) to cover gap between seat riser/fascia and floor.
   4. Standard Extension (Forward-Folding): Top row fixed to floor, adjacent to wall, forward extension (away from wall); attachment to wall acceptable.
   5. Recoverable Wheelchair Seating:
      a. Provide in accordance with ICC A117.1 and ADA Standards,
      b. Recoverable wheelchair seating shall be manually retracted without affecting other rows to provide wheelchair seating, or manually extended to provide regular bench seating.
      c. Provide manufacturer's standard recoverable wheelchair notchouts; one row(s) deep.
         1) Provide where indicated, but not less than 2 spaces.
         2) Where accessible seating is not indicated, locate at bank ends.
   6. Cutouts: Fit units to irregular wall surfaces, columns, pilasters, roof drain leaders, and other obstructions; take field measurements prior to fabrication.
   7. Operation: Motor operated.

B. Design Loads: Design to withstand the following loading conditions:
   1. Live Load on Structural Supports: 100 psf, minimum, of gross horizontal projection.
   2. Live Load on Seats and Walking Surfaces: 120 pounds per linear foot.
   3. Lateral Sway Stress on Structural Supports: 24 pounds per linear foot of seat plank.
   4. Perpendicular Sway Stress on Structural Supports: 10 pounds per linear foot of seat plank.

C. Dimensions: Unless otherwise indicated or required to meet maximum allowable seating arera or seating capacity.
   1. See drawings for overall dimensions.
   2. Rise Per Row: 10.25 inches.
   3. Row Depth: 22 inches.
   4. Seat Height Above Tread: 6 inches.

D. Structural Supports: Steel or aluminum; manufacturer's standard wheeled carriages supporting each tier separately, with moving parts permanently lubricated and metal parts cushioned to prevent metal-to-metal contact during operation.
   1. Design each row carriage to individually support design loads and be self supporting when fully assembled without dependence on platform panels or boards, seats, or fascia.
   2. Welding: In accordance with AWS D1.1/D1.1M and AWS D1.3/D1.3M.
   3. Bolting: Use lock-washers or locknuts.

4. Wheels: Minimum 5 inch diameter by 1-1/4 inch wide, with non-marring rubber tires; ball, roller, or oil-impregnated metal bearings; minimum of 2 wheels at each floor support.
5. Finish: Manufacturer's standard enamel or powder coating.
6. Row Locking: Automatically mechanically lock each carriage to adjacent carriages when fully extended.
7. Unlocking: Automatically unlock all rows before engaging retraction mechanism.

E. Motor Operation: Traction wheels, with non-marring rubber covering, using motor adequately sized for the purpose.
1. Provide UL listed electrical components and wiring.
2. Controls: Start, Stop, Forward, and Reverse in a single control unit.
3. Control Station: Each motor shall be equipped with an integral receiver for wireless remote control; provide 2 wireless remote control units .
   a. Provide removable plug-in low-voltage pendant station, with first-row plug-in location for each motor as secondary means of control; provide 2 pendants.
4. Limit Switches: Automatically stop operation when unit has reached fully open or fully closed position.
5. Provide all wiring internal to bleacher units, to junction box located where indicated; ensure that wiring is not energized except during operation.
6. Electrical Characteristics: 208/230V, 5 wire, 3-phase, 60 Hz.
7. Provide access to motor from front side of bleachers; a hinged front skirt or hinged section at least 30 inches wide is acceptable.

2.03 SEAT AND PLATFORM COMPONENTS

A. Seat/Fascia Assembly: Continuous, molded UV-stabilized high-density polyethylene plastic, seat minimum 1 inch thick, textured finish, homogeneous color throughout, colors as selected from manufacturer's standard selection; approximately 18 inch long sections independently removable with tongue-and-groove or rabbeted interlock at end joints.
1. Colors: One standard color as selected by Architect. Design Intent: Black..
2. Shape: Ergonomically contoured, with internal ribs spaced for natural flexibility; rear edge cantilevered to provide toe room of not less than 3 inches; no openings to trap debris.
3. Seat Depth: 12 inches.
4. Provide end caps of same material and finish on each exposed end.
5. Supports: Internal steel reinforcement of each seat segment bolted to platform nose member; minimum two bolts per segment.
6. Seat and Row Numbers: Provide recessed pockets and number plates.

B. Platform, Tread, and Step Structure: Plywood continuously supported on front and rear with side joints tongue-and-grooved.
1. Plywood: PS 1, 5-ply polyethylene-overlaid douglas fir or southern pine, Grade C-C.
2. Plywood Thickness: 5/8 inch, minimum.
3. Front (Nose), Rear, and Intermediate Supports: Steel channel or tube, hot-dipped galvanized.
4. Provide end caps of same material and finish on each exposed end.
5. Finish: Polyethylene plastic; 0.030 inch thick, minimum.
   a. Color: 1 standard color as selected by Architect
6. Nosings: Extruded aluminum; mill finish.
7. At aisles provide permanently attached intermediate steps of same construction and finish.
8. At bottom of aisles provide step in front of first riser, hinged to first platform to fold for storage.

2.04 HANDRAILS AND RAILINGS

A. Provide the following railings:
1. Aisle Handrails: Single post folding railing segment mounted in center of aisle at every other row beginning at row 2.

2. End of Row Guardrails: Self-storing, at open ends of sections beginning at row 2.
3. Height: 42 inches above adjacent platform or tread.

B. Design handrails and railings to withstand the following loads:
1. Concentrated Load on Handrails: 200 pounds in any direction.
2. Concentrated Load on Guardrails: 200 pounds in any direction along top rail.
3. Live Load on Handrails: 50 pounds per linear foot, applied in any direction.
4. Live Load on Guardrails:
a. Horizontal: 50 pounds per linear foot, applied at the guardrail height.
b. Vertical: 100 pounds per linear foot, applied vertically to top of guardrail.

C. Railing Construction: Round steel pipe or tube, with formed elbows at corners and caps at ends of straight runs.
1. Finish Colors: 1 standard color as selected by Architect.

2.05 ACCESSORIES

A. Fillers and Closures:
1. Top Row: Provide seat level rear filler panels to close openings between top row seat and wall; finish to match platforms.
2. Sides of Extended Units: Vinyl curtains.
a. Vinyl Curtains: 18 ounce vinyl with grommets; color as selected from manufacturer's standard palette.

B. Scorer's Table: 8 feet wide by 18 inches deep; relocatable to any row of any section without mounting brackets.

C. Fasteners: Provide hardware and fasteners in accordance with manufacturer's recommendations.

D. Anchorage: As indicated on drawings; provide hardware in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are consistent with those on the shop drawings.

B. Verify that electrical rough-ins have been installed and are accessible.

C. Verify that substrates have been properly prepared and area has been cleared of obstructions.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install seat/fascia assemblies in color patterns indicated by Architect.

C. Do not field cut or alter seats, fascia, or structural members without approval.

D. Provide manufacturer's field representative to inspect completed installation.

3.04 ADJUSTING

A. Lubricate, test, and adjust each moving assembly to ensure proper operation in compliance with manufacturer's recommendations.

3.05 CLEANING

A. Clean exposed and semi-exposed assembly surfaces.

B. Touch up finishes on damaged or soiled areas.

3.06 CLOSEOUT ACTIVITIES

A. Demonstration and Training: Provide manufacturer's field representative to demonstrate to and train Owner's operating personnel in proper operation of equipment.
1. Location: On site using installed equipment.
2. Time: As agreed between Owner and Contractor.

3.07 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 14 2123.16 - MACHINE ROOM-LESS ELECTRIC TRACTION PASSENGER ELEVATORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Complete machine room-less electric traction elevator systems.
   1. Passenger type.

1.02 ABBREVIATIONS AND ACRONYMS

A. MRL: Machine room-less.

1.03 REFERENCE STANDARDS

A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
B. AISC 360 - Specification for Structural Steel Buildings; 2022.
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. ASME A17.1 - Safety Code for Elevators and Escalators Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters with Automatic Transfer Devices; 2019, with Errata (2021).
E. ASME A17.2 - Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, Inclined Elevators, Limited-Use/Limited-Application Elevators, Private Residence Elevators, Escalators, Moving Walks, and Dumbwaiters; 2020.
F. ASME QEI-1 - Standard for the Qualification of Elevator Inspectors; 2018.
G. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023.
H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
I. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2023.
J. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
K. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
L. 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.
M. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
N. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
O. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
Q. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
R. NEMA MG 1 - Motors and Generators; 2017.
S. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
T. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
U. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate this work with installation of hoistway wall construction.

2. Coordinate work of this section with installers providing associated equipment, accessories, hardware, and related items and systems not included in this section but required for a complete and proper elevator installation. Work not included in this section, includes, but is not limited to, the following:
   a. Concrete and masonry items; refer to Divisions 03 and 04 :
      1) Concrete and masonry inserts, sleeves, and anchors.
   b. Steel items; refer to Division 05:
      1) Hoist beams.
      2) Pit ladders.
      3) Auxiliary steel supports for guide rail brackets.
      4) Steel angle supports for sills.
   c. Floor finishes; refer to Division 09:
      1) Floor finishes.
   d. Fire suppression items; refer to Division 21:
      1) Hoistway fire protection sprinkler system.
   e. Mechanical items; refer to Divisions 22 and 23:
      1) Elevator pit sump pump.
      2) Hoistway venting or pressurization system.
   f. Electrical items; refer to Divisions 26 and 27:
      1) Electrical service to elevators.
      2) Telephone service to machine room.
      3) Conduits for wiring between automatic transfer switch and controller cabinet.
      4) Conduits for wiring between fire alarm panel and controller cabinet.
      5) Smoke detectors and heat detectors; including contacts wired to controller cabinet.
      6) Automatic transfer switches with auxiliary contacts for emergency power transfer status indication.
      7) Shunt trip devices for automatic disconnection of elevator power prior to fire suppression system activation; including shunt trip power monitoring.
      8) Elevator pit lighting and duplex outlet.
      9) Machine space lighting and duplex outlet.
   g. Miscellaneous items:
      1) Governor access door.

B. Preinstallation Meeting: Convene meeting at least one week prior to start of this work.
   1. Review schedule of installation, proper procedures and conditions, and coordination with related work.

C. Construction Use of Elevator: Not permitted.

1.05 SUBMITTALS

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

B. Product Data: Submit data on following items:
   1. Signal and operating fixtures, operating panels, and indicators.
   2. Car design, dimensions, layout, and components.
   3. Car and hoistway door and frame details.
   4. Electrical characteristics and connection requirements.

C. Shop Drawings: Provide appropriate plans, elevations, sections, diagrams, and details including, but not limited to, the following:
   1. Car, shaft and elevator pit dimensions.
   2. Elevator Equipment and Machines: Size and location of driving machines, power units, controllers, governors, and other components.
   3. Hoistway Components: Size and location of car machine beams, guide rails, buffers, ropes, and other components.

4. Rail bracket spacing; maximum loads imposed on guide rails requiring load transfer to building structural framing.
5. Individual weight of principal components; load reaction at points of support.
6. Loads on hoisting beams.
7. Clearances and over-travel of car and counterweight.
8. Locations in hoistway and machine room of traveling cables and connections for car lighting, telephone, and any other equipment indicated or required.
9. Location and sizes of hoistway and car doors and frames.
10. Electrical characteristics and connection requirements.
11. Indicate arrangement of elevator equipment and allow for clear passage of equipment through access openings.

D. Samples:
1. Finishes: Submit 3 samples 3 by 6 inches in size for each material, finish and color selected; including, but not limited to, the following:
a. Car interior finishes.
b. Car and hoistway door and frame finishes.
c. Handrail material and finish.
d. Signaling equipment finishes.

E. Selection Samples: Where colors and finishes are not specified, submit 3 sets of color and finish selection charts or chips.

F. Manufacturer's Qualification Statement.

G. Installer's Qualification Statement.

H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

I. Initial Maintenance Contract.

J. Maintenance Contract: Submit proposal to Owner for standard two year continuing maintenance contract agreement in accordance with ASME A17.1 and requirements as indicated, starting on date initial maintenance contract is scheduled to expire.
1. Indicate in proposal the services, obligations, conditions, and terms for agreement period and for renewal options.

K. Operation and Maintenance Data:
1. Parts catalog with complete list of equipment replacement parts; identify each entry with equipment description and identifying code.
2. Operation and maintenance manual.
3. Schematic drawings of equipment, and wiring diagrams of installed electrical equipment with list of corresponding symbols to identify markings on machine room and hoistway apparatus.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design guide rails under direct supervision of a licensed Professional Structural Engineer experienced in design of this type of work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum ten years documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience and approved by elevator manufacturer.

D. Products Requiring Electrical Connection: Listed and classified by UL (DIR) or testing agency acceptable to authorities having jurisdiction as suitable for the purpose indicated in construction documents.

1.07 WARRANTY

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

B. Provide manufacturer's warranty for elevator operating equipment and devices for one year from Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design - MRL Electric Traction Elevators: KONE Inc.; MonoSpace 300: www.kone.us.

B. Other Acceptable Products - MRL Electric Traction Elevators:

1. Otis Elevator Company; Gen3 Core: www.otis.com.
2. Schindler Elevator Corporation; Schindler 3300XL: www.us.schindler.com.
3. ThyssenKrupp Elevator ; Evolution 100:: www.thyssenkruppelevator.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

C. Products other than Basis of Design are subject to compliance with specified requirements and shaft and pit dimensions indicated on Drawings. By using products other than Basis of Design, the Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees, changes to elevator pit dimensions, changes to elevator shaft dimensions including openings, and changes to floor plans as a result of changes to the elevator shaft dimensions.

D. Source Limitations: Provide elevator and associated equipment and components produced by a single manufacturer and obtained from a single supplier.

2.02 PERFORMANCE REQUIREMENTS

A. Elevator Car Floor Deflection:

1. Limit car floor deflection to L/960.

B. Regulatory Requirements: Comply with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).

C. Accessibility Requirements: Comply with ADA Standards and ICC A117.1.

D. Perform structural steel design, fabrication, and installation in accordance with AISC 360.

E. Comply with seismic design requirements in accordance with ASME A17.1, applicable local codes, and authorities having jurisdiction (AHJ).

1. Comply with Elevator Safety Requirements for Seismic Risk Zone in accordance with ASME A17.1, ASCE 7 and other related requirements.
   a. Project Seismic Risk: As indicated on drawings.

F. Perform welding of steel in accordance with AWS D1.1/D1.1M.

G. Fabricate and install door and frame assemblies in accordance with NFPA 80 and complying with requirements of authorities having jurisdiction (AHJ).

H. Perform electrical work in accordance with NFPA 70.

2.03 MATERIALS

A. Rolled Steel Sections, Shapes, Rods: ASTM A36/A36M.

B. Steel Sheet: ASTM A1008/A1008M, Designation CS (commercial steel), with matte finish.

C. Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.

D. Stainless Steel Sheet: ASTM A666, Type 304; No. 4 Brushed finish unless otherwise indicated .

E. Stainless Steel Bars, Shapes and Moldings: ASTM A276/A276M, Type 304.

F. Textured Stainless Steel Sheet: ASTM A240/A240M, Type 304 with embossed texture rolled into exposed surface.

1. Products:
   a. Rigidized Metals Corp.; 5WL pattern: www.rigidized.com.

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

G. Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper.

H. Nickel Silver Extrusions: ASTM B151, Alloy UNS No. C74500 or UNS No. C77600

I. 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.

2.04 MRL ELECTRIC TRACTION ELEVATORS

A. Electric Traction Passenger Elevator:
1. Drawing Designation(s): ELEV 1.
2. Electric Traction Elevator Equipment:
a. Permanent magnet gearless traction machine.
3. Drive System:
a. Synchronous alternating current (AC) motors and variable voltage variable frequency (VVVF) drive.
4. Operation Control Type:
a. Selective Collective Automatic Operation Control.
5. Service Control Type:
a. Standard service control.
b. Independent service control.
6. Electrical Power: 480 volts; alternating current (AC); three phase; 60 Hz.
7. Freight Car Loading Classification: Class A - General Freight Loading in compliance with ASME A17.1.
8. Rated Net Capacity: 3500 pounds.
9. Rated Speed: 150 feet per minute.
10. Interior Car Height: 93 inches (7 feet, 9 inches).
11. Interior Car Platform Size:
a. Width: 77-1/2 inches (6 feet, 5-1/2 inches).
b. Depth: 66-1/2 inches (5 feet, 6-1/2 inches).
12. Car and Hoistway Entrance Sizes:
a. Width: 48 inch.
b. Depth: 86 inch.
13. Hoistway Size:
a. Width: 102 inches (8 feet, 6 inches).
b. Depth: 77 inches (6 feet, 11 inches).
14. Elevator Pit Depth: 60 inches (5 feet). - Coordinate with manufacturer.
15. Overhead Clearance at Top Floor: 140 inches 11 feet, 8 inches) - Coordinate with manufacturer.
16. Travel Distance: As indicated on drawings.
17. Number of Stops: 2.
18. Number of Openings: 2 as follows:
a. Front: 2.
19. Traction Machine Location: Top of hoistway shaft against wall.
20. Auxiliary Features:
a. Automatic dispatching of loaded car.
b. Nuisance-call cancel.
c. Automatic leveling.
d. Automatic operation of lights and fan.
21. Emergency Power: Battery back-up.

2.05 CAR AND HOISTWAY ENTRANCES

A. Hall Signals and Controls: Stainless steel.
1. Finish/Pattern: No. 4 Brushed.

B. Car and Hoistway Entrances:

1. Drawing Designation(s): ELEV 1.
2. Hoistway Fire Rating: As indicated on drawings.
3. Elevator Door Fire Rating: As indicated on drawings.
4. Framed Car Opening Finish and Material: Brushed stainless steel.
5. Car Door Material: Stainless steel, with rigid sandwich panel construction.
   a. Finish/Pattern: No. 4 Brushed.
6. Hoistway Frame Material: Stainless steel.
   a. Finish/Pattern: No. 4 Brushed.
7. Hoistway Door Material: Stainless steel, with rigid sandwich panel construction.
   a. Finish/Pattern: No. 4 Brushed.
8. Door Type: Double leaf.
9. Door Operation: Side opening, two speed.
10. Sills: Nickel silver.
    a. Finish: Mill.

C. Sills/Thresholds: Configure to align with frame return and coordinate with floor finish.

D. Gasketing: Provide acoustic type gasketing at hoistway doors and frames to minimize audible noise due to car activities in the hoistway, and air pressure differential between hoistway and landing floors.

2.06 CAR EQUIPMENT AND MATERIALS

A. Elevator Car:

1. Drawing Designation(s): ELEV 1.
2. Car Control Panel:
   a. Material: Stainless steel.
   b. Finish/Pattern: No. 4 Brushed.
3. Car Position Indicator:
   a. Location: Integral with car control panel.
4. Provide convenience outlet receptacle; 110VAC, 15 amps, integral with car control panel or located below it.
5. Ventilation: Two speed fan with grille above ceiling.
6. Flooring: Resilient vinyl tile.
   a. Refer to Section 09 6500 - Resilient Flooring.
7. Wall Base: Recessed stainless steel, 4 inch high.
   a. Finish: No. 4 Brushed.
8. Door Wall/Front Return Panel: Stainless steel.
   a. Finish/Pattern: No. 4 Brushed.
9. Side Walls: Stainless steel.
   a. Finish/Pattern: No. 4 Brushed.
10. Rear Wall: Stainless steel.
    a. Finish/Pattern: No. 4 Brushed
11. Reveals: Stainless steel.
    a. Finish/Pattern: No. 4 Brushed.
12. Hand Rail: Stainless steel, at rear and side walls. Provide open clearance space 1-1/2 inch (38 mm) wide to face of wall.
    a. Flat Bar Stock, Solid: 3/8 inch thick by 4 inch high.
    b. Stainless Steel Finish: No. 4 Brushed.
13. Ceiling:
    a. Concealed Frame Suspended Panel Ceiling: Stainless steel.
    b. Panel Finish: No. 4 Brushed stainless steel.
    c. Lighting: Round LED recessed spotlights.
14. Provide emergency access panel for egress from car at ceiling.
15. Car Top Inspection Station: Provide inspection station on car top for inspection and maintenance. Station to include the following:

a. GFCI convenience outlet receptacle; 110VAC, 20 amps.
b. LED/incandescent light with guard; locate light switch on cab top.
c. Control panel with the following controls:
1) Constant contact up and down buttons.
2) Emergency stop button.
3) Inspection control toggle switch.
d. Safety railings complying with ASME A17.1.

B. Car Accessories:
1. Certificate Frame: Stainless steel frame glazed with clear tempered glass, and attached with tamper-proof screws.
2. Protective Pads: Canvas cover, padded with impact-resistant fill material, sewn with piping edges; fire resistant in compliance with ASME A17.1; brass grommets for supports, covering side and rear walls and front return, with cut-out for control panel; provide one set for each elevator.
a. Color: Grey.
b. Provide at least 4 inch clearance from bottom of pad to finished floor.
c. Pad Supports: Stainless steel studs, and mounted from top of wall panels.

2.07 COMPONENTS

A. Elevator Equipment:
1. Motors, Controllers, Controls, Buttons, Wiring, Devices, and Indicators: Comply with NFPA 70 requirements, and refer to Section 26 0583 for additional requirements.
2. Guide Rails, Cables, Counterweights, Sheaves, Buffers, Attachment Brackets and Anchors: Design criteria for components includes safety factors in accordance with applicable requirements of Elevator Code, ASME A17.1.
3. Buffers:
a. Spring type for elevators with speed less than or equal to 200 feet per minute.
4. Lubrication Equipment:
a. Provide grease fittings for periodic lubrication of bearings.
b. Grease Cups: Automatic feed type.
c. Lubrication Points: Visible and easily accessible.

B. Electrical Equipment:
1. Motors: NEMA MG 1.
2. Boxes, Conduit, Wiring, and Devices: Complying with NFPA 70 and in accordance with Division 26.
3. Spare Conductors: Provide ten percent in extra conductors and two pairs of shielded audio cables in traveling cables.
4. Include wiring and connections to elevator devices remote from hoistway and between elevator machine room. Provide additional components and wiring to suit machine room layout. Comply with Division 26.

2.08 OPERATION CONTROLS

A. General:
1. Provide signal and control equipment with buttons that light when activated and remain lit until call has been fulfilled.
2. Provide vandal-resistant buttons and lighted elements illuminated with LEDs.
3. Provide flush mounted recessed units.

B. Hall Signals and Controls:
1. Call Stations:
a. Provide one button for originating "Up" calls and one button for originating "Down" calls; provide single button at terminating landings.
b. Emergency Pictorial Signage: Provide text and graphics as required by authorities having jurisdiction, indicating that in case of fire, elevators are out of service and other exits should be used.

2. Hall Lanterns:
   a. Provide illuminated "Up" and "Down" arrows; provide single arrow at terminating landings.
   b. Mount above entrance frames.
3. Hall Annunciator: Provide audible signals indicating car arrival and direction of travel.
   a. Signals sound once for "Up" and twice for "Down".
   b. Provide at each hall lantern or mount on car.
4. Car Position Indicators:
   a. Provide illuminated, digital car position indicators, located above hoistway entrance at main lobby.
   b. Car position indicators may be integrated with hall lanterns mounted above entrance frames.

C. Car Control Panel:
1. Mount in return panel adjacent to car door.
2. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
3. Provide illuminated, digital car position indicator.
4. Provide lIluminated arrows indicating travel direction.
5. Provide audible signals to indicate car is either stopping at or passing a floor.
6. Push Buttons: Provide the following:
   a. One button for each floor/stop.
   b. Door open and close buttons.
   c. Alarm.
7. Keyed Switches:
   a. Provide keyed switches for the following:
      1) Independent service operation.
      2) Lights.
      3) Fan.
      4) Inspection control.
8. Provide additional emergency buttons and switches as required by code.
9. Emergency Communication System:
   a. Hands-free, two-way voice communication system.
   b. Include identification, instructions for use, and battery backup power supply.
   c. Connect to elevator phone monitoring service as directed by Owner.
10. Each car control panel shall be etched or engraved with State serial number, capacity, and number of passengers as certified by the State Inspector.

D. Door Operation Controls:
1. Program door control to open hoistway and car doors automatically and simultaneously when car arrives at floor landing.
2. Door Safety Devices: Provide infrared curtain unit with auxiliary photo-eyes. Infrared sensor system shall be full height on the leading door edge and opposite jamb.
   a. System shall project infrared beams across the car opening detecting the presence of a person or object. If beams are interrupted while doors are closing, doors shall reverse and reopen. After the obstruction is cleared, the doors shall begin to close again.
3. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, buzzer shall sound and doors shall begin to close at reduced kinetic energy.

E. Interconnect elevator control system with fire alarm and smoke alarm systems.

F. Provide "Firefighter's Emergency Operation" in accordance with ASME A17.1, applicable building codes, and authorities having jurisdiction (AHJ).
1. Designated Landing: At ground floor.

2.09 OPERATION CONTROL TYPE

A. Selective Collective Automatic Operation Control: Applies to car in single elevator shaft.
   1. Refer to description provided in ASME A17.1.
   2. Automatic operation by means of one button in the car for each landing served and by "UP" and "DOWN" buttons at the landings.
   3. Stops are registered by momentary actuation of landing car buttons without consideration of the number of buttons actuated or the sequence buttons are actuated, but the stops are made in the order that landings are reached in each direction of travel.
   4. All "UP" landing calls are made when car is traveling in the up direction.
   5. All "DOWN" landing calls are made when car is traveling in the down direction.
   6. Uppermost and lowermost calls are answered as soon as they are reached without consideration of the car travel direction.

2.10 SERVICE CONTROL TYPE

A. Independent Service Control:
   1. Provide key operated "Independent Service" on car operating panel. Key activation will remove that car from normal operation and cancel pre-registered car calls.
   2. Car will respond to selected floor. Car will not respond to any calls from landing call buttons. Car will only respond to calls placed on the car operating panel. Doors will remain open at last landing requested. Doors will close with a constant pressure on "Door Close" button.
   3. Key activation to normal operation will return car to normal operation.

2.11 AUXILIARY FEATURES

A. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors begin closing.
   1. Car shall bypass all hall calls when Automatic Dispatching is activated
   2. Car shall cancel all travel when load limits are exceeded.
B. Nuisance-Call Cancel: When car calls exceed preset number while car load is less than predetermined weight, all car calls are canceled.
   1. Preset number of calls and predetermined weight are adjustable.
C. Automatic Leveling: Automatic leveling shall bring car to a stop within 1/8 inch of the landing level regardless of load or direction of travel.
D. Automatic Operation of Lights and Fan: When elevator is stopped and unoccupied with doors closed, lighting, ventilation fan, and cab displays are de-energized after five minutes and are re-energized before car doors open.

2.12 EMERGENCY POWER

A. Elevator Emergency Power Supply: Supplied by battery backup; provide elevator system components as required for emergency power characteristics.
B. Emergency Lighting: Comply with ASME A17.1 elevator lighting requirements.
C. Provide operational control circuitry for adapting the change from normal to emergency power.
D. Battery-Powered Automatic Evacuation: If power fails, cars that are at a floor remain at that floor, open their doors, and shut down. Cars that are between floors are moved one at a time to the next floor above or below, open their doors, and shut down. System includes rechargeable battery and automatic recharging system

2.13 MACHINE ROOM FITTINGS

A. Key Cabinet: Wall-mounted, lockable, keyed to building keying system, for control and operating panel keys.
   1. Provide three control/operating panel keys.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting this work.
B. Verify that hoistway, pit, and machine room are ready for work of this section.
C. Verify hoistway shaft and openings are of correct size and within tolerance.
D. Verify location and size of machine foundation and position of machine foundation bolts.
E. Verify that electrical power is available and of correct characteristics.

3.02 INSTALLATION

A. Install MRL electric traction elevator systems in accordance with manufacturer's instructions, ASME A17.1, and NFPA 70.
B. Install system components, and connect equipment to building utilities.
C. Install machinery, guides, controls, car and all equipment and accessories to provide a quiet, smoothly operating installation, free from side sway, oscillation or vibration
D. Mount machines and motors on vibration and acoustic isolators.
    1. Place on structural supports and bearing plates.
    2. Securely fasten to building supports.
    3. Prevent lateral displacement.
E. Install hoistway, elevator equipment, and components in accordance with approved shop drawings.
F. Install guide rails to allow for expansion and contraction movement of guide rails.
G. Accurately machine and align guide rails, forming smooth joints with machined splice plates.
H. Install hoistway door sills, frames, and headers in hoistway walls; grout sills in place, set hoistway floor entrances in alignment with car openings, and align plumb with hoistway.
    1. At masonry and concrete walls, fill hoistway door frames solid with grout in accordance with Section 04 2000 - Unit Masonry and as follows:
        a. Grout to have maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
    2. At stud walls, fill head and jamb members with mineral fiber insulation prior to installation.
I. Adjust equipment for smooth and quiet operation.

3.03 TOLERANCES

A. Guide Rail Alignment: Plumb and parallel to each other in accordance with ASME A17.1 and ASME A17.2.
B. Car Movement on Aligned Guide Rails: Smooth movement, without any objectionable lateral or oscillating movement or vibration.

3.04 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for additional requirements.
B. Acceptance testing: Upon completion of the elevator installation and before permitting use of elevator, perform acceptance tests as required by Code and authorities having jurisdiction (AHJ).
    1. Schedule tests and notify Architect two weeks in advance.
    2. Perform tests required by regulatory agencies.
    3. Inspectors shall be certified in accordance with ASME QEI-1.
    4. Perform tests in accordance with ASME A17.2.
    5. Document tests and inspections in accordance with requirements.
    6. Furnish test and approval certificates issued by authorities having jurisdiction (AHJ).

3.05 ADJUSTING

A. Adjust for smooth acceleration and deceleration of car to minimize passenger discomfort.

B. Adjust with automatic floor leveling feature at each floor landing to reach 1/4 inch maximum from flush with sill.

3.06 CLEANING

A. Remove protective coverings from finished surfaces.
B. Clean surfaces and components in accordance with manufacturers written instructions.

3.07 CLOSEOUT ACTIVITIES

A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
B. Demonstration: Demonstrate operation of system to Owner's personnel.
   1. Use operation and maintenance data as reference during demonstration.
   2. Briefly describe function, operation, cleaning and maintenance of each component.

3.08 PROTECTION

A. Do not permit construction traffic within car after cleaning.
B. Protect installed products until Date of Substantial Completion.
C. Touch-up, repair, or replace damaged products and materials before Date of Substantial Completion.

3.09 MAINTENANCE

A. Refer to Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to initial maintenance service.
B. Provide Initial Maintenance Contract of elevator system and components in accordance with ASME A17.1 and requirements as indicated for twelve months from Date of Substantial Completion.
C. Submit proposal for continuation of Maintenance Contract in accordance with ASME A17.1 and requirements as indicated for installed elevator equipment.
D. Perform maintenance contract services using competent and qualified personnel under the supervision and direct employ of the elevator manufacturer or installer.
E. Maintenance contract services shall not be assigned or transferred to any agent or other entity without prior written consent of Owner.
F. Examine system components bi-monthly.
G. Include systematic examination, adjustment, and lubrication of elevator equipment.
H. Maintain and repair or replace parts, whenever required, using parts produced by original equipment manufacturer.
I. Perform work without removing cars from use during peak traffic periods.
J. Provide emergency call back service for 24 hours a day/7 days a week throughout period of this maintenance contract.
K. Maintain an adequate stock of parts for replacement or emergency purposes, and have personnel available to ensure the fulfillment of this maintenance contract without unreasonable loss of time.

END OF SECTION

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

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 **REFRIGERANT HANDLING**

A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.
2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.

B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.02 **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

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

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, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.
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.

2.10 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. 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.

KK. 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.

LL. Verify final equipment locations for roughing-in.

MM. 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. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section “Domestic Water Piping.”

D. 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.

E. 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

SECTION 20 0513 - MOTORS

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 "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 20 Section “Variable Frequency Controllers”.
4. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
5. Division 26 Section “Enclosed Switches and Circuit Breakers”.
6. Division 26 Section “Enclosed Controllers”.
7. Division 26 Section “Fuses”.

1.02 SUMMARY

A. This Section includes basic requirements for factory-installed motors.

1.03 DEFINITIONS

A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

C. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.04 **QUALITY ASSURANCE**

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

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 NFPA 70.

1.05 **DELIVERY, STORAGE, AND HANDLING**

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.06 **COORDINATION**

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:
    a. Magnetic controllers.
    b. Multispeed controllers.
    c. Reduced-voltage controllers.
    d. Solid-state controllers.
    e. Variable frequency controllers.
2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate electrical scope of work to be provided by Division 20, 21, 22, and 23 with this Section, related Division 20, 21, 22, and 23 Specifications, Division 26 Specifications and the Drawings.

C. Electrical work provided under Division 20, 21, 22, and 23: Furnish UL Listed components in accordance with this section, Division 26, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.

D. Furnished, installed and wired under Division 20, 21, 22, and 23 unless otherwise indicated:

1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.

E. Furnished and installed under Division 20, 21, 22, and 23 and wired under Division 26 unless otherwise indicated:

1. Motors required for mechanical equipment
2. Packaged Self-Contained Equipment:
    a. Provide equipment ready to accept a single electrical service connection.

b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.

3. Variable frequency controllers.

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. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.

2. Spare Indicating Lights: Six of each type installed.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Subject to compliance with requirements, provide products by one of the following:

1. Dayton.

2. Toshiba Intl.

3. Baldor Electric/Reliance.

4. Rockwell Automation/Allen-Bradley.

5. Nidec Motor Corporation; U.S. Electrical Motors.

6. Regal Beloit/GE Commercial Motors.

7. Regal Beloit/Leeson.

8. Regal Beloit/Marathon.

9. Siemens.

2.02 **MOTOR REQUIREMENTS**

A. Motor requirements apply to factory-installed motors except as follows:

1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 26.

C. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.03 **MOTOR CHARACTERISTICS**

A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.

B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.

I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.04 **POLYPHASE MOTORS**

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

	1800 RPM OPEN DRIP-PROOF MOTORS 4 POLE		1800 RPM ENCLOSED MOTORS 4 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
HP	EFF	EFF	EFF	EFF
1	82.5	81.5	82.5	81.5
1.5	84	82.5	84	82.5
2	84	82.5	84	82.5
3	86.5	85.5	87.5	86.5
5	87.5	86.5	87.5	86.5
7.5	88.5	87.5	89.5	88.5
10	89.5	88.5	89.5	88.5
15	91	90.2	91	90.2
20	91	90.2	91	90.2
25	91.7	91	92.4	91.7
30	92.4	91.7	92.4	91.7
40	93	92.4	93	92.4
50	93	92.4	93	93
60	93.6	93	93.6	93
75	94.1	93.6	94.1	93.6
100	94.1	93.6	94.5	94.1
125	94.5	94.1	94.5	94.1
150	95	94.5	95	94.5
200	95	94.5	95	94.5

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
	NOMINAL	MINIMUM	NOMINAL	MINIMUM
HP	EFF	EFF	EFF	EFF
1	80	78.5	--	--
1.5	84	82.5	82.5	81.5
2	85.5	84	84	82.5
3	86.5	85.5	84	82.5
5	87.5	86.5	85.5	84

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5
15	90.2	89.5	89.5	88.5
20	91	90.2	90.2	89.5
25	91.7	91	91	90.2
30	92.4	91.7	91	90.2
40	93	92.4	91.7	91
50	93	93	92.4	91.7
60	93.6	93	93	92.4
75	93.6	93	93	92.4
100	94.1	93.6	93	92.4
125	94.1	93.6	93.6	93
150	94.5	94.1	93.6	93
200	94.5	94.1	94.5	94.1

C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated 600 Volts or Less (Random Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
1	82.5	85.5	77.0	82.5	85.5	77.0
1.5	86.5	86.5	84.0	87.5	86.5	84.0
2	87.5	86.5	85.5	88.5	86.5	85.5
3	88.5	89.5	85.5	89.5	89.5	86.5
5	89.5	89.5	86.5	89.5	89.5	88.5
7.5	90.2	91.0	88.5	91.0	91.7	89.5
10	91.7	91.7	89.5	91.0	91.7	90.2
15	91.7	93.0	90.2	91.7	92.4	91.0
20	92.4	93.0	91.0	91.7	93.0	91.0
25	93.0	93.6	91.7	93.0	93.6	91.7
30	93.6	94.1	91.7	93.0	93.6	91.7
40	94.1	94.1	92.4	94.1	94.1	92.4
50	94.1	94.5	93.0	94.1	94.5	93.0
60	94.5	95.0	93.6	94.5	95.0	93.6
75	94.5	95.0	93.6	94.5	95.4	93.6
100	95.0	95.4	93.6	95.0	95.4	94.1
125	95.0	95.4	94.1	95.0	95.4	95.0
150	95.4	95.8	94.1	95.8	95.8	95.0
200	95.4	95.8	95.0	95.8	96.2	95.4

Nominal Efficiencies For "NEMA Premium™" Induction Motors
Rated Medium Volts for 5kV or Less (Form Wound)

	Open Drip-Proof			Totally Enclosed Fan-Cooled		
HP	6-pole	4-pole	2-pole	6-pole	4-pole	2-pole
250	95.0	95.0	94.5	95.0	95.0	95.0
300	95.0	95.0	94.5	95.0	95.0	95.0
350	95.0	95.0	94.5	95.0	95.0	95.0
400	95.0	95.0	94.5	95.0	95.0	95.0
450	95.0	95.0	94.5	95.0	95.0	95.0
500	95.0	95.0	94.5	95.0	95.0	95.0

D. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

E. Rotor: Squirrel cage, unless otherwise indicated.

F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V- belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:

1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.

2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.

3. Fire Pump Motors: NEMA starting Code (KVA Code) B.

J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.05 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.

C. Severe-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.

2. Read no-load current and speed at rated voltage and frequency.

3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.06 **ELECTRONICALLY COMMUTATED MOTOR (ECM)**

A. Furnish for equipment where specified or scheduled with ECM.

1. Synchronous, constant torque, ECM with permanent magnet rotor. Rotor magnets to be time-stable, nontoxic ceramic magnets (Sr-Fe).
2. Driven by a frequency converter with an integrated power factor correction filter. Conventional induction motors will not be acceptable.
3. Each motor with an integrated variable-frequency drive, tested as one unit by manufacturer.
4. Motor speed adjustable over full range from 0 rpm to maximum scheduled speed.
5. Variable motor speed to be controlled by a 0- to 10 V-dc or 4- to 20-mA input.
6. Integrated motor protection verified by UL to protect equipment against over-/undervoltage, overtemperature of motor, electronics, or both, overcurrent, locked rotor, and dry run (no-load condition).

2.07 **SINGLE-PHASE MOTORS**

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.08 **ENCLOSED CONTROLLERS**

A. Provide enclosed controllers in accordance with requirements specified in Division 26 Section “Enclosed Controllers”.

2.09 **ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 26 Section “Enclosed Switches and Circuit Breakers”.

2.10 **FUSES**

A. Provide fuses in accordance with requirements specified in Division 26 Section “Fuses”.

PART 3 EXECUTION

3.01 **FIELD QUALITY CONTROL**

A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.

B. Prepare for acceptance tests as follows:

1. Check motor nameplates for horsepower, speed, phase and voltage.
2. Check coupling alignment and shaft end play.

3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control features for proper operation.
5. Verify that current in each phase is within nameplate rating.

C. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.02 **ADJUSTING**

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.03 **CLEANING**

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 20 0516 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

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. BR: Butyl rubber.

B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).

C. CSM: Chlorosulfonyl-polyethylene rubber (Hypalon).

D. EPDM: Ethylene-propylene-diene terpolymer rubber.

E. NBR: Buna-N/Nitrile rubber.

F. NR: Natural rubber.

G. PTFE: Polytetrafluoroethylene plastic.

1.03 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.

1.05 **INFORMATIONAL SUBMITTALS**

A. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

2. Locations of pipe anchors and alignment guides and expansion joints and loops.

B. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.

2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.

3. Alignment Guide Details: Detail field assembly and attachment to building structure.

4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

1.06 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.07 **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 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.

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 **FLEXIBLE CONNECTORS**

A. Rubber Flexible Connectors/Expansion Joints: ASTM F 1123, fabric-reinforced rubber with external control rods or cables, and complying with FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

1. Manufacturers:

a. Flex-Weld, Inc./Keflex.

b. Mason Industries, Inc.; Mercer Rubber Co.

c. Metraflex, Inc.

d. Senior Flexonics, Inc.; Pathway Division.
e. Twin City Hose, Inc.
f. Vibration Mountings & Controls, Inc.

2. Arch Type: Multiple arches.
3. Spherical Type: Multiple spheres.
   a. Working Pressure Ratings for NPS 1-1/2 to NPS 4: 225 psig at 170 deg F.
   b. Working Pressure Ratings for NPS 5 and NPS 6: 225 psig at 170 deg F.
   c. Working Pressure Ratings for NPS 8 to NPS 12: 225 psig at 170 deg F.
   d. Working Pressure Ratings for NPS 14: 150 psig at 170 deg F.
   e. Working Pressure Ratings for NPS 16 to NPS 20: 125 psig at 170 deg F.
   f. Working Pressure Ratings for NPS 24: 110 psig at 170 deg F.
4. Material: EPDM.
5. End Connections: Full-faced, integral, steel flanges with steel retaining rings.
6. Coating: Factory applied Hypalon paint for outdoor applications.

B. PTFE Flexible Connectors/Expansion Joints: Molded PTFE bellows with external reinforcing rings and external limit bolts.
   1. Manufacturers:
      a. Flex-Weld, Inc./Keflex.
      b. Mason Industries, Inc.; Mercer Rubber Co.
      c. Metraflex, Inc.
      d. Senior Flexonics, Inc.; Pathway Division.
      e. Twin City Hose, Inc.
      f. Vibration Mountings & Controls, Inc.
   2. Arch Type: Multiple arches.
   3. End Connections: Full-faced, integral, ductile iron flanges.

C. Metal-Bellows Flexible Connectors: Circular-corrugated-bellows type with external tie rods and compression stops.
   1. Manufacturers:
      a. Adsco Manufacturing, LLC.
      b. Flex-Weld, Inc./Keflex.
      c. Hyspan Precision Products, Inc.
      d. Metraflex, Inc.
      e. Senior Flexonics, Inc.; Pathway Division.
      f. Twin City Hose, Inc.
   2. Metal-Bellows Flexible Connectors for Steel Piping: Multiple-ply 300 Series stainless-steel bellows.
   3. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
   4. Maximum Temperature Rating: 850 deg F.
   5. End Connections: Flanged

D. Hose and Braid Flexible Connectors:

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Hose Co., Inc.
   c. Flex-Weld, Inc.
   d. Hyspan Precision Products, Inc.
   e. Metraflex, Inc.
   f. Senior Flexonics, Inc.; Pathway Division.
   g. Twin City Hose, Inc.
2. Flexible Connectors for Copper Piping: Multiple-ply phosphor-bronze corrugated hose with bronze outer braid, copper ferrule, and copper pipe end connections.
3. Flexible Connectors for Steel Piping: Multiple-ply stainless-steel corrugated hose with stainless steel outer braid, and steel pipe end connections.
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 450 deg F for copper piping connectors, 800 deg F for steel piping connectors.

E. Grooved Mechanical Flexible/Expansion Joint:

1. Manufacturers:
   a. Anvil International, Inc.; Fig. 7420 Expansion Joint.
   b. Victaulic Company; Model 77 Flexible Coupling, W77 AGS Flexible Coupling, and 177N QuickVic Installation-Ready Flexible Coupling.
2. Description: Comprised of multiple flexible style couplings, and precision machined grooved end pipe nipples. Assembly uses factory installed ties to custom preset expansion joint in the expanded, compressed, or intermediate position.
3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
   a. Flexible Type: To provide a flexible pipe joint which allows for vibration isolation, expansion, contraction, and deflection. Quantity and arrangement as recommended by manufacturer.

2.03 EXPANSION JOINTS

A. Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.

2. Metal-Bellows Expansion Joints for Stainless-Steel Waterway: Single-ply stainless-steel bellows, stainless-steel-pipe end connections.
3. Metal-Bellows Expansion Joints for Steel Piping: Single- or multiple-ply stainless-steel bellows, and steel pipe end connections.
4. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 650 deg F.
6. Configuration: Single- or double -bellows type, unless otherwise indicated.
7. End Connections: Threaded, Flanged or weld.

B. Externally Pressurized Metal-Bellows Expansion Joints: ASTM F 1120, circular-corrugated-bellows type with removable shipping bar.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.
2. Metal-Bellows Expansion Joints for Steel Piping: Multiple-ply or laminated stainless-steel bellows, steel pipe end connections, internal guide ring and stop, and carbon-steel shroud with drain plug.
3. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
4. Maximum Temperature Rating: 750 deg F.
5. Configuration: Single- or double -bellows type, unless otherwise indicated.
6. End Connections: Flanged or weld.

C. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.
2. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
3. Configuration for Copper Piping: Two-ply stainless-steel bellows and bronze or stainless-steel shroud.
4. Configuration for Steel Piping: Two-ply stainless-steel bellows and carbon-steel shroud.
5. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint.
6. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint.
7. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.

8. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or Weld.

D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

1. Manufacturers:
   a. Flex-Hose Co., Inc.
   b. Metraflex, Inc.; Metraloop.
   c. Twin City Hose, Inc.
2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- or brazed- joint end connections.
   a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with minimum 300 psig at 70 deg F and 230 psig at 400 deg F ratings.
   b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 230 psig at 70 deg F and 180 psig at 400 deg F ratings.
3. Flexible-Hose Expansion Joints for Steel Piping: Carbon-steel fittings with threaded end connections for NPS 2 and smaller and flanged or weld end connections to match piping system for NPS 2-1/2 and larger.
   a. NPS 2 and Smaller: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 450 psig at 70 deg F and 325 psig at 600 deg F ratings; and 300 psig maximum saturated steam pressure rating.
   b. NPS 2-1/2 to NPS 6: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 165 psig at 70 deg F and 120 psig at 600 deg F ratings; and 130 psig maximum saturated steam pressure rating.
   c. NPS 8 to NPS 12: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 160 psig at 70 deg F and 115 psig at 600 deg F ratings; and 90 psig maximum saturated steam pressure rating.

E. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 250 psig at 400 deg F minimum pressure rating; complying with ASME Boiler and Pressure Vessel Code: Section II, "Materials," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.

1. Manufacturers:
   a. Advanced Thermal Systems, Inc.
   b. Hyspan Precision Products, Inc.; Barco.
2. Angular Deflection for NPS 6 and Smaller: 30-degree minimum.
3. Angular Deflection for NPS 8 and Larger: 15-degree minimum.
4. End Connections for NPS 2 and Smaller: Threaded.
5. End Connections for NPS 2-1/2 and Larger: Flanged.

2.04 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.

b. Flex-Weld, Inc.

c. Hyspan Precision Products, Inc.

d. Metraflex, Inc.

e. Senior Flexonics, Inc.; Pathway Division.

2.05 **SLIDING/GUIDING DEVICES**

A. For pipe size 4 inch and smaller on all hot piping, provide guides equal to Flexonics semi-steel spider and guiding cylinder pipe alignment guides for all expansion joints and loops. Provide pipe alignment guides in quantities at all locations as required according to the manufacturer's design criteria and recommendations. Pipe alignment guides shall serve to guide the expansion joints, loops or bends.

1. Manufacturers:

a. B-Line by Eaton; Figure 3281 Series.

b. Senior Flexonics.

c. Sypris Technologies; Tube Turns Division;

d. U.S. Flexible Metallic Tubing Co., Kelflex Type M.

e. Metraflex, Inc.

B. For pipe sizes 6 inches and above and all guides on cold piping, furnish pre-engineered pre-insulated guides with published vertical and lateral load ratings. Construction shall consist of an insulted shield containing structural calcium silicate (100 psi non-load bearing and 600 psi load bearing) encased in 360 degrees of overlapping sheet metal. A 36 steel clamps torqued onto insulated shield with recommended catalog torque valves. Slide service shall be stainless steel to polyethylene or Teflon with a maximum coefficient of friction of 0.15.

1. Manufacturers:

a. Pipe Shields, Inc. B3000, B4000, B7000 and B8000 series.

b. Carpenter and Paterson, Inc.

c. Rilco Mfg. HG 3000, HG 4000, HG 7000, and HG 8000 series.

2.06 **MATERIALS FOR ANCHORS**

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Stud: Threaded, zinc-coated carbon steel.

2. Expansion Plug: Zinc-coated steel.

3. Washer and Nut: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

2. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.

3. Washer and Nut: Zinc-coated steel.

F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, 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 FLEXIBLE CONNECTOR APPLICATIONS

A. Use rubber flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.

1. Rubber Flexible Connectors for Pipe Sized NPS 2 and Smaller: Twin-sphere with female union end connections.

2. Rubber Flexible Connectors for Pipe Sized NPS 2-1/2 and Larger: Twin-sphere with floating flange end connections.

B. Flexible Pipe Connectors for Refrigerant Pipe: Refer to Division 23 Section “Refrigerant Piping.”

3.02 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

D. Install alignment guides at spacing recommended by expansion joint manufacturer.

E. Control expansion joint movement by installing two rigid pipe guides on each side of the expansion joint. Spacing shall be as follows:

Nom. Pipe Size	Exp. Joint to 1st	1st to 2nd	Maximum Distance Between Intermediate Guides (Ft.) For Tabulated pressures, PSIG							
(In.)	Guide	Guide	50	100	150	200	250	300	350	400
1	0'-4"	1'-4"	21	15	12					
1 1/4	0'-5"	1'-5"	23	17	13					
1 1/2	0'-6"	1'-9"	28	20	17					
2	0'-8"	2'-4"	32	23	18					
2 1/2	0'-10"	2'11"	35	28	22					
3	1'-0"	3'-6"	21	19	17	16	15	14	13	13
4	1'-4"	4'-8"	35	29	25	22	20	19	18	17
6	2'-0"	7'-0"	57	44	37	32	29	27	25	23
8	2'-8"	9'-4"	66	52	45	40	36	33	31	29
10	3'-4"	11'-8"	91	69	58	51	46	42	39	36
12	4'-0"	14'-0"	107	79	66	58	52	48	44	41
14	4'-8"	16'-4"	115	85	71	62	56	51	47	
16	5'-4"	18'-8"	127	94	78	68	61	56	52	
18	6'-0"	21'-0"	139	102	85	74	67	61	56	
20	6'-8"	23'-4"	151	110	91	80	71			
24	8'-0"	28'-0"	172	125	103	89	80			
30	10'-0"	35'-0"	200	144	118	103	92			

3.03 **PIPE BEND AND LOOP INSTALLATION**

A. Attach pipe bends and loops to anchors.

1. Steel Anchors: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.04 **SWING CONNECTIONS**

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.05 **ALIGNMENT-GUIDE INSTALLATION**

A. Install guides on piping adjoining pipe expansion joints and bends and loops.

B. Attach guides to pipe and secure to building structure.

3.06 **ANCHOR INSTALLATION**

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION

SECTION 20 0519 - METERS AND GAGES

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 21 Section “Fire-Suppression Piping” for listed or approved pressure gages.
4. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
5. Division 23 Section "Fuel Gas Piping" for gas utility meters.

1.02 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FPR: Fiberglass reinforced plastic.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Schedule for the following indicating manufacturer's number, scale range, and location for each:

1. Thermometers.
2. Gages.
3. Flowmeters.
4. Thermal-energy meters.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For the following to include in operation and maintenance manuals:

1. Flowmeters.
2. Thermal-energy meters.

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 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.

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 **METAL-CASE, LIQUID-IN-GLASS THERMOMETERS**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Miljoco Corporation.
3. REOTEMP Instrument Corporation.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 **PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Marsh Bellofram.
3. Miljoco Corp.
4. REOTEMP Instrument Corporation.
5. Trerice, H. O. Co.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Plastic, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanent scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.04 **THERMOWELLS**

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F; ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.05 **PRESSURE GAGES**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Cambridge.
3. Dwyer Instruments, Inc.
4. Marsh Bellofram.
5. Miljoco Corporation.
6. Trerice, H. O. Co.
7. Weiss Instruments, Inc.
8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Stainless steel, aluminum, or FRP, 6-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.

5. Dial: Satin-faced, nonreflective aluminum with permanent scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Stainless steel or chrome plated metal.

C. Accuracy: Grade A, plus or minus 1 percent of middle halfscale.

1. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
2. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
3. Steam (15 psig and less): 30 inches Hg vacuum-30 PSIG (1 inch divisions below 0 psi; 1 psi divisions above 0 psi), silicone dampened.
4. Steam (16 to 60 psig): 30 inches Hg vacuum-100 PSIG, silicone dampened.
5. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass ball type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.06 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.
2. Miljoco Corporation.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.

D. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.

E. Test Kit: Furnish test kit(s) containing one pressure gage and adaptor, thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.

1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
3. Carrying case shall have formed instrument padding.

2.07 FLOW MEASURING DEVICES

A. Manufacturers:

1. Dietrich Standard Subsidiary of Rosemount Division of Emerson Process Management; Diamond II - Flo-Tap Model.
2. Preso Meters Corporation.
3. Taco, Inc.

B. Flow measuring device shall be used where indicated on the drawings and in sizes NPS 6 and larger and shall be annular primary flow elements. The annular primary flow elements shall be type 316, stainless steel, diamond shape or elliptical shape in cross-section. Pressure rating shall meet or exceed system minimum pressure rating as indicated for each system. Provide permanent, rust-proof metal identification tag on a chain indicating design flow rates, metered fluid and line size. Flow measuring devices shall be weld insert type. Units shall be capable of being inserted without system shut-down.

C. Accuracy shall be plus or minus 1 percent over a flow turndown at least 10 to 1, independent of Reynold's number. Repeatability shall be plus or minus 0.1 percent.

D. Sensors shall be installed in strict accordance with the manufacturer's recommendations with special attention given to alignment and straight run requirements.

E. Flow measuring device in chilled water system de-coupler pipe shall have bi-directional flow measurement capability, or two uni-directional devices shall be provided.

F. Flow gages which read in actual GPM shall be provided for all flow measuring devices on pumps 200 GPM or larger, and for both flow directions on the chilled water system de-coupler pipe flow measuring device. Gage scale shall be linear to flow. Maximum flow rate on scale shall be selected at 120 percent of the pump's scheduled flow rate (120 percent of the scheduled flow rate of one chiller for the chilled water system de-coupler). Gage scale shall be 2.5 inch x 6 inch minimum, or 4 inch diameter minimum, and shall be mounted at eye level on unistrut support.

2.08 PITOT-TUBE FLOWMETERS

A. Manufacturers:

1. Dieterich Standard; Subsidiary of Rosemount Division of Emerson Process Management.
2. Preso Meters Corporation.
3. Taco, Inc.
4. World Class Engineered Products, Inc.; PSE Division.

B. Description: Insertion-type, differential-pressure design for inserting probe into piping and measuring flow directly in gallons per minute.

C. Construction: Stainless-steel probe of length to span inside of pipe; with integral transmitter and direct-reading scale.

D. Pressure Rating: 150 psig minimum.

E. Temperature Rating: 250 deg F minimum.

F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.

G. Integral Transformer: For low-voltage power connection.

H. Accuracy: Plus or minus 1 percent for liquids and gases.

2.09 WAFER-ORIFICE FLOWMETERS

A. Manufacturers:

1. ABB, Inc.; ABB Instrumentation.
2. Armstrong Pumps, Inc.
3. Badger Meter, Inc.; Industrial Div.
4. Bell & Gossett; Xylem Inc.
5. Meriam Instruments Div.; Scott Fetzer Co.

B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.

C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.

D. Pressure Rating: 300 psig.

E. Temperature Rating: 250 deg F.

F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.

G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

1. Scale: Gallons per minute.

2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.

H. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.

1. Scale: Gallons per minute.

2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.

I. Operating Instructions: Include complete instructions with each flowmeter.

2.10 VENTURI FLOWMETERS

A. Manufacturers:

1. Armstrong Pumps, Inc.

2. Badger Meter, Inc.; Industrial Div.

3. Bailey-Fischer & Porter Co.

4. Flow Design, Inc.

5. Gerand Engineering Co.

6. Hyspan Precision Products, Inc.

7. Leeds & Northrup.

8. McCrometer, Inc.

9. Preso Meters Corporation.

10. Victaulic Co. of America.

B. Description: Differential-pressure design for installation in piping; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.

C. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data.

D. Pressure Rating: 250 psig.

E. Temperature Rating: 250 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged or welded.

H. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.

I. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.

1. Scale: Gallons per minute.
2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.

J. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two 12-foot hoses in carrying case.

1. Scale: Gallons per minute.
2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.

K. Operating Instructions: Include complete instructions with each flowmeter.

2.11 TURBINE FLOWMETERS

A. Manufacturers:

1. Badger Meter, Inc.; Industrial Div.
2. Bailey-Fischer & Porter Co.
3. Data Industrial Corp.
4. Engineering Measurements Company.
5. ERDCO Engineering Corp.
6. Fisher, George Inc.
7. Hoffer Flow Controls, Inc.
8. ISTEC Corporation.
9. Midwest Instruments & Controls Corp.
10. ONICON Incorporated.
11. SeaMetrics Inc.
12. Sponsler Company, Inc.
13. Thermo Measurement Ltd.
14. Venture Measurement.

B. Description: Insertion type for inserting turbine into piping and measuring flow directly in gallons per minute.

C. Construction: Bronze or stainless-steel body; with plastic turbine or impeller and integral direct-reading scale.

D. Pressure Rating: 150 psig minimum.

E. Temperature Rating: 180 deg F minimum.

F. Display: Visual instantaneous rate of flow, with register to indicate total volume in gallons.

G. Accuracy: Plus or minus 2-1/2 percent.

2.12 FLOW INDICATORS

A. Manufacturers:

1. Brooks Instrument Div.; Emerson Electric Co.
2. Clark-Reliance Corporation; Jacoby-Tarbox.
3. Dwyer Instruments, Inc.
4. McCrometer, Inc.
5. OPW Engineered Systems; Dover Corp.
6. Penberthy, Inc.

B. Description: Instrument for installation in piping systems for visual verification of flow.

C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.

D. Pressure Rating: 125 psig.

E. Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.13 **MAGNETIC INDUCTIVE FLOWMETER**

A. Manufacturers:

1. Badger Meter, Inc.; Magnetoflow with Primo Amplifier.
2. Emerson Process Management; Rosemount Division.

B. Description: Magnetic inductive flowmeter and amplifier for measuring the flow of conductive liquids, with flanged ends, suitable for in-line installation.

C. Accuracy: 0.25 percent of rate at 1 to 39 fps.

D. Pressure Limits: 150 psi.

E. Ambient Temperature Limits: Minus 4 deg F to 140 deg F.

F. Liner Material:

1. Meter Sizes NPS 1/4 to NPS 3/8: PFA.
2. Meter Sizes NPS 1/2 to NPS 24: PTFE.
3. Meter Sizes NPS 1 to NPS 54: Soft and hard rubber.
4. Meter Sizes NPS 14 to NPS 36: Halar.
5. NSF Listed Meters Sizes NPS 4 and Larger: Hard Rubber.

G. Measured Fluid Temperature Limits:

1. Remote Amplifier:
   a. PFA, PTFE, and Halar Liners:311 deg F.
   b. Rubber Liner: 178 deg F.
2. Meter Mounted Amplifier:
   a. PFA, PTFE, and Halar Liners: 212 deg F.
   b. Rubber Liner: 178 deg F.

H. Flowmeter:

1. Meter Housing Material: Carbon steel, welded.
2. Flanges: Carbon steel, ANSI B16.5 Class 150 raised face.
3. Pipe Spool Material: Type 316 stainless steel.
4. Electrode Material: Type 316 stainless steel.

I. Meter Enclosure Classification: NEMA 4.

J. Junction Box Enclosure: Die-cast aluminum with powder coat finish. NEMA 4.

K. Amplifier: Microprocessor based with back-lit LCD display in cast aluminum, powder coated NEMA 4X enclosure suitable for either remote wall mounting or mounting on meter, and with:

1. Digital and analog outputs.

2. Bidirectional flow sensing/totalization.
3. Automatic zero point stability.
4. Empty pipe detection.
5. RS232 serial communication.
6. 115 VAC, 60 Hz power supply.

2.14 **MAGNETIC INDUCTIVE FLOWMETER (INSERTION TYPE)**

A. Manufacturers:
1. KOBOLD Instruments Inc.; Model PME-12R40.
2. KROHNE Inc.

B. Description: Magnetic inductive flowmeter for measuring the flow of conductive liquids in pipes and suitable for installation in pipes size NPS 1-1/2 to NPS 12.

C. Input Power: 24 VDC, 2.5 watts.

D. Current Output: 4-20mA, active bi-directional measurement, output always positive.

E. Temperature Ratings:
1. Ambient Temperature: 140 deg F maximum.
2. Measured Fluid Temperature: 0 to 212 deg F.

F. Pressure Rating: 230 psig at 75 deg F.

G. Transmitter Span: 1-5 meters/second (adjustable).

H. Accuracy: Plus or minus 2 percent of velocity at the measuring electrode.

I. Repeatability: Plus or minus 2 percent of measured value.

J. Noise Immunity: CE per EN 50081-1-2 and EN 50082-1-2.

K. Electrical Protection (Enclosure) Type: NEMA 4X/IP 65.

L. Wetted Parts:
1. Sensor Tip: PVDF with Viton O-ring.
2. Electrodes: Type 316 L stainless steel.
3. Flow Transmitter: Provided with Type 316L stainless steel weld sleeve.
4. Sealing Ring: Buna-N.

M. Case: Aluminum, epoxy powder coated.

PART 3 EXECUTION

3.01 **THERMOMETER APPLICATIONS**

A. Install liquid-in-glass thermometers in the following locations:
1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. Inlet and outlet of each hydronic heat exchanger.
5. Inlet and outlet of each hydronic heat-recovery unit.
6. Inlet and outlet of each thermal storage tank.
7. Outside-air, return-air, and mixed-air ducts.

B. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
2. Domestic Cold Water: 30 to 130 deg F, with 2-degree scale divisions.
3. Heat Pump Loop Water: 30 to 240 deg F, with 2-degree scale divisions.

3.02 **GAGE APPLICATIONS**

A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.

C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.03 **INSTALLATIONS**

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending to center of pipe and in vertical position in piping tees where thermometers are indicated.Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

C. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

D. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).

E. Install ball valve and syphon fitting in piping for each pressure gage for steam.

F. Install test plugs in tees in piping.

G. Install flow indicators, in accessible positions for easy viewing, in piping systems.

H. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

I. Install flowmeter elements in accessible positions in piping systems.

J. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

K. Install wafer-orifice flowmeter elements between pipe flanges.

L. Install permanent indicators on walls or brackets in accessible and readable positions.

M. Install connection fittings for attachment to portable indicators in accessible locations.

N. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

O. Assemble components and install thermal-energy meters.

P. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.04 **CONNECTIONS**

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy-meter transmitters to meters.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **ADJUSTING**

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION

SECTION 20 0529 - HANGERS AND SUPPORTS

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: For1/4-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 rood, 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

SECTION 20 0533 - ELECTRIC HEAT TRACING

****ADD2****

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:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 22 Section “Heat Tracing for Plumbing Piping” for domestic hot-water-temperature maintenance, and snow and ice melting on roofs, in gutters and downspouts, and rain conductors.

1.02 SUMMARY

A. Section includes electric heat tracing for piping freeze prevention and flow control.

1.03 PERFORMANCE REQUIREMENTS

A. Pipe Heat Tracing: Select electric heat tracing cable capable of providing freeze protection and flow control with outside temperature at minus 10 deg F.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal:

1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.

2. Accurately record actual locations of heating cable, thermostats, and branch circuit connections.

3. Include diagrams for power, signal, and control wiring.

1.06 **CLOSEOUT SUBMITTALS**

A. Field quality-control reports.

B. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1. Include description of operating controls.

2. Include repair methods and parts list of components.

1.07 **COORDINATION**

A. Coordinate with installation of piping insulation.

PART 2 PRODUCTS

2.01 **SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thermon Americas Inc.; FLX Self-Regulating Heating Cable.

2. Raychem; nVent Electric plc; XLTrace.

3. Delta-Therm Corporation; IN Series.

4. Chromalox Advanced Thermal Technologies; a business of Spirax-Sarco Engineering PLC.

B. Comply with IEEE 515.1.

C. Heating Element: Pair of No. 16 AWG, parallel, nickel-coated copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

D. Electrical Insulating Jacket: Flame-retardant polyolefin.

E. Cable Cover: Tinned-copper braid and polyolefin outer jacket.

F. Maximum Operating Temperature (Power On): 150 deg F.

G. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL acceptable to authorities having jurisdiction, and marked for intended location and application.

H. Capacities and Characteristics:

1. Maximum Heat Output: W/ft as recommended by manufacturer.

2. Piping Diameter: As indicated on the Drawings.

3. Number of Parallel Cables: As recommended by manufacturer.

4. Electrical Characteristics for Single-Circuit Connection: Coordinate electrical system requirements with Division 26.

I. Electrical Power System Characteristics: As scheduled on the Drawings.

2.02 **CONTROLS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thermon Americas Inc.
2. Raychem; nVent Electric plc.
3. Delta-Therm Corporation.
4. Chromalox Advanced Thermal Technologies; a business of Spirax-Sarco Engineering PLC.

B. Pipe-Mounted Thermostats for Freeze Protection:

1. Remote bulb unit with adjustable temperature range from 30 to 50 deg F.
2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
3. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
4. Corrosion-resistant, waterproof control enclosure.

2.03 **ACCESSORIES**

A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

B. Warning Labels: Self-adhesive labels with legend “ELECTRIC HEAT TRACING.” Refer to Division 20 Section "Mechanical Identification" for additional requirements

C. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, 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.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Freeze Protection for Piping:

1. Install electric heating cables after piping has been tested and before insulation is installed.
2. Install electric heating cables according to IEEE 515.1.
3. Install insulation over piping with electric cables according to Division 20 Section "Mechanical Insulation."
4. Install warning labels at 10 foot intervals, or install continuous warning tape on piping insulation where piping is equipped with electric heating cables.

C. Set field-adjustable switches and circuit-breaker trip ranges.

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. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

2. Test cables for electrical continuity and insulation integrity before energizing using 2500 Vdc megohmmeter (megger).

3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.

C. Cables will be considered defective if they do not pass tests and inspections.

D. Remove and replace damaged heat-tracing cables.

E. Prepare test and inspection reports.

3.05 **PROTECTION**

A. Protect installed heating cables, including non-heating leads, from damage during construction.

END OF SECTION

SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

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 ACTION SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1.03 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.01 VIBRATION ISOLATION EQUIPMENT BASES

A. **Type A**: Direct Isolator Attachment

1. Unit to be isolated is so constructed that vibration isolators of the type specified may be directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.

B. **Type B**: Factory-fabricated, welded, structural-steel bases or rails.

1. Structural Steel Bases:

a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WF or a comparable product by one of the following:

1) Amber/Booth; a VMC Group Company.
2) Kinetics Noise Control, Inc.
3) Korfund Dynamics; a VMC Group Company.
4) Vibration Eliminator Co., Inc.
5) Vibration Isolation Co., Inc. (Pump Bases Only)
6) Vibration Mountings & Controls; a VMC Group Company.
7) Vibro-Acoustics.

b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2. Structural-Steel Rails:

a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ICS or a comparable product by one of the following:

1) Amber/Booth; a VMC Group Company.
2) Kinetics Noise Control, Inc.
3) Korfund Dynamics; a VMC Group Company.
4) Vibration Eliminator Co., Inc.
5) Vibration Isolation Co., Inc. (Pump Bases Only)
6) Vibration Mountings & Controls; a VMC Group Company.
7) Vibro-Acoustics.

b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. **Type C** Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type BMK/KSL or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.
b. Kinetics Noise Control, Inc.
c. Korfund Dynamics; a VMC Group Company.
d. Vibration Eliminator Co., Inc.
e. Vibration Isolation Co., Inc. (Pump Bases Only)
f. Vibration Mountings & Controls; a VMC Group Company.
g. Vibro-Acoustics.

2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

D. **Type D** Curb Mounted Aluminum Bases:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type CMAB or a comparable product by one of the following:
   a. Kinetics Noise Control, Inc.
   b. ThyCurb/Thybar.
   c. Vibro-Acoustics.
   d. Vib-Iso.
2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.
3. Upper Frame: Corrosion resistant extruded aluminum. Upper frame shall overlap lower frame for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.
4. Lower Frame: Corrosion resistant extruded aluminum. Lower framed shall overlap roof curb for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.
5. Safety Stops: Neoprene, mounted in corners of lower frame for extreme wind conditions and mild seismic disturbances under normal conditions.
6. Isolators: Cadmium plated free-standing springs with positive spring retainer and flexible ties.
7. Splicing Kit: Required for bases shipped in multiple pieces.
8. Weatherseal: Flexible frictionless EPDM.
9. Static Deflection: Nominal 1 inch.

E. **Type E** Rooftop Spring Curb:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type RSC or a comparable product by one of the following:
   a. Kinetics Noise Control, Inc.
   b. ThyCurb/Thybar.
   c. Vibro-Acoustics.
2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment; and to withstand wind forces as required by local codes.
3. Lower Support Assembly: Sheet-metal "Z" section containing adjustable and removable steel springs that support upper floating frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist wind forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for

attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.

4. Spring Isolators: Adjustable, restrained spring isolators shall be mounted on 1/4-inch- thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
    a. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with restraint.
        1) Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
        2) Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
        3) Minimum Additional Travel: 50 percent of the required deflection at rated load.
        4) Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
        5) Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
    b. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
        1) Material: Bridge-bearing neoprene, complying with AASHTO M 251.
        2) Durometer Rating: 40.
5. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
6. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
7. Sound Isolation: Within perimeter of roof curb rails and as detailed on the Drawings:
    a. Two layers of 2-inch thick board insulation, minimum 3-lb/cu. ft. density, glass fibers bonded with a thermosetting resin. Comply with ASTM C 612 Type IA or Type IB.
    b. Two layers of 5/8-inch thick water-resistant gypsum core wall panel surfaced with paper on front, back, and long edges. Comply with ASTM C 1396.
    c. One layer of 6-inch thick fiberglass blanket insulation.
8. Static Deflection: Nominal 1 inch, 2 inches, or 3 inches.

2.02 VIBRATION ISOLATORS

A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
    a. Amber/Booth; a VMC Group Company.
    b. Kinetics Noise Control, Inc.
    c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Material: Standard neoprene for indoor applications.

3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Material: Standard neoprene for indoor applications.

3. Material: Bridge-bearing neoprene, complying with AASHTO M 251 for outdoor applications.

C. **Type 2** Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ND or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Durometer Rating: Selected for maximum possible static deflection with the loading of each piece of equipment.

3. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.

4. Neoprene: Bridge-bearing neoprene as defined by AASHTO.

D. **Type 3** Spring Isolators: Freestanding, open-spring isolators.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type SLF or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. **Type 4** Restrained Spring Isolators: Restrained single and multiple spring mounts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Types SLR and SLRS or comparable products by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch- thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. **Type 5** Thrust Restraints

1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression or tension as required, and with a load stop. Include rod and angle-iron brackets with back-up plates for attaching to equipment and ductwork.

a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WBI for fan inlet connections, and Type WBD for fan outlet connections, or comparable products by one of the following:

1) Amber/Booth; a VMC Group Company.

2) Kinetics Noise Control, Inc.

3) Korfund Dynamics; a VMC Group Company.

4) Vibration Eliminator Co., Inc.

5) Vibration Mountings & Controls; a VMC Group Company.

6) Vibro-Acoustics.

b. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

c. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

d. Minimum Additional Travel: 50 percent of the required deflection at rated load.

e. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

f. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

g. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

h. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.03 **VIBRATION ISOLATION HANGERS**

A. **Type 8a** Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type 30N or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

B. **Type 8b** Spring Hangers with Vertical-Limit Stop: Precompressed combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type PC30N or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.

e. Vibration Mountings & Controls; a VMC Group Company.

f. Vibro-Acoustics.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

2.04 **FACTORY FINISHES**

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.

2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.

3. Baked enamel for metal components on isolators for interior use.

4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."

B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.

3.03 **APPLICATION**

A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.04 **CONNECTIONS**

A. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.

B. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.05 **EQUIPMENT BASES**

A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.

1. Cast-in-place concrete materials and placement requirements are specified in Division 03.

B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.

1. 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.
2. Install epoxy-coated anchor bolts for supported equipment 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 embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.06 **FIELD QUALITY CONTROL**

A. Testing: Perform the following field quality-control testing:

1. Isolator deflection.
2. Snubber minimum clearances.

3.07 **ADJUSTING**

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.

D. Adjust active height of spring isolators.

E. Adjust snubbers according to manufacturer's written recommendations.

3.08 **CLEANING**

A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.

END OF SECTION

SECTION 20 0553 - MECHANICAL IDENTIFICATION

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

Pipe System Label	Drawing Abbrev.	Labels	Piping
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

Pipe System Label	Drawing Abbrev.	Labels	Piping
Natural Gas	G	Black on Yellow	Yellow

Pipe System Label	Drawing Abbrev.	Labels	Piping
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
Heat Pump Loop Water Supply	HPLS	Black on Yellow	Dark Blue
Heat Pump Loop Water Return	HPLR	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
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

Service	Abbrev.	Labels	Ductwork
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

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.

1. 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

SECTION 20 2923 - VARIABLE FREQUENCY CONTROLLERS

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.

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 “Motors.”

1.02 REFERENCES

A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. ANSI/NEMA MG 1 - Motors and Generators.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. EMI: Electromagnetic interference.

C. LED: Light-emitting diode.

D. RFI: Radio-frequency interference.

E. THD: Total harmonic disturbance.

F. VFC: Variable frequency controller. Variable frequency controllers may also be referred to as variable speed drives, variable frequency drives, VSDs, or VFDs in other Specification Sections or on the Drawings.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type and rating of VFC indicated.

1. Include dimensions and finishes for VFCs.

2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.05 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Indicating power, control and instrument wiring including ladder diagrams for field work as well as factory assembled work. Manufacturer's drawings are acceptable only when modified and supplemented to reflect project conditions. The drawings shall include:

1. Overall schematic (elementary) diagram in JIC form of the entire system of power and control circuitry. Indicate interfaces with control wiring by temperature controls contractor.

2. Wiring diagrams showing the wiring layout of component assemblies or systems.

3. Interconnection wiring diagrams showing terminations of interconnecting conductors between component assemblies, systems, control devices, and control panels complete with conductor identification, number of conductors, conductor and conduit size.

4. Sequence of operation for components, assemblies or systems.

5. Dimensional data.

B. Product Certificates: For each VFC from manufacturer.

C. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

D. Coordination Data for Motor-Driven Equipment: Accompanied by complete information concerning the respective motors including the following.

1. Principal dimensions.

2. Weights.

3. Horsepower.

4. Voltage, phase, frequency.

5. Speed.

6. Class of insulation.

7. Enclosure type.

8. Frame.

9. Bearings including ABMA Rating Life (L-10 basis).

10. Design letter.

11. Manufacturer.

12. Service Factor

E. Descriptive data shall include catalogues, guaranteed performance data with efficiency and power factor indicated at 75 percent and 100 percent of rated load and verification of conformance with other requirements of the Contract Documents. The information enumerated under NEMA MG1 Paragraph MG1-10.38, shall be arranged on one sheet for each motor.

1.06 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1.07 **QUALITY ASSURANCE**

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Product Options for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NFPA 70.

E. Comply with IEEE 519 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

1.08 **DELIVERY, STORAGE, AND HANDLING**

A. Store VFCs in permanently enclosed and conditioned spaces.

B. If stored in space that is not permanently enclosed and conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.09 **COORDINATION**

A. For Electrical Work Provided under Division 20, 22, and 23 Specifications: Furnish UL Listed components, in accordance with Division 26 Specifications and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.

B. Provide Electrical Work required for the operation of components and assemblies provided as part of the Work under Division 20, 22, and 23 Specifications.

C. Coordinate with temperature controls contractor for interfaces with temperature controls wiring.

D. Mount line voltage (120 VAC) control components specified as part of the Work under Division 20, 22, and 23 Specifications.

E. Refer to ELECTRICAL DRAWINGS and Division 26 Specifications for specified information regarding provisions for the arrangement of electrical circuits and components and for interface with Work specified under Division 20, 22, and 23 Specifications.

F. The mechanical contractor shall furnish and install the variable frequency controller. Electrical trades shall make power connections to both load and line side of the VFC.

1.10 **WARRANTY**

A. Warranty shall be 36 months from date of project acceptance. The warranty shall include all parts, labor, travel time and expenses.

PART 2 PRODUCTS

2.01 **GENERAL**

A. Electrical Power Supply Characteristics: 480 volts, 3 phase, 60 hertz (Hz).

B. Controller(s) shall be suitable for use with standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor. At any time in the future, it shall be possible to substitute standard motor (equivalent horsepower, voltage and RPM) in the field.

2.02 **VARIABLE FREQUENCY CONTROLLERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. ABB Group.

2. Danfoss.

3. Eaton Corporation.
4. General Electric.
5. Hitachi America, Ltd.
6. Johnson Controls Incorporated (Private labeled ABB).
7. Mitsubishi Electric Automation, Inc.
8. Square D; Schneider Electric.
9. Toshiba International Corporation.
10. Yaskawa Electric America, Inc.

B. Provide variable frequency controllers as scheduled including coasting motor restart, and step over frequency.
   1. The ratio of the total impedance to common system impedance shall be greater than or equal to 10.
   2. The voltage notch area shall be limited to 16-400 volt microseconds.
   3. The total harmonic disturbance (THD) as a result of voltage notching shall be 3 percent or less at the point of common coupling.
   4. The THD as a result of current notching shall be 100 percent or less at the point of common coupling.

C. Provide 3 percent AC input line reactors sized appropriate for each current rating variable frequency controller.

D. Variable frequency controller (VFC) shall comply with all applicable provisions of the National Electrical Code.

E. Line side of the VFC shall have a displacement power factor of 0.95 or greater when motor is operating at 50 to 100 percent motor speed.

F. VFC shall have efficiency greater than 85 percent when motor is operating at 50 to 100 percent motor speed.

G. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

H. Unit Operating Requirements:
   1. Input AC Voltage Tolerance: Plus 10 and minus 5 percent of VFC input voltage rating.
   2. Input Frequency Tolerance: Plus 2 percent of VFC frequency rating.

I. Each variable frequency controller shall consist of an adjustable frequency converter which shall convert input power into an adjustable frequency output in an ambient temperature of zero to 40 deg C. Output power shall be suitable capacity and waveform to provide stepless speed control of the specified horsepower motor throughout the required speed range under variable torque load not exceeding the motor's full-load rating.

J. Provide fault detection and trip circuits to protect itself and the connected motor against line voltage transients, power line under voltage, output overvoltage and overcurrent. A disconnect with padlockable door interlocked external handle shall be supplied to disconnect the incoming power.
   1. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.

K. Minimum output frequency shall be the lowest frequency at which the connected motor can be operated without overheating.

L. Inverter shall contain current limiting circuitry, adjustable to 100 percent of motor full-load current to provide soft start, acceleration, and running without exceeding motor rated current. The current

limit circuit shall be of the type for variable torque load, which acts to diminish output frequency while limiting, without directly causing shutdown.

M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts. For safety, drive shall shut down and require manual reset and restart if automatic reset/restart function is not successful within three attempts.

N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

O. Isolate signal circuits from the power circuits and design to accept a speed signal from a remote process controller in the automatic mode and from the speed control potentiometer in the manual mode. A door-mounted switch shall provide mode selection. The selected signal shall control the motor speed between the adjustable minimum and maximum speed settings. Maximum speed shall be field adjustable to 100 percent of rated speed. The speed signal shall follow a linear time ramp, adjustable from 4-20 seconds to provide acceleration from zero to minimum speed. When minimum speed is reached, the speed signal shall follow the linear time ramp for acceleration and deceleration control.

P. Mount the adjustable frequency inverter and other electrical components that provide the operation specified in a NEMA 1 or 4 enclosure, refer to floor plans for VFC locations. Equipment shall have external heat sinks, or air filters on all vents. The enclosure shall have hinged front access doors with latch. Cabinet to cabinet interconnecting wiring shall be factory dressed, tagged and harnessed, and shipped with one end attached.

Q. Controller shall have the ability to step-over certain set frequencies that may cause a system to resonate. The controller shall have at least two manually set points of frequency in which the controller shall step-over during operation.

R. Operating and monitoring devices for the inverter shall be door mounted and shall include the following:

1. Manual Speed Control to set speed in the hand (manual) mode.
2. Speed indicating meter, either in revolutions per minute, proportional to the applied frequency and voltage to indicate speed of the converter-powered motor or frequency (hertz).
3. VFC "fault/reset" pilot light pushbutton combination with dry contact for external alarm. Fault alarm shall not actuate upon normal shutdown.
4. Inverter "control power" indicator.
5. Motor "running" indicator and two dry contacts that close when motor is running.
6. Output current meter calibrated in "AC amps."
7. Operating selector switches and indicating light to perform the following functions:
    a. One hand-off-auto switch for the VFC with indicating lights (red-running, green-energized). In hand position, unit (VFC or bypass starter) shall start. In auto position, unit (VFC or bypass starter) shall start when remote dry contact is closed.
    b. Unit shall be capable of being padlocked in the off position.
8. Output voltmeter (0 - 600 VAC) (analog or digital).

S. The VFC is to be provided with isolated 4-20 mA DC output signals proportional to speed, current and voltage for connection by others.

T. The VFC shall be provided with the ability to communicate (monitoring) through RS485 connector.

U. Remote speed control shall be 4-20 mA control signal from a remote controller.

V. Variable frequency controller shall not cause motor to produce noise levels exceeding 80 dBA measured at a distance of 3 feet from the motor. If noise level of motor exceeds this amount, the contractor shall be responsible for correcting the problem.

W. Provide connection points for system safety controls such as smoke detectors, freeze stats, damper end switches, etc. as shown on mechanical temperature control drawings. Opening of a contact on safety controls wired to the drive shall shut down the motor(s).

X. Provide in each VFC, a relay, that upon loss of the automatic speed control signal shall:

1. Automatically set the motor rpm to half speed. This loss of signal relay shall be manually adjustable to be able to set default speed to some other value than half speed if required later in the field.

Y. Coordinate with the Temperature Controls Contractor for the interface of control wiring to the drive as required to meet the requirements of the temperature control drawings. Drive shall be furnished with internal control wiring configured in the factory to allow single connections of field wiring to terminal blocks in the drive by the Temperature Controls Contractor.

Z. All indicating lights shall be push to test or LED.

2.03 **SOURCE QUALITY CONTROL**

A. Factory Tests: The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:

1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.

2. All printed circuit boards shall be tested at 50 deg C for 50 hours. The VFC manufacturer shall provide certification that the tests have been completed.

3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install and adjust materials and equipment in accordance with the manufacturer's instructions.

B. Obtain the manufacturer's instructions for materials and equipment provided under the Contract in detail necessary to comply with the requirements of the Contract Documents.

C. If unit is free standing, provide a concrete housekeeping pad.

3.03 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Upon completion of each installation, conduct complete acceptance tests in the presence of duly notified authorities having jurisdiction and the Owner to demonstrate component, assembly or system performance in accordance with the requirements of the Contract Documents.

C. In the event that a test demonstrates that a component assembly or system performance is deficient, the Owner may require additional tests after corrective work.

D. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

E. Component assembly and systems acceptance is predicated upon completion of specified work and receipt by the Owner of data specified under "Submittals."

F. Electrical testing of motors is specified in Division 20 Section “Motors.”

3.04 **ADJUSTING**

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set the taps on reduced-voltage autotransformer controllers.

C. Set field-adjustable circuit-breaker trip ranges.

D. Set field-adjustable pressure switches.

3.05 **PROTECTION**

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.06 **DEMONSTRATION**

A. The VFC supplier/support group shall provide the following additional services:

1. On-site training of customer personnel in operation and maintenance of variable frequency controllers.

2. Provide four copies of a troubleshooting manual and factory training manuals to help the building operator determine what steps must be taken to correct any problem that may exist in the system.

3. Coordinate enrollment of customer personnel in factory-held service schools.

END OF SECTION

SECTION 21 1100 - FIRE-SUPPRESSION SYSTEM

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Provisions of Division 20 Section “Mechanical General Requirements” apply to this Section.

C. Related Sections include the following:

1. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Hangers and Supports.”
4. Division 28 Section "Fire Alarm" for alarm devices not specified in this Section.

1.02 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.

C. PE: Polyethylene plastic.

D. Underground Service-Entrance Piping: Underground service piping below the building.

E. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.

F. Hose Station: Hose connection, fire hose rack, and fire hose.

G. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.03 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.04 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet shall be based on NFPA 14 and the requirements of the Owner:
    a. Examples:
        1) NPS 1-1/2 Hose Connections: 65 psig.
        2) NPS 2-1/2 Hose Connections: 100 psig.
2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:
    a. NPS 1-1/2 Hose Connections: 100 psig.
    b. NPS 2-1/2 Hose Connections: 175 psig.

D. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:
    a. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
    a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500-sq. ft. area.
4. Maximum Protection Area per Sprinkler:
    a. Office Spaces: 225 sq. ft**.**
    b. Storage Areas: 130 sq. ft.
    c. Mechanical Equipment Rooms: 130 sq. ft.
    d. Electrical Equipment Rooms: 130 sq. ft.
    e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

1.05 **ACTION SUBMITTALS**

A. Product Data: For each type of product indicated.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
    1. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
    1. Domestic water piping.
    2. Compressed air piping.
    3. HVAC hydronic piping.
    4. Items penetrating finished ceiling include the following:
        a. Lighting fixtures.
        b. Air outlets and inlets.

D. Qualification Data: For qualified Installer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction
    1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

F. Fire-hydrant flow test report.

1.07 **CLOSEOUT SUBMITTALS**

A. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test for Underground Piping."

B. Field quality-control reports.

C. Operation and Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals.

1.08 **QUALITY ASSURANCE**

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

2. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. The provisions and requirements of the NFPA and the Owner’s insurance underwriter constitute mandatory minimum requirements for the work of this Section.

C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."

1.09 **COORDINATION**

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Coordinate with ceiling installer to ensure proper grid type and installation for use with flexible sprinkler drops.

1.10 **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. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **DUCTILE-IRON PIPE AND FITTINGS**

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

C. Encasement for Underground Ductile-Iron Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.03 **STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS**

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll- grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.

2. Grooved-Joint Piping Systems:
   a. Manufacturers:
      1) Anvil; Models 74FP and 7401; ASC Engineered Solutions.
      2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.
      3) Victaulic Co. of America; Style 005H, 009N, 107N and 109.
   b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
   c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

D. Steel Pressure-Seal Fittings:

1. Manufacturers:
   a. Viega North America; MegaPress System.
2. NPS 1/2 through NPS 2: Conforming to ASME B31.1, ASME B31.3, or ASME B31.9 pressure-seal fittings with zinc and nickel coating for use with carbon steel pipe conforming to ASTM A53, ASTM A106, ASTM A135, or ASTM A795.
3. Fittings shall have EPDM sealing element, Type 420 stainless steel grip ring, and Type 304 stainless steel separator ring.
4. Sealing elements verified for the intended use.

5. Tools: Manufacturer's special tools.
6. Maximum 200-psig working-pressure rating at 250 deg F.

2.04 **STANDARD-WEIGHT GALVANIZED STEEL PIPE AND FITTINGS**

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized, with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1, hot-dip galvanized.
2. Malleable-Iron Threaded Fittings: ASME B16.3, hot-dip galvanized.
3. Gray-Iron Threaded Fittings: ASME B16.4, hot-dip galvanized.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe, hot-dip galvanized. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865, hot-dip galvanized.

B. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized with factory- or field-formed, square-cut-grooved ends.

1. Grooved-Joint Piping Systems:
   a. Manufacturers:
      1) Anvil; Models 74FP and 7401; ASC Engineered Solutions.
      2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.
      3) Victaulic Co. of America; Styles 005H, 009N, 107N, and 109.
   b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
   c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

C. Steel Pressure-Seal Fittings:

1. Manufacturers:
   a. Viega North America; MegaPress System.
2. NPS 1/2 through NPS 2: Conforming to ASME B31.1, ASME B31.3, or ASME B31.9 pressure-seal fittings with zinc and nickel coating for use with carbon steel pipe conforming to ASTM A53, ASTM A106, ASTM A135, or ASTM A795.
3. Fittings shall have EPDM sealing element, Type 420 stainless steel grip ring, and Type 304 stainless steel separator ring.
4. Sealing elements verified for the intended use.
5. Tools: Manufacturer's special tools.
6. Maximum 200-psig working-pressure rating at 250 deg F.

2.05 **SCHEDULE 10 BLACK STEEL PIPE AND FITTINGS**

A. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13 specified wall thickness in NPS 6 to NPS 10, and with factory applied antimicrobial coating on inner wall of pipe.

1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
2. Steel Flanges and Flanged Fittings: ASME B16.5.

B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.

1. Grooved-Joint Piping Systems:

a. Manufacturers:

1) Anvil; Models 74FP and 7400; ASC Engineered Solutions.

2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.

3) Victaulic Co. of America; Styles 005H, 009N, 107N, and 109.

b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.

c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.06 COPPER TUBE AND FITTINGS

A. Plain-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L, water tube, drawn temper.

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.

2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match tubing system.

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.

4. Brazing Filler Metals: AWS A5.8, BCuP-3 or BCuP-4.

B. Grooved-End, Hard Copper Tube: ASTM B 88, Type K or ASTM B 88, Type L water tube, drawn temper; with factory- or field-formed, roll-grooved ends.

1. Grooved-Joint Systems:

a. Manufacturers:

1) Anvil; Model 7401; ASC Engineered Solutions.

2) Tyco Fire Protection Products by Johnson Controls Company; Grinnell G-Fire.

3) Victaulic Co. of America; Style 606.

b. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting. Fittings may have ends factory or field expanded to steel-pipe OD if required for copper tube systems using grooved-end-pipe couplings.

c. Grooved-End-Tube Couplings: UL 213, rigid pattern, unless otherwise indicated; gasketed fitting equivalent to AWWA C606 but made to match copper-tube OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts. Use grooved-end-pipe couplings for tube and fitting that have expanded ends.

2.07 BACKFLOW PREVENTION DEVICES

A. Double-Check, Detector-Assembly Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 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 1048 and FMG approved or UL listed.

3. Operation: Continuous-pressure applications.

4. Pressure Loss: 5 psi maximum, through middle 1/3 of flow range.

5. Size and Capacities: As scheduled on the drawings.

6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.

7. End Connections: Flanged.

8. Configuration: Designed for horizontal, straight through

9. Accessories:

a. Valves: Outside screw and yoke gate-type with flanged, or grooved ends on inlet and outlet.

b. Bypass: With displacement-type water meter, shutoff valves, and double-check backflow prevention device.

2.08 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.

B. Sprinkler Drain and Alarm Test Fittings: Cast-bronze or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

1. Manufacturers:

a. Tyco Fire Protection Products by Johnson Controls Company.

b. Fire-End and Croker Corp.

c. Viking Corp.

d. Victaulic Co. of America; Series UTD Universal Test and Drain.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

1. Manufacturers:

a. Elkhart Brass Mfg. Co., Inc.

D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Manufacturers:

a. AGF Manufacturing Co.

b. G/J Innovations, Inc.

c. Triple R Specialty of Ajax, Inc.

d. Tyco Fire Protection Products by Johnson Controls Company.

E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

1. Manufacturers:
    a. CECA, LLC.
    b. Merit.

F. Flexible Sprinkler Drop Fittings:
1. Manufacturers:
    a. Victaulic Co. of America; VicFlex Sprinkler Fittings; AH-2 or AH2-CC with AB1 Bracket Assembly.
    b. Reliable Automatic Sprinkler Co., Inc.; RASCOflex Series RFB.
    c. FlexHead Industries, Inc.; ASC Engineered Solutions
2. Description: UL listed and FMG approved stainless steel flexible hose for connection to sprinkler, and with bracket for connection to commercial ceiling grid.
3. Standard: UL 2443.
4. Pressure Rating: 175 psig minimum; 300 psig if fittings are components of high-pressure piping system.
5. Size: Same as connected piping, for sprinkler.

G. Dry-Pipe-System Fittings: UL listed for dry-pipe service.

2.09 **LISTED FIRE-PROTECTION VALVES**

A. Valves: UL listed or FMG approved.
1. Valves shall have 175-psig minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:
1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with, extension rod, locking device, and cast-iron barrel.
3. Manufacturers:
    a. McWane, Inc.; Kennedy Valve Div.
    b. NIBCO.
    c. Crane Co.; Crane Valve Group; Stockham Valves.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
3. NPS 3: Ductile-iron body with grooved ends.
4. Manufacturers:
    a. NIBCO.
    b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.
1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
    a. Manufacturers:
        1) McWane, Inc.; Kennedy Valve Div.

2) Mueller Company; ASC Engineered Solutions.
3) NIBCO.
4) Tyco Fire Protection Products by Johnson Controls Company.
5) Victaulic Co. of America; Series 705.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
a. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Jenkins Valves.
c. Crane Co.; Crane Valve Group; Stockham Valves.
d. Hammond Valve.
e. McWane, Inc.; Kennedy Valve Div.
f. Mueller Company; ASC Engineered Solutions.
g. NIBCO.
h. Tyco Fire Protection Products by Johnson Controls.
i. Victaulic Co. of America.
j. Watts Water Technologies, Inc.; Watts Regulator Co.

F. Gate Valves: UL 262, OS&Y type.
1. NPS 2 and Smaller: Bronze body with threaded ends.
a. Manufacturers:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.
2. NPS 2-1/2 and Larger: Cast or ductile -iron body with flanged or grooved ends.
a. Manufacturers:
1) McWane, Inc.; Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Hammond Valve.
5) Milwaukee Valve Company.
6) Mueller Company.
7) NIBCO.
8) Victaulic Co. of America: Series 771.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory.
2. NPS 2 and Smaller: Ball or butterfly valve with brass or bronze body and threaded ends.
a. Manufacturers:
1) Milwaukee Valve Company.
2) NIBCO.

3) Victaulic Co. of America; Series 728.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

1) Tyco Fire Protection Products by Johnson Controls.

2) McWane, Inc.; Kennedy Valve Div.

3) Milwaukee Valve Company.

4) NIBCO.

5) Victaulic Co. of America.

2.10 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.11 ALARM CHECK VALVES

A. General Requirements:

1. Standard: UL listed or FMG approved.

2. Pressure Rating:

a. Standard-Pressure Valves: 175 psig minimum.

b. High-Pressure Valves: 300 psig.

3. Body Material: Cast or ductile iron.

4. Size: Same as connected piping.

5. End Connections: Flanged or grooved.

B. Manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.

2. Tyco Fire Protection Products by Johnson Controls Company.

3. Viking Corp.

4. Victaulic Co. of America.

C. Description: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.

1. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

2.12 AUTOMATIC (BALL DRIP) DRAIN VALVES

A. General:

1. Standard: UL 1726.

2. Pressure Rating: 175 psig minimum.

3. Type: Automatic draining, ball check.

4. Size: NPS 3/4.
5. End Connections: Threaded.

B. Manufacturer:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.

2.13 **SPRINKLERS**

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire Protection Products by Johnson Controls Company.
3. Victaulic Co. of America.
4. Viking Corp.

C. Automatic Sprinklers:

1. With heat-responsive glass bulb element complying with the following:
   a. UL 199, for nonresidential applications.
   b. UL 1626, for residential applications.
   c. UL 1767, for early-suppression, fast-response applications.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Flush ceiling sprinklers, including escutcheon.
4. High-pressure sprinklers.
5. Institution sprinklers, made with a small, breakaway projection.
6. Open sprinklers.
7. Pendent sprinklers.
8. Pendent, dry-type sprinklers.
9. Quick-response sprinklers.
10. Recessed sprinklers, including escutcheon.
11. Sidewall sprinklers.
12. Sidewall, dry-type sprinklers.
13. Concealed sidewall sprinklers, including cover plate.
14. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with

sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

1. Ceiling Mounting: Chrome-plated steel, 2 piece, with 3/4-inch vertical adjustment.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.14 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:

1. Elkhart Brass Mfg. Co., Inc.
2. Potter Roemer Fire Pro; A Member of Morris Group International.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."

1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
2. Type: Flush, with two inlets and square or rectangular escutcheon plate.
3. Finish: Polished chrome-plated.

2.15 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Motor-Operated Alarm: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings, and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS 3/4 inlet and NPS 1 drain connections.

1. Manufacturers:
   a. AFAC Inc.
   b. Firematic Sprinkler Devices, Inc.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire Protection Products by Johnson Controls Company.
   e. Viking Corp.

C. Electrically Operated Alarm: UL 464, with 6-inch- minimum- 8-inch- minimum- diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.

1. Manufacturers:
   a. Potter Electric Signal Company, LLC.
   b. System Sensor.

D. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers:
   a. Potter Electric Signal Company, LLC.

b. System Sensor.

E. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.

1. Manufacturers:

a. Potter Electric Signal Company, LLC.

b. System Sensor.

F. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:

a. Potter Electric Signal Company, LLC.

b. System Sensor.

G. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

1. Manufacturers:

a. Potter Electric Signal Company, LLC.

b. System Sensor.

2.16 **PRESSURE GAGES**

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.
2. Ashcroft Inc.
3. Marsh Bellofram.
4. Viking Corp.
5. Weiss Instruments, Inc.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum

1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

PART 3 EXECUTION

3.01 **PREPARATION**

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.02 **EARTHWORK**

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.03 **EXAMINATION**

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.04 **PIPING APPLICATIONS, GENERAL**

A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints; or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

C. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints.

3.05 **SPRINKLER RISER AND STANDPIPE SYSTEM PIPING APPLICATIONS**

A. Sprinkler Risers and Standpipes: Use the following:

Pipe Type	4" & Smaller	5" & 6"	8" - 12"
Standard weight steel, threaded fittings	YES	YES	NO
Standard weight steel, grooved fittings	YES	YES	YES
Standard weight steel, welded fittings	YES	YES	YES
Galv. standard weight steel, threaded fittings	YES	YES	NO
Galv. standard weight steel, grooved fittings	YES	YES	YES
Schedule 10 steel, grooved fittings	NO	NO	NO
Schedule 10 steel, welded fittings	NO	NO	NO
Type K copper, grooved fittings	NO	NO	NO
Type L copper, grooved fittings	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO
Type L copper, brazed fittings	NO	NO	NO

3.06 **SPRINKLER SYSTEM PIPING APPLICATIONS**

A. Wet-Pipe Sprinklers: Use the following:

Pipe Type	1 ½" & Smaller	2"	2 ½" – 3 ½"	4"	5" – 6"
Standard weight steel, threaded fittings	YES	YES	YES	YES	NO
Standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Standard weight steel, welded fittings	NO	YES	YES	YES	YES
Galv. standard weight steel, threaded fittings	YES	YES	YES	YES	YES
Galv. standard weight steel, grooved fittings	NO	NO	YES	YES	YES
Schedule 10 steel, welded fittings	NO	YES	YES	YES	YES

Pipe Type	1 ½" & Smaller	2"	2 ½" – 3 ½"	4"	5" – 6"
Schedule 10 steel, grooved fittings	NO	NO	YES	YES	YES
Type K copper, brazed fittings	NO	NO	NO	NO	NO
Type L copper, brazed fittings	NO	NO	NO	NO	NO
Type K copper, brazed fittings	NO	NO	NO	NO	NO
Type L copper, grooved fittings	NO	NO	NO	NO	NO
CPVC pipe, solvent cement fittings	YES	YES	YES	NO	NO

3.07 **VALVE APPLICATIONS**

A. The following requirements apply:

1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.
    a. Shutoff Duty: Use ball, butterfly, or gate valves.
2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
    a. Shutoff Duty: Use ball, butterfly, or gate valves.
    b. Throttling Duty: Use ball or globe valves.

3.08 **JOINT CONSTRUCTION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

D. Use of saddle style tees is not acceptable.

E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
2. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings. Follow manufacturer's instructions, including use of torque wrench where applicable.
3. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.
4. Copper Tube: Roll-groove tubing. Use grooved-end fittings and grooved-end-tube couplings.
5. Dry-Pipe Systems: Use fittings and gaskets listed for dry-pipe service.

3.09 **SERVICE-ENTRANCE PIPING**

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 33 Section "Water Distribution" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping.

3.10 **PIPING INSTALLATION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install drain valves on standpipes.

J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13 for hanger materials.

1. Install standpipe system piping according to NFPA 14.

2. Install sprinkler system piping according to NFPA 13, except use of “C” clamps, or beam clamps of “C” pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.

3. Refer to Division 20 Section “Hangers and Supports” for additional requirements.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Fill wet-standpipe system piping with water.

O. Fill wet-pipe sprinkler system piping with water.

3.11 **INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING**

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.12 **VALVE INSTALLATION**

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.

D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.

E. Specialty Valves:

1. Alarm Check Valves: Install in vertical position for proper direction of flow, including bypass check valve and retarding chamber drain-line connection.

2. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

a. Air-Pressure Maintenance Devices for Dry-Pipe Systems: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.

b. Install air compressor and compressed-air supply piping.

c. Install compressed-air supply piping from building's compressed-air piping system.

3. Deluge Valves: Install in vertical position, in proper direction of flow, in main supply to deluge system.

3.13 SPRINKLER APPLICATIONS

A. Use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.

2. Rooms with Suspended Ceilings: Extended coverage concealed sprinklers.

3. Wall Mounting: Sidewall sprinklers.

4. Sprinkler Finishes:

a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.

b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.

5. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.14 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

B. Install sprinklers into flexible sprinkler drop fittings and install into bracket on ceiling grid. Install according to manufacturer’s instructions and NFPA, State, and local guidelines. Ceiling grid must meet requirements of ASTM C 635 and C 636, coordinate with ceiling installer.

3.15 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connections in vertical wall.

B. Install freestanding-type, fire department connections in level surface.

1. Install protective pipe bollards on two sides of each fire department connection. Refer to Division 05 Section "Metal Fabrications" for pipe bollards.

C. Install ball drip valve at each check valve for fire department connection.

3.16 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 22 Section "Domestic Water Piping Specialties" for backflow preventers.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

E. Connect excess-pressure pumps to the following piping and wiring:

1. Sprinkler system, hydraulically.
2. Pressure gages and controls, hydraulically.
3. Electrical power system.
4. Alarm device accessories for pump.
5. Fire alarm.

F. Connect compressed-air supply to dry-pipe sprinkler piping.

G. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire alarm devices, including low-pressure alarm.

H. Electrical Connections: Power wiring and fire alarm wiring are specified in Division 26.

I. Connect alarm devices to fire alarm.

J. Ground equipment according to Division 26 Section "Grounding and Bonding."

K. Connect wiring according to Division 26 Section "Conductors and Cables."

L. 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.

3.17 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 20 Section "Mechanical Identification."

3.18 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
5. Verify that equipment hose threads are same as local fire department equipment.

6. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

C. Verify that excess-pressure pumps and accessories are installed and operate correctly.

D. Verify that air compressors and their accessories are installed and operate correctly.

E. Verify that specified tests of piping are complete.

F. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

G. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

H. Verify that potable-water supplies have correct types of backflow preventers.

I. Pressurize and check dry-pipe sprinkler piping air-pressure maintenance devices and air compressors.

J. Verify that hose connections are correct type and size.

K. Verify that hose stations are correct type and size.

L. Energize circuits to electrical equipment and devices.

M. Start and run excess-pressure pumps.

N. Start and run air compressors.

O. Adjust operating controls and pressure settings.

P. Coordinate with fire alarm tests. Operate as required.

Q. Coordinate with fire-pump tests. Operate as required.

R. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.19 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.20 DEMONSTRATION

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

END OF SECTION

SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING

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 Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Systems: Valve ends may be grooved.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.

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. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

I. Extended Valve Stems: On insulated valves.

J. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

K. Valve Grooved Ends: AWWA C606.

L. 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.

M. Threaded: With threads according to ASME B1.20.1.

N. 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. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.

b. Bray International, Inc.

c. DeZurik.

d. Emerson Automation Solutions; Keystone.

e. Forum Energy Technologies; ABZ Valve.

f. Hammond Valve.

g. Milwaukee Valve Company.

h. NIBCO INC.; LD-2000-3/5.

i. Tyco Flow Control; Grinnell Flow Control.

j. Watts Water Technologies.

C. 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 IRON SWING CHECK VALVES

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.

b. Crane Co.; Crane Valves.

c. Crane Co.; Stockham Div.

d. Hammond Valve; IR1124-HI.

e. Milwaukee Valve Company; Model F-2974.

f. NIBCO INC.; Model F-918-B.

g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 920F.

b. Crane Co.; Crane Valves.

c. Crane Co.; Stockham Div.

d. Hammond Valve; IR322.

e. Milwaukee Valve Company; Model F-2970.

f. NIBCO INC.; Model F-968-B.

g. Watts Water Technologies.

D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Mueller Co.

b. NIBCO, INC.; Model G-917-W.

c. Victaulic Co. of America.

2.06 LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).

b. Bonomi USA, Inc.; Series 100002 and 100003.

c. Hammond Valve; UP943 and UP947.

d. Milwaukee Valve Company; UP548T and UP1548T.

e. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.

f. Watts Water Technologies; LF600.

2. Description:

a. Standard: MSS SP-80, Type 2.

b. CWP Rating: 250 psig.

c. Body Design: Vertical flow.

d. Body Material: Lead free brass or bronze.

e. Ends: Threaded or Solder.

f. Disc: PTFE, TFE, or Polyethermide.

2.07 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model W-910-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model W-960-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-910-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends and having 400 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-960-B-LF.

b. Mueller Steam Specialty.

c. Milwaukee Valve Company.

d. Hammond Valve.

2.08 **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.

2.09 **CAST-IRON GLOBE VALVES**

A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Model 711F.

b. Crane Co.; Crane Valves.

c. Crane Co.; Stockham Valves.

d. Hammond Valve.

e. Milwaukee Valve Company; Model F-2981.

f. NIBCO INC.; Model F-718-B.

g. Watts Water Technologies, Inc.

2.10 **CAST-IRON ANGLE VALVES**

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-818-B.

b. Crane Co.; Stockham Valves.

c. Crane Co.; Crane Valves.

2.11 **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.

2.12 **CHAINWHEEL ACTUATORS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.

2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron , of type and size required for valve

1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.

2. Chain: Hot-dip, galvanized steel , of size required to fit sprocket rim.

2.13 **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

SECTION 22 0533 - HEAT TRACING FOR PLUMBING

****ADD2****

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:

1. Division 20 Section “Mechanical General Requirements.”

1.02 SUMMARY

A. Section includes plumbing piping heat tracing for snow and ice melting in roof drains and rain conductors with the following electric heating cables:

1. Self-regulating, parallel resistance.

1.03 DEFINITIONS

A. BAS: Building Automation System.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Delegated-Design Submittal:

1. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.

B. Shop Drawings: For electric heating cable.

1. Include plans, elevations, sections, and attachment details.

2. Include diagrams for power, signal, and control wiring.

1.06 **CLOSEOUT SUBMITTALS**

A. Field quality-control reports.

B. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.07 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL acceptable to authorities having jurisdiction, and marked for intended location and application.

1.08 **COORDINATION**

A. Coordinate with installation of piping insulation.

1.09 **SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES FOR SNOW AND ICE MELTING**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Thermon Americas Inc.; SnoTrace RGS.
2. Raychem; nVent Electric plc; IceStop.
3. Delta-Therm Corporation, IN Series CBT Cables.

B. Comply with IEEE 515.1.

C. Performance Requirements: Select electric heat tracing cable capable of maintaining flow in roof drains and rain conductors with outside temperature at minus 10 deg F.

D. Heating Element: Pair of parallel No. 16 AWG, nickel-coated, copper bus wires embedded in crosslinked conductive polymer core, which varies heat output in response to temperature along its length. Terminate with waterproof, factory-assembled, non-heating leads with connectors at one end, and seal the opposite end watertight. Cable shall be capable of crossing over itself once without overheating.

E. Electrical Insulating Jacket: Flame-retardant polyolefin.

F. Cable Cover: Tinned-copper braid and polyolefin outer jacket with ultraviolet inhibitor.

G. Maximum Operating Temperature (Power On): 150 deg F.

H. Maximum Exposure Temperature (Power Off): 185 deg F.

I. Capacities and Characteristics:

1. Voltage: As recommended by manufacturer.
2. Number of Cables: As recommended by manufacturer.
3. Electrical Characteristics for Single-Circuit Connection: Coordinate electrical system requirements with Division 26.

J. Electrical Power System Characteristics: As scheduled on the Drawings.

K. Installation Accessories:

1. Circuit Fabrication Kit: Designed to terminate one circuit for both power connection and end termination.
2. Labels: Self-adhesive labels with legend “ELECTRIC HEAT TRACING.” Refer to Division 20 Section "Mechanical Identification" for additional requirements
3. Cable Mounting Clips: Secures cable to roof.

4. Cable Roof Fasteners: Attaches cable to roof or fascia material.
5. Downspout Cable Hangers: Secures cable at downspouts to remove strain.
6. Aluminum Tape: Attaches cable to bottom of clean gutter to keep cable in place during rain.

1.10 **CONTROLS**

A. Precipitation and Temperature Sensor for Snow Melting on Roofs and in Gutters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Thermon Americas Inc.
   b. Raychem; nVent Electric plc.
   c. Delta-Therm Corporation.
2. Automatic control with manual on, automatic, and standby/reset switch.
3. Precipitation and temperature sensors shall sense the surface conditions of roof and gutters and shall be programmed to energize the cable as follows:
   a. Temperature Span: 34 to 44 deg F.
   b. Adjustable Delay-Off Span: 30 to 90 minutes.
   c. Energize Cables: Following two-minute delay if ambient temperature is below set point and precipitation is detected.
   d. De-Energize Cables: On detection of a dry surface plus time delay.
4. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
5. Minimum 30-A contactor to energize cable or close other contactors.
6. Precipitation sensor shall be freestanding.
7. Provide relay with contacts to indicate operational status, on or off, for interface with central BAS workstation.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.

B. Electric Heating-Cable Installation for Snow and Ice Melting: Install on roof and in gutters and downspouts with clips and other hardware furnished by manufacturer that are compatible with roof, gutters, and downspouts.

C. Set field-adjustable switches and circuit-breaker trip ranges.

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. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.

2. Test cables for electrical continuity and insulation integrity before energizing using 2500 Vdc megohmmeter (megger).

3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Remove and replace damaged heat-tracing cables.

D. Prepare test and inspection reports.

3.05 **PROTECTION**

A. Protect installed heating cables, including non-heating leads, from damage during construction.

END OF SECTION

SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
3. Division 20 Section “Hangers and Supports.”
4. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and fittings.
5. Division 22 Section “General-Duty Valves for Plumbing.”
6. Division 22 Section "Domestic Water Piping Specialties" for water distribution piping specialties.

1.02 SUMMARY

A. This Section includes domestic water piping inside the building.

1.03 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 STAINLESS-STEEL PIPE AND FITTINGS

A. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L

C. , seamless or electric resistance welded pipe.

B. Grooved-Joint Systems:

1. Manufacturers:

a. ASC Engineered Solutions; Gruvlok; Fig. 472 and Fig. 770.

b. Victaulic Company; Style 489.

2. Grooved-End, Stainless Steel-Piping Fittings: Schedule 10S, Type 304L or 316L stainless steel from material conforming to ASTM A 403 or pipe conforming to ASTM A 312, or sheet conforming to ASTM A 240; with dimensions matching stainless steel pipe.

3. Grooved-End, Stainless Steel-Piping Couplings: ASTM A 743, cast Type 316L stainless steel, EPDM gaskets, and stainless steel bolts and nuts.

a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 304L stainless steel.

2.05 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.

2.06 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

SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 22 Section "Domestic Water Piping " for water meters.
5. Division 22 Section "Emergency Plumbing Fixtures" for water tempering equipment.
6. Division 22 Section "Drinking Fountains, Water Coolers and Cuspidors" for water filters for water coolers.

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. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; Conbraco Industries, Inc.

b. MIFAB, Inc.

c. Watts Water Technologies, Inc.; Watts Regulator Co.

d. Woodford Manufacturing Company.

2. Standard: ASSE 1011.

3. Body: Bronze or brass, nonremovable, with manual drain.

4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. 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. Double-Check Backflow-Prevention Assemblies:
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 1015.
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: 5 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.

D. 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.

E. Hose-Connection 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. Woodford Manufacturing Company.
2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

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.

C. Calibrated Balancing Valves NPS 2-1/2 to NPS 4:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Armstrong International, Inc.
   b. Bell & Gossett; Xylem Inc.
   c. Flo Fab Inc.
   d. Flow Design Inc.
   e. Griswold Controls.
   f. NIBCO INC.
   g. IMI Indoor Climate; Tour & Andersson.
   h. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.
3. Size: Same as connected piping, but not smaller than NPS 2-1/2.
4. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.04 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 PREPIPED TEMPERED WATER MIXING SYSTEM

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Controls; Morris Group International.
   b. Armstrong International, Inc. (RADA).
   c. Bradley Corporation.
   d. Lawler Manufacturing Company, Inc.; Prepiped 802 Hi-Low Tempered water Mixing System.
   e. Leonard Valve Company.
   f. Symmons Industries, Inc.
   g. Watts Water Technologies, Inc.; Powers Division.
   h. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Description: Completely assembled and tested prepiped manifold system including mixing valve(s), recirculation pump, circuit setting balancing valve, aquastat, circulator switch box, thermometers, isolation valves, mounting strut, and test connection.
3. Standard: ASSE 1017.
4. Mixing Valve: Exposed-mounting, thermostatically controlled water mixing valve.
   a. Material: Bronze body with corrosion-resistant interior components.
   b. Connections: Threaded union inlets and outlet.
   c. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
   d. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
   e. Size, Settings, and Capacities: As scheduled on the drawings.
   f. Valve Finish: Rough bronze.

2.06 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.

2.07 OUTLET BOXES

A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sioux Chief Manufacturing Company, Inc.; Ox Box.

b. Oatey SCS.

c. Guy Gray Manufacturing Co., Inc.

2. Mounting: Recessed.

3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.

4. Faucet: Combination, valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.

5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.

6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.

7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.

8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.

B. Icemaker Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sioux Chief Manufacturing Company, Inc.; Ox Box.

b. Oatey SCS.

c. LSP Products Group, Inc.

d. Acorn Engineering Company.

2. Mounting: Recessed.
3. Material and Finish: Enameled- or epoxy-painted-steel or Stainless-steel box and faceplate.
4. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
5. Supply Shutoff Fitting: NPS 1/2 gate, globe, or ball valve and NPS 1/2 copper, water tubing.

2.08 **HOSE BIBBS**

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Chrome or nickel plated.
9. Finish for Service Areas: Chrome or nickel plated.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.09 **WALL HYDRANTS**

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company.
    b. MIFAB, Inc.
    c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    d. Tyler Pipe; Wade Div.
    e. Watts Water Technologies, Inc.; Watts Regulator co.
    f. Woodford Manufacturing Company.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.21.3M for self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.

7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
10. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MIFAB, Inc.
b. PPP Inc.
c. Sioux Chief Manufacturing Company, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AMTROL, Inc.
b. Josam Company.
c. MIFAB, Inc.
d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.11 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.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

H. Install water hammer arresters in water piping according to PDI-WH 201.

I. Install air vents at high points of water piping

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

SECTION 22 1123 - DOMESTIC WATER CIRCULATION PUMPS

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 Packaged Booster Pumps" for booster systems.
4. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”
5. Division 33 Section "Water Supply Wells" for well pumps.

1.02 DEFINITIONS

A. PEI: Pump Energy Index as defined by the Department of Energy.

B. PEI_{CL}: Pump Energy Index – Constant Load, as defined by the Department of Energy.

C. PEI_{VL}: Pump Energy Index – Variable Load, as defined by the Department of Energy.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.

1. Constant load pumps supplied shall bear the acceptable PEICL index.

2. Variable load pumps supplied with variable speed controls shall bear the acceptable $PEIv_L$ index.

3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.

D. 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.

E. 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.

F. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

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 **CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS (SMALL)**

A. Manufacturers:

1. Armstrong Pumps Inc.

2. Bell & Gossett; Xylem Inc.; Series PL.

3. Grundfos Pumps Corp.

4. Taco, Inc.; Series 1400.

B. Description: Factory-assembled and –tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; and designed for installation with pump and motor shafts mounted horizontally.

1. Pump Construction: All bronze.

a. Casing: Radially split, bronze, with threaded companion-flange connections.

b. Impeller: Glass-reinforced corrosion-resistant material; keyed to shaft.

c. Shaft: High-strength alloy steel.

d. Seal: Mechanical, carbon/silicon carbide seal.

e. Bearings: Permanently oil-lubricated type.

2. Motor-Single speed, with oil-lubricated bearings, unless otherwise indicated; and directly mounted to pump casing. Comply with requirements in Division 20 Section “Motors.”

C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.03 **CONTROLS**

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Manufacturers:

a. Honeywell International, Inc.; Aquastat.

b. Johnson Controls, Inc.

c. Schneider Electric USA, Inc.

d. Siemens Industry, Inc.; Building Technologies Division.

e. White-Rodgers Div.; Emerson Electric Co.

2. Type: Strap-on sensor, with suitable removable spring clip attaching thermostat to hot-water circulation piping.

3. Range: 65 to 200 deg F.

4. Operation of Pump: On or off.

5. Transformer: Provide if required.

6. Power Requirement: 24 V, ac or 120 V, ac.

7. Settings: Start pump at 110 deg F and stop pump at 130 deg F.

2.04 **FLEXIBLE CONNECTORS**

A. Refer to Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

2.05 **BUILDING-AUTOMATION-SYSTEM INTERFACE**

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.

2. Alarm status.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.02 **PUMP INSTALLATION**

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping. Do not use pump motors as a support point.

D. Install centrifugal pumps with motor and pump shafts horizontal.

E. Install continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 20 Section "Mechanical Vibration

Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 20 Section "Hangers and Supports."

F. Suspend vertically mounted, in-line centrifugal pumps independent of piping. Install pumps with motor and pump shafts vertical. Use continuous-thread hanger rods and spring hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 20 Section "Mechanical Vibration Controls." Hanger and support materials are specified in Division 20 Section "Hangers and Supports."

3.03 CONTROL INSTALLATION

A. Install thermostats in hot-water return piping.

B. Install timers where indicated on Drawings.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 22 Section "Domestic Water Piping."

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
    a. Separately coupled, in-line centrifugal pumps.
    b. Separately coupled, horizontally mounted, in-line centrifugal pumps.
    c. Close-coupled, horizontally mounted, in-line centrifugal pumps.
    d. Close-coupled, vertically mounted, in-line centrifugal pumps.
2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 20 Section "Valves" for general-duty valves for domestic water piping and Division 22 Section "Domestic Water Piping Specialties" for strainers.
3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 20 Section "Meters and Gages" for pressure gages and gage connectors.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. Connect thermostats to pumps that they control.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
    a. Verify bearing lubrication.

b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.

7. Start motor.

8. Open discharge valve slowly.

9. Adjust temperature settings on thermostats.

10. Adjust timer settings.

3.06 **DEMONSTRATION**

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

END OF SECTION

SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

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 "Sewage Pumps."
5. 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.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group; SD 4000.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.
   d. Norma Group; Clamp-All Products; HI-TORQ 125.
2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 **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 **DUCTILE-IRON PIPE AND FITTINGS**

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Flanges: ASME 16.1, Class 125, cast iron.

2.06 **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.

2.07 **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.

2.08 **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. Sovent Drainage System: Comply with ASSE 1043 and sovent fitting manufacturer's written installation instructions.
3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

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.
3. NPS 4 and NPS 5: 60 inches with 5/8-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.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and NPS 8: 12 feet with 3/4-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.
4. NPS 6: 10 feet with 5/8-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.
5. NPS 6: 10 feet with 5/8-inch rod.
6. NPS 8: 10 feet with 3/4-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.
4. NPS 6 and NPS 8: 48 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 48 inches with 7/8-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

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PUR: Polyurethane plastic.

H. PVC: Polyvinyl chloride plastic.

1.03 **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 Floor Cleanouts (Not-On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. MIFAB, Inc.; C-1100-C-R-34.
    c. Sioux Chief Manufacturing Company, Inc.
    d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 4333C.
    e. Tyler Pipe; Wade Div.
    f. Watts Drainage Products Inc.
    g. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M.
3. Type: Adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Spigot.
7. Closure: Brass, bronze, or plastic plug with tapered threads.
8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.

9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

E. Cast-Iron Wall Cleanouts (Finished Wall Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company; Josam Div.; Model 58790-20.
   b. MIFAB, Inc.; C1460-RD.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.
5. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
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.

B. Cast-Iron Floor Drains (Showers) FD-2:

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: 5 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.

C. Cast-Iron Floor Drains (Mechanical Rooms, Electrical Rooms, and Penthouses) FD-3:

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 2142.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. 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. Sediment Bucket: 3-3/4 inches deep, slotted sediment bucket with lift bar.
10. Top or Strainer Material: Cast-iron.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area. Provide partial grate where required to accept equipment drains.
13. Top Loading Classification: Heavy Duty.
14. Outlet 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 AIR-ADMITTANCE VALVES

A. Fixture Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Ayrlett, LLC.
    b. Durgo, Inc.
    c. Oatey.
    d. ProSet Systems Inc.
    e. RectorSeal.
    f. Studor, Inc.
2. Standard: ASSE 1051, Type A for single fixture or Type B for branch piping.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected fixture or branch vent piping.

2.05 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Acorn Engineering Company; Elmdor/Stoneman Div.
    b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 6 inches from pipe, with boot reinforcement and counterflashing fitting.

1. Open-Top Vent Cap: Without cap.
2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
3. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.06 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.

b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.

2. Standard: ASSE 1072-2007.

3. Sealing Element: Neoprene rubber or chemically resistant elastomer.

4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.

5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.07 ROOF DRAINS

A. Metal Roof Drains RD-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 1015/1074.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4

3. Pattern: Roof drain.

4. Body Material: Cast iron.

5. Dimensions of Body: Minimum 10 inch diameter body.

6. Combination Flashing Ring and Gravel Stop: Required.

7. Flow-Control Weirs: Not required.

8. Outlet: Bottom unless otherwise noted.

9. Dome Material: Cast iron, or ductile iron.

10. Extension Collars: Required.

11. Underdeck Clamp: Required.

12. Sump Receiver: Required.

B. Metal Secondary Roof Drains ORD-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 1015/1074.

d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.

f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4

3. Pattern: Roof drain.

4. Body Material: Cast iron.

5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
7. Flow-Control Weirs: Not required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
10. Extension Collars: Required.
11. Underdeck Clamp: Required.
12. Sump Receiver: Required.
13. Standpipe: Cast iron. 2 inches high where overflow drains are indicated.

2.08 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Hub Outlets:

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping.

B. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

D. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

E. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

F. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Expansion Joints:

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

H. Conductor Nozzles DNZ-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 1770-NB-BS.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.; RD-940-83.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Description: Bronze body with threaded inlet, bronze wall flange with mounting holes, and bird screen.
3. Size: Same as connected conductor.

2.09 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.
2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.10 GREASE INTERCEPTORS

A. Grease Interceptors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

~~a. Josam Company; Josam Div.~~

b. Lowe Engineering; a div. of Highland Tank & Manufacturing Co., Inc.

c. MIFAB, Inc.

~~d. Schier Products Company.~~

e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.

f. **Tyler Pipe; Wade Div.**

~~g. Watts Drainage Products Inc.~~

~~h. Zurn Plumbing Products Group.~~ ****ADD2****

2. Standard: ASME A112.14.3, for intercepting and retaining fats, oils, and greases from food-preparation or -processing wastewater.

3. Plumbing and Drainage Institute Seal: Required.

4. Body Material: Stainless steel.

5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.

6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.

7. Body Extension: As required.

8. Size and Capacities: As indicated on the drawings.

9. Cleanout: Integralor field installed on outlet.Mounting: Recessed, flush with floor.

11. Flow-Control Fitting: Required.

12. Operation: Manual cleaning.

2.11 SOLIDS INTERCEPTORS

A. Solids Interceptors:

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.

d. Striem.

e. Tyler Pipe; Wade Div.

f. Watts Drainage Products Inc.

g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Type: Factory-fabricated interceptor made for removing and retaining sediment from wastewater.

3. Body Material: Cast iron, steel, or polypropylene.
4. Interior Separation Device: Screens.
5. Interior Lining: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
6. Exterior Coating: Corrosion-resistant enamel for cast iron or steel bodies. Not required for polypropylene bodies.
7. Size and Capacities: As indicated on the drawings.
8. Mounting: Above floor.

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 fixture air-admittance valves on fixture drain piping.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.

2. Position roof drains for easy access and maintenance.

I. Assemble open drain fittings and install with top of hub 2 inches above floor.

J. Install deep-seal traps on floor drains and other waste outlets, if indicated.

K. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.

L. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

M. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

N. Install vent caps on each vent pipe passing through roof.

O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

P. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

Q. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.

2. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

R. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction. Install control panel adjacent to unit, unless otherwise indicated.

S. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

T. Install wood-blocking reinforcement for wall-mounting-type specialties.

U. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

V. 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.

W. 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

SECTION 22 1413 - STORM DRAINAGE PIPING

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 "Sump Pumps."
5. Division 33 Section “Storm Utility Drainage Piping” for piping outside building.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. LLDPE: Linear, low-density polyethylene plastic.

C. PE: Polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

E. 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. Storm Drainage Piping: 10-foot head of water.
2. Storm Drainage, Force-Main Piping: 125 psig.

1.04 **SYSTEMS DESCRIPTIONS**

A. Storm drainage 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. Controlled-Flow Storm Drainage System: Include calculations, plans, 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 and "NSF-sewer" for plastic sewer piping.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

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. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.

C. 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.

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.

D. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:

a. ANACO-Husky; McWane Plumbing Group; SD 4000.

b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).

c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.

d. Norma Group; Clamp-All Products; HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 **PVC PIPE AND FITTINGS**

A. Solid-Wall PVC Pipe: Schedule 40, ASTM D 2665, drain, waste, and vent.

1. PVC Socket Fittings: ASTM D 2665, 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.

PART 3 EXECUTION

3.01 **EXCAVATION**

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 **PIPING SYSTEM INSTALLATION**

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 22 Section "Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside 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.

F. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

G. Install underground, copper, force-main tubing according to Copper Development Association's "Copper Tube Handbook."

1. Install encasement on piping according to ASTM A 674 or AWWA C105.

H. 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."

I. 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.

J. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drain 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.

L. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:

1. Building Storm Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

2. Horizontal Storm-Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

M. Install force mains at elevations indicated.

N. Install engineered controlled-flow storm drainage piping in locations indicated.

O. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

P. Install ABS storm drainage piping according to ASTM D 2661.

Q. Install PVC storm drainage piping according to ASTM D 2665.

R. Install underground PVC storm drainage piping according to ASTM D 2321.

S. Install underground ABS storm drainage piping according to ASTM D 2321.

T. 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. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.04 **CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Storm Sewer: To exterior force main or storm manhole.

2. Sump Pumps: To sump pump discharge.

3.05 **FIELD QUALITY CONTROL**

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

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.

3.06 **CLEANING**

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 1429 - SUMP PUMPS

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 “Sewage Pumps” for applications in sanitary drainage systems.

1.02 SUMMARY

A. This Section includes sump pumps and accessories, inside the building, for building storm drainage systems.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of sump pump specified, include certified performance curves with operating points plotted on curves, rated capacities of selected models, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each sump pump to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of sump pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

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.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.08 **COORDINATION**

A. Coordinate size and location of concrete basins. Concrete, reinforcement, and formwork requirements are specified in Division 03.

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 **SUBMERSIBLE SUMP PUMPS**

A. Manufacturers:

1. ABS Pumps, Inc.
2. Bell & Gossett; Xylem Inc.
3. Crane Pumps and Systems; Barnes.
4. EBARA International Corporation; Standard Pump Division.
5. Goulds Pumps; Xylem Inc.
6. Gorman-Rupp Company (The).
7. Grundfos Pumps Corporation.
8. Hydromatic.
9. Little Giant Pump Co.
10. Metropolitan Industries, Inc.
11. Weil Pump Company, Inc.
12. Zoeller Company.

B. Description: Factory-assembled and -tested, duplex, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and Hydraulic Institute HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

C. Casing: Cast iron; with cast-iron inlet strainer, legs that elevate pump to permit flow into impeller, and vertical discharge with companion flange for piping connection.

D. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, semi-open non-clog design, overhung, single suction, keyed and secured to shaft.

E. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and double-mechanical seals.

F. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 20 Section "Motors."

G. Pump Discharge Piping: Factory or field fabricated. Refer to Division 22 Section “Storm Drainage Piping.”

H. Basin Cover: Cast iron or steel with bituminous coating and strong enough to support controls. See Part 2 "Sump Pump Basins" Article for other requirements.

I. Controls:

1. Mount controls in NEMA 250, Type 4X enclosure. Controls shall include: Fused disconnect switches and combination magnetic starters with overload protection for each phase to protect against single phasing. Three phase units shall include control transformer and control circuit fuse.

   a. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.

2. Furnish an automatic alternator with manual on-off switch to change sequence of pump operation on the completion of each pump cycle.

   a. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:

      1) NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

      2) NEMA KS 1, heavy-duty, nonfusible switch.

      3) UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.]

3. Mount three position, hand-off-auto, selector switches and magnetic starter manual reset push-buttons on the control panel door for manual operation and resetting of the magnetic starters.

4. Station shall be furnished with four, single pole, normally-open NON-mercury mechanical float switches with 20 ft. cords, clamps, cord grips, and fasteners for pump off/lead pump on/lag pump on/high-water-alarm operation. The high-water-alarm switch shall be mounted as indicated on the Drawings. System shall be complete with cover mounting bracket. (1-inch diameter support pole by Contractor.)

5. Provide high water alarm switch, complete with actuating mechanism for operation on an electric circuit other than the motor circuit. The switch shall be designed to operate indicated alarm device(s) and one set of spare contacts whenever a predetermined high-water level is reached in the sump. Provide alarm pilot light and alarm bell with silence switch. Mount controls on pedestal on the sump cover plate.

J. Guide-Rail Supports: Include the following for each sump pump:

1. Guide Rails: Vertical pipes or structural members, made of galvanized steel or other corrosion-resistant metal, attached to baseplate and basin sidewall or cover.

2. Baseplate: Corrosion-resistant metal plate, attached to basin floor, supporting guide rails and stationary elbow.

3. Pump Yoke: Motor-mounted or casing-mounted yokes or other attachments for aligning pump during connection of flanges.

4. Movable Elbow: Pump discharge-elbow fitting with flange, seal, and positioning device.

5. Stationary Elbow: Fixed discharge-elbow fitting with flange that mates to movable-elbow flange and support attached to baseplate.
6. Lifting Cable: Stainless Steel; attached to pump and cover at manhole.

2.03 **SUBMERSIBLE ELEVATOR SUMP PIT PUMPS**

A. Manufacturers:
1. ABS Pumps, Inc.
2. Bell & Gossett; Xylem Inc.
3. Crane Pumps and Systems; Barnes.
4. EBARA International Corporation; Standard Pump Division.
5. Goulds Pumps; Xylem Inc.
6. Gorman-Rupp Company (The).
7. Grundfos Pumps Corporation.
8. Hydromatic.
9. Little Giant Pump Co.
10. Metropolitan Industries, Inc.
11. Stancor, Inc.
12. Weil Pump Company, Inc.
13. Zoeller Company.

B. Description: Factory-assembled and -tested, simplex, single-stage, centrifugal, end-suction, submersible, direct-connected sump pumps complying with UL 778 and Hydraulic Institute HI 1.1-1.2 and HI 1.3 for submersible sump pumps.

C. Casing: Cast iron; with cast-iron inlet strainer, or stainless steel; with stainless-steel inlet strainer; legs that elevate pump to permit flow into impeller, and vertical discharge connection suitable for piping.

D. Impeller: Hardened 17-4ph stainless steel, or ASTM A 532/A 532M, abrasion-resistant cast iron; statically and dynamically balanced, semi-open non-clog design, overhung, single suction, keyed and secured to shaft.

E. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings and mechanical seals constructed of silicon carbide.

F. Motor: Hermetically sealed, capacitor-start type, with built-in overload protection; three-conductor waterproof power cable of length required, and with grounding plug and cable-sealing assembly for connection at pump. Comply with requirements in Division 20 Section "Motors."

G. Pump Discharge Piping: Factory or field fabricated.

H. Basin or Pit Cover: Fiberglass grating, or cast iron or steel grating with bituminous coating.

I. Controls:
1. Electrical Characteristics: 115 volts, single phase.
2. Controls housed in NEMA 250, Type 4X enclosure having high decibel warning horn with silencing switch. Controls include:
a. Alarm and separate LED lights for:
1) Power.
2) Overload.
3) Pump run.

4) Interceptor high oil level.

5) Interceptor high liquid level.

6) General alarm.

3. Furnish additional dry contact for remote alarm.

4. Pump Controllers:

a. Three-float system for pump off/pump on/ operation, and high level alarm.

2.04 **SUMP PUMP BASINS**

A. Manufacturer: Sump pump and basin are to be provided by the same manufacturer.

B. Description: Factory fabricated basin with sump, pipe connections, and separate cover.

C. Sump: Fabricate watertight, with sidewall openings for pipe connections.

1. Material: Fiberglass.

2. Reinforcement: Mounting plates for pumps, fittings, and accessories.

3. Anchor Flange: Same material as or compatible with sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

D. Cover: Fabricate with openings having gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Material: Cast iron or steel.

2. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

E. Capacity and Characteristics:

1. Refer to Drawings for capacity and characteristics.

2.05 **BUILDING AUTOMATION SYSTEM INTERFACE**

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.

2. Alarm status.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in of plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.02 **CONCRETE**

A. Install concrete bases of dimensions indicated for pumps and controllers. Refer to Division 20 Section "Basic Mechanical Materials and Methods."

B. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.03 **SUMP PUMP INSTALLATION**

A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earthwork."

B. Install sump pumps according to applicable requirements in Hydraulic Institute HI 1.4.

C. Install pumps and arrange to provide access for maintenance including removal of motors, impellers, couplings, and accessories.

D. Set submersible sump pumps on basin floor. Make direct connections to storm drainage piping.

E. Install sump pump basins and connect to drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install cover so top surface is flush with finished floor.

F. Install packaged, submersible, drainage pump unit basins on floor or concrete base unless recessed installation is indicated. Make direct connections to storm drainage piping.

G. Support piping so weight of piping is not supported by pumps.

3.04 **CONNECTIONS**

A. Piping installation requirements are specified in Division 22 Section "Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to sump pumps to allow service and maintenance.

C. Connect storm drainage piping to pumps. Install discharge piping equal to pump discharge connection size. If pump discharge connection size is different from storm drainage piping size, provide transition from pump discharge piping size to storm drainage piping size. Refer to Division 22 Section “Storm Drainage Piping.”

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **STARTUP SERVICE**

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Disconnect couplings and check motors for proper direction of rotation.
4. Verify that each pump is free to rotate by hand. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

B. Start pumps without exceeding safe motor power:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.

C. Test and adjust controls and safeties.

D. Remove and replace damaged and malfunctioning components.

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.
2. Set field-adjustable switches and circuit-breaker trip ranges as indicated, or if not indicated, for normal operation.

E. 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.

3.06 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION

SECTION 22 3410 - CONDENSING, FUEL-FIRED DOMESTIC WATER HEATERS

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 Section includes the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Breechings, Chimneys, and Stacks.”

1.02 DEFINITIONS

A. LP Gas: Liquefied-petroleum fuel gas.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection

1. Wiring Diagrams: Power, signal, and control systems. Differentiate between manufacturer-installed and field-installed wiring.

B. Product Certificates: For each type of water heater, signed by product manufacturer.

C. Source quality-control test reports.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For water heaters to include in operation and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.06 **QUALITY ASSURANCE**

A. Source Limitations: Obtain same type of water heaters 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 NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

3. Where ASME-code construction is indicated, fabricate and label commercial direct-fired storage water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV, HLW.

D. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

1. ASHRAE 90.1, “Energy Efficient Design of New Buildings except Low-Rise Residential Buildings,” for commercial water heaters.

E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

1.07 **COORDINATION**

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

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 **COMMERCIAL, GAS WATER HEATERS**

A. Commercial, Modulating/Condensing, High-Efficiency, Tank-Type Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.

1. Manufacturer's proprietary design to provide minimum thermal efficiency of 95 percent at optimum operating conditions.

2. Manufacturers:

a. Bock Water Heaters, Inc.; OptiTherm Series

b. Bradford White Corporation; EF Series.

c. Heat Transfer Products, Inc. (HTP); Phoenix Series.

d. Laars Heating Systems; a Subsidiary of Bradford White Corporation; U.H.E. Series.

e. Lochinvar Corporation; Shield and TurboCharger Series.

f. Rheem Water Heating; Triton Series.

g. Smith, A. O. Water Products Company; Cyclone Xi Series.

3. Storage-Tank Construction: ASME-code steel or Type 316L stainless steel with 150-psig minimum working-pressure rating.
    a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
        1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
        2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
    b. Lining for Steel Tanks: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.
4. Factory-Installed, Storage-Tank Appurtenances:
    a. Anode Rod or Impressed Current Cathodic Protection: Required for glass-lined tanks.
    b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
    c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
    d. Insulation: Comply with ASHRAE/IESNA 90.1.
    e. Jacket: Plastic, or steel with enameled finish.
    f. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating.
5. Burner and Heat Exchanger:
    a. Pre-mix power burner and submerged combustion chamber.
    b. Helical or spiral heat exchanger coil.
    c. Comply with ANSI Z21.10.3, UL 795 or approved NRTL requirements for high-efficiency water heaters and for natural-gas fuel.
6. Sealed Combustion/Direct Vent: Combustion air is ducted to the combustion chamber from the outdoors.
7. Temperature Control: Digital display for system monitoring and temperature adjustment.
8. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
9. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.
10. Capacity and Characteristics: Refer to Schedule on Drawings.

B. Commercial, Circulating, High-Efficiency, Gas Water Heaters: Comply with ANSI Z21.10.3/CSA 4.3.
1. Manufacturers:
    a. Lochinvar Corporation; Armor AWH Series with Lock-Temp Storage Tank.
    b. Laars Heating Systems; a Subsidiary of Bradford White Corporation; Summit and Neotherm Series with Custom ASME Jacketed and Insulated Tank.
    c. Smith, A. O. Water Products Company; XP Series with Custom ASME Jacketed and Insulated Tank.

d. Laars Heating Systems; a Subsidiary of Bradford White Corporation; Rheos+ Series with Custom ASME Jacketed and Insulated Tank.

e. Smith, A. O. Water Products Company; XP Plus Series with Custom ASME Jacketed and Insulated Tank.

f. Heat Transfer Products, Inc. (HTP); Elite Premier VWH, EXL VWH, and ModCon VWH.

2. Description: Manufacturer's proprietary design with boiler, storage tank, pump, piping, and controls to provide at least 95 percent thermal efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.

3. Boiler Construction: ASME code with 160-psig working-pressure rating for hot-water-boiler-type water heater.

   a. Modulating, Condensing Heat Exchanger: Stainless steel, built to ASME Section IV requirements.

   b. Connections: Factory fabricated of materials compatible with boiler. Attach to boiler before testing.

      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

4. Boiler Appurtenances:

   a. Insulation: Comply with ASHRAE/IESNA 90.1.

   b. Jacket: Steel with enameled finish.

   c. Burner: For use with finned-tube water heaters and for natural-gas fuel.

   d. Temperature Control: Adjustable, storage tank temperature-control fitting and flow switch, interlocked with circulator and burner.

   e. Safety Control: Automatic, high-temperature-limit cutoff device or system.

   f. Automatic Ignition: Intermittent electronic ignition complying with ANSI Z21.20.

5. Energy Management System Interface: Normally closed dry contacts for enabling and disabling water heater.

6. Support: Leveling legs, certified for installation on combustible floors.

7. Sealed Combustion/Direct Vent: Combustion air is ducted to the combustion chamber from the outdoors.

8. Hot-Water Storage Tank: Connected with piping to circulating pump and water heater.

   a. Construction: According to ASME Boiler and Pressure Vessel Code: Section VIII, steel with 150-psig working-pressure rating.

   b. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

   c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

d. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.

e. Jacket: Steel with enameled finish.

f. Anode Rods: Factory installed, magnesium.

g. Drain Valve: Corrosion-resistant metal complying with ASSE 1005, factory installed.

h. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

9. Circulating Pump: UL 778, all-bronze, centrifugal, overhung-impeller, separately-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3. Include mechanical seals, 125-psig minimum working-pressure rating, and 225 deg F continuous-water-temperature rating.

10. Piping: Copper tubing; copper, solder-joint fittings; and brazed or flanged joints.

11. Capacity and Characteristics: Refer to Schedule on Drawings.

2.03 **EXPANSION TANKS**

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

1. Manufacturers:

a. AMTROL Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett; Xylem Inc.

d. Taco, Inc.

e. Wessels Co.

2. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics: Refer to Schedule on Drawings.

B. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

1. Manufacturers:

a. AMTROL Inc.

b. Armstrong Pumps, Inc.

c. Bell & Gossett; Xylem Inc.

d. Taco, Inc.

e. Wessels Co.

2. Construction:

a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics: Refer to Schedule on Drawings.

2.04 **WATER HEATER ACCESSORIES**

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.

F. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

G. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

H. Flue Side Condensate Neutralizer:

1. Description: Designed to raise the PH level of flue side condensate to near neutral prior to condensate entering the sanitary drainage system.

2. Materials: Neutralizer constructed of PVC pipe and fittings mounted on channel strut base with galvanized or stainless steel clamps and hardware; and charged with calcium carbonate.

3. Manufacturers:

a. Axiom Industries Ltd.; NeutraPal and NeutraPro Series.

b. BKI Industries, Inc.; Acid Neutralizer Kits.

c. J.J.M. Boiler Works; JM Neutralizing Tubes.

d. Neutrasafe Corporation; Neutra-Safe Condensate Neutralizers.

e. Any of the approved water heater manufacturers.

2.05 **SOURCE QUALITY CONTROL**

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

2. Concrete base construction requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

C. Install gas water heaters according to NFPA 54.

D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

H. Install pressure relief valves in water piping for water heaters without storage. Extend commercial-water-heater relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.

J. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.

K. Install pressure gages on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 20 Section "Meters and Gages" for pressure gages.

L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 20 Section "Valves" for general-duty valves and to Division 20 Section "Meters and Gages" for thermometers.

M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

N. Fill water heaters with water.

O. Install expansion tanks with isolation and drain valves. Charge expansion tanks with air.

3.02 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 water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Connect vent to full size of water heater flue outlet. Refer to Division 23 Section "Breechings, Chimneys, and Stacks" for venting materials.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and test. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, confirm proper operation.

3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.04 **DEMONSTRATION**

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

END OF SECTION

SECTION 22 4200 - PLUMBING FIXTURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 22 Section "Emergency Plumbing Fixtures."
5. Division 22 Section "Security Plumbing Fixtures."
6. Division 22 Section "Drinking Fountains and Water Coolers."
7. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
8. Division 22 Section “Drainage Piping Specialties” for floor drains, and specialty fixtures not included in this Section.
9. Division 22 Section "Water Distribution" for exterior plumbing fixtures and hydrants.

1.02 **DEFINITIONS**

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. PVC: Polyvinyl chloride plastic.

G. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 **ACTION SUBMITTALS**

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Diagram power, signal, and control wiring.

B. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components – Lead Content for potable domestic water piping and components.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.

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.

PART 2 PRODUCTS

2.01 **WATER CLOSETS**

A. Water Closets, WC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.; Madera FloWise 16-1/2" Elongated Toilet.
   b. Kohler Co.; Highcliff Ultra K-96057.
   c. Sloan Valve Company.
   d. Zurn Plumbing Products Group.
2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
   a. Style: Flushometer valve.
      1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
      2) Supply Spud Location: Top.
      3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
      4) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
      5) Color: White.
   b. Flushometer: FV-2-1.
   c. Toilet Seat: TS-1.

B. Water Closets, WC-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.; Madera FloWise 16-1/2" Elongated Toilet.
   b. Kohler Co.; Highcliff Ultra K-96057.
   c. Sloan Valve Company.
   d. Zurn Plumbing Products Group.
2. Description: Accessible, floor-mounting, floor-outlet, vitreous-china fixture designed for flushometer valve operation.
   a. Style: Flushometer valve.
      1) Bowl Type: Elongated with siphon-jet design. Include bolt caps matching fixture.
      2) Supply Spud Location: Top.
      3) Height: 16-1/2 to 16-3/4 inches, universal/accessible.
      4) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
      5) Color: White.
   b. Flushometer: FV-2-2.
   c. Toilet Seat: TS-1.

2.02 MANUAL WATER CLOSET FLUSHOMETERS

A. Flushometers, FV-2-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Delany Products.
   c. Delta Faucet Company; 81T201.
   d. Kohler Co.: MACH Series.
   e. Sloan Valve Company.
   f. Zurn Plumbing Products Group.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
   a. Internal Design: Diaphragm or piston operation.
   b. Style: Exposed.
   c. Inlet Size: NPS 1.
   d. Trip Mechanism: Oscillating, low-force ADA compliant lever-handle actuator.
   e. Consumption: 1.28 gal./flush.

f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.03 **BATTERY OPERATED SENSOR WATER CLOSET FLUSHOMETERS**

A. Flushometers, FV-2-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Delany Products.
   c. Delta Faucet Company; 81T201BTA-MMO.
   d. Kohler Co. Wave.
   e. Moen Commercial.
   f. Sloan Valve Company.
   g. Speakman Company.
   h. Zurn Plumbing Products Group.
2. Description: Flushometer for water-closet-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, courtesy flush feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
   a. Internal Design: Diaphragm or piston operation.
   b. Style: Exposed.
   c. Inlet Size: NPS 1.
   d. Trip Mechanism: Battery-operated sensor actuator.
   e. Consumption: 1.28 gal./flush.
   f. Tailpiece Size: NPS 1-1/2 and standard length to top of bowl.

2.04 **URINALS**

A. Urinals, UR-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.; Washbrook Urinal System.
   b. Kohler Co.; Bardon K 4991-ETSS.
   c. Sloan Valve Company.
   d. Zurn Industries, Inc.; EcoVantage.
2. Description: Wall-mounting, back-outlet, ultra-low water consumption, vitreous-china fixture designed for flushometer valve operation.
   a. Type: High efficiency.
   b. Strainer or Trapway: Open trapway with integral trap.
   c. Design Consumption: Operates in the range of 1/8 gal./flush to 1 gal./flush.
   d. Color: White.
   e. Supply Spud Size: NPS 3/4.
   f. Supply Spud Location: Top.
   g. Outlet Size: NPS 2.
   h. Flushometer: FV-1-1.
   i. Fixture Support: Urinal chair carrier.

2.05 **MANUAL URINAL FLUSHOMETERS**

A. Flushometers, FV-1-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Standard Companies, Inc.
   b. Delany Products.
   c. Delta Faucet Company; 81T231.
   d. Kohler Co.; MACH Series.
   e. Sloan Valve Company.
   f. Zurn Plumbing Products Group; Z6003-WS1.

2. Description: Flushometer for urinal-type fixture. Include brass body with corrosion-resistant internal components, non-hold-open feature, control stop with check valve, vacuum breaker, copper or brass tubing, and polished chrome-plated finish on exposed parts.
   a. Internal Design: Diaphragm or piston operation.
   b. Style: Exposed.
   c. Inlet Size: NPS 3/4.
   d. Trip Mechanism: Oscillating, low-force ADA compliant lever-handle actuator.
   e. Consumption: 0.125 gal./flush.
   f. Tailpiece Size: NPS 3/4 and standard length to top of fixture.

2.06 TOILET SEATS

A. Toilet Seats, TS-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bemis Manufacturing Company; 1955SSC/1955SSCT.
      b. Centoco Manufacturing Corp.
      c. Church Seats; 295SSC/295SSCT.
      d. Comfort Seats; a Jones Stephens Brand; Model Number C106SSC.
      e. Ferguson Enterprises, Inc.; ProFlo PFTSCOF2000WH.
      f. Olsonite Seat Company; Model 10SSC/10SSCT.
      g. Plumbtech; Plumbing Technologies, LLC.
      h. Sanderson Plumbing Products, Inc.; Beneke Div.
      i. Zurn Plumbing Products Group; 5955STS-WH.
   2. Description: Toilet seat for water-closet-type fixture.
      a. Material: Molded, solid plastic.
      b. Configuration: Open front without cover.
      c. Size: Elongated.
      d. Hinge Type: SC, self-sustaining, check.
      e. Class: Standard commercial.
      f. Color: White.

2.07 LAVATORIES

A. Lavatories, LAV-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Standard Companies, Inc.; Lucerne Model 0355.012.
      b. Ferguson Enterprises, Inc.; ProFlo PF5504.
      c. Kohler Co.; K 2005 Kingston.
      d. Sloan Valve Company.
      e. Zurn Plumbing Products Group; Z5344.
   2. Description: Accessible, wall-mounting, vitreous-china fixture.
      a. Type: With contoured back and side shields.
      b. Size: 20 by 18 inches rectangular.
      c. Faucet Hole Punching: Three holes, 2-inch centers.
      d. Color: White.
      e. Faucet: LF-1.
      f. Water Temperature Limiting Device: Required.
      g. Drain: Grid.
      h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
         1) Exception: Omit P-trap if hair interceptor is required.
      i. Hair Interceptor: Not required.
      j. Fixture Support: Lavatory with concealed arms.
B. Lavatories, LAV-2:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard Companies, Inc.; Lucerne Model 0355.012.
b. Ferguson Enterprises, Inc.; ProFlo PF5504.
c. Kohler Co.; K 2005 Kingston.
d. Sloan Valve Company.
e. Zurn Plumbing Products Group; Z5344.

2. Description: Accessible, wall-mounting, vitreous-china fixture.
a. Type: With contoured back and side shields.
b. Size: 20 by 18 inches rectangular.
c. Faucet Hole Punching: Three holes, 2-inch centers.
d. Color: White.
e. Faucet: LF-2.
f. Water Temperature Limiting Device: Required.
g. Drain: Grid.
h. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.
1) Exception: Omit P-trap if hair interceptor is required.
i. Hair Interceptor: Not required.
j. Fixture Support: Lavatory with concealed arms.

C. Lavatories, LAV-3:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bradley Corp.
b. Willoughby Industries; WELS-2260.
c. AquaDesign; SLV02-B-60: 60". ****ADD3****
2. Description: Accessible, wall-mounting, multi station lavatory system.
a. Type: Two station solid surface lavatory system.
b. Faucet Hole Punching: One hole per station.
c. Color: Coordinate top material and color with architect.
d. Faucet: LF-1.
e. Water Temperature Limiting Device: Required.
f. Drain: Grid.
g. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.

D. Lavatories, LAV-4:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bradley Corp.
b. Willoughby Industries; WELS-2290.
c. AquaDesign; SLV03-B-90: 90". ****ADD3****
2. Description: Accessible, wall-mounting, multi station lavatory system.
a. Type: Three station solid surface lavatory system.
b. Faucet Hole Punching: One hole per station.
c. Color: Coordinate top material and color with architect.
d. Faucet: LF-1.
e. Water Temperature Limiting Device: Required.
f. Drain: Grid.
g. Drain Piping: NPS 1-1/4 chrome-plated, cast-brass P-trap; NPS 1-1/4, 17 gage tubular brass waste to wall; and wall escutcheon.

2.08 LAVATORY FAUCETS

A. Lavatory Faucets, LF-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.; Heritage Metering Faucet Model 1340.000.
b. Chicago Faucets; Model 333-665VPA.

c. Delta Faucet Company; 86T Series.
d. Geberit Manufacturing, Inc.
e. Kohler Co.
f. Moen Commercial.
g. Speakman Company; Model S-4122-4DP.
h. T & S Brass and Bronze Works, Inc.
i. Zurn Plumbing Products Group; Z81600.

2. Description: Single-control nonmixing faucet, vandal resistant, single hole with escutcheon plate for 4 inch centers.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow: 0.25 gal.
d. Mounting: Deck, concealed.
e. Valve Handle(s): Push button, requiring less than 5 pounds of operating force.
f. Inlet(s): NPS 1/2.
g. Spout Outlet: Vandal resistant aerator.
h. Operation: Self-closing, metering, with replaceable valve cartridge.

B. Lavatory Faucets, LF-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.; Innsbrook Model 6055.205.
b. Chicago Faucets; Model 115.737.21.1.
c. Delta Faucet Company; Model 591-LGHGMHDF.
d. Geberit Manufacturing, Inc.
e. Kohler Co.; K13461 (with K13478-A escutcheon).
f. Moen Commercial.
g. Sloan Valve Company.
h. Speakman Company.
i. Zurn Plumbing Products Group; Z6917.

2. Description: Single hole faucet with escutcheon suitable for 4 inch centers, grid strainer, and no lift rod hole.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Mounting: Deck, concealed.
d. Inlet(s): NPS 1/2.
e. Spout Outlet: Vandal resistant spray, 0.5 gpm.
f. Operation: Sensor/Battery.

2.09 COUNTER-MOUNTING SINKS

A. Sinks, SK-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elkay Manufacturing Co.
b. Franke Consumer Products, Inc., Commercial Div.
c. Just Manufacturing Company.
d. Moen Commercial.

2. Description: Single-bowl, counter-mounting, lay-in stainless-steel sink.
a. Overall Dimensions: 22 inches left to right by 19 inches front to back.
b. Metal Thickness: 18 gage, with sound dampened underside.
c. Bowl:
1) Dimensions: 18 inches by 14 inches by 6 inches deep.
2) Drain: 3-1/2-inch grid.
d. Sink Faucet: SF-1.
e. Water Temperature Limiting Device: Required.

f. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
g. Disposer: Not required.
h. Dishwasher Air-Gap Fitting: Not required.
i. Hot-Water Dispenser: Not required.

B. Sinks, SK-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Elkay Manufacturing Co.
b. Franke Consumer Products, Inc., Commercial Div.
c. Just Manufacturing Company.
d. Moen Commercial.
2. Description: Double-bowl, counter-mounting, lay-in stainless-steel sink.
a. Overall Dimensions: 33 inches left to right by 19 inches front to back.
b. Metal Thickness: 18 gage, with sound dampened underside.
c. Left Bowl:
1) Dimensions: 14 inches by 14 inches by 6 inches deep.
2) Drain: 3-1/2-inch outlet for disposer.
a) Location: Centered in bowl.
d. Right Bowl:
1) Dimensions: 14 inches by 14 inches by 6 inches deep.
2) Drain: 3-1/2-inch grid.
a) Location: Centered in bowl.
e. Sink Faucet: SF-1.
f. Water Temperature Limiting Device: Required.
g. Drain Piping: NPS 1-1/2 chrome-plated, cast-brass P-trap; 17 gage tubular brass waste to wall; and wall escutcheon(s).
h. Disposer: D-1.
i. Dishwasher Air-Gap Fitting: Not required.
j. Hot-Water Dispenser: Not required.

C. Sinks, SK-3:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.; Lakewell Service Sink.
b. Kohler Co.; Bannon K 6718.
c. Zurn Plumbing Products Group; Z5888.
2. Description: Trap-standard- and wall-mounting, enameled, cast-iron fixture with roll-rim with plain back and rim guard on front and sides.
a. Size: 22 by 18 inches.
b. Faucet: Sink SF-2.
c. Drain: Grid with NPS 3 outlet.
d. Trap Standard: NPS 3 enameled, cast iron with cleanout and floor flange.
e. Fixture Support: Required.

2.10 **SERVICE SINKS**

A. Service Sinks, SS-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.; Florwell Cast Iron Service Sink.
b. Kohler Co.; Whitby K 6710.
c. Zurn Plumbing Products Group; Z5850.
2. Description: Floor-mounting, enameled, cast-iron fixture with front apron, raised back, and coated, wire rim guard.
a. Size: 28 by 28 inches.
b. Color: White.

c. Faucet: Sink SF-7.
d. Drain: Grid with NPS 3outlet.

2.11 **SERVICE BASINS**

A. Service Basins; SB-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Engineering Company.
b. Crane Plumbing, LLC; Fiat Products; an American Standard Brand.
c. Florestone Products Co., Inc.
d. Precast Terrazzo Enterprises, Inc.
e. Stern-Williams Co., Inc.
2. Description: Flush-to-wall, floor-mounting, precast terrazzo fixture with rim guard.
a. Shape: Square.
b. Size: 24 by 24 inches.
c. Height: 12 inches.
d. Tiling Flange: Not required.
e. Rim Guard: On all top surfaces.
f. Color: Not applicable.
g. Faucet: SF-3.
h. Drain: Grid with NPS 3 outlet.

2.12 **SINK FAUCETS**

A. Sink Faucets, SF-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Chicago Faucets; No. 895-317.
c. Delta Faucet Company; Model 27C4842.
d. Kohler Co.; K7305-5A.
e. Moen Commercial.
f. Speakman Company; SC-3085.
g. T & S Brass and Bronze Works, Inc.
h. Zurn Plumbing Products Group; Z812A4-140.
2. Description: Sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Mixing Valve: Two handle.
d. Centers: 4 inches.
e. Mounting: Deck.
f. Handle(s): Wrist blade, 4 inches.
g. Operation: Noncompression, manual.
h. Inlet(s): NPS 1/2.
i. Spout Type: 70 to 120-degree restricted gooseneck.
j. Spout Outlet:
1) Aerator.
2) Laminar flow or plain end for patient care areas.
k. Maximum Flow Rate:
1) 1.5 gpm.

B. Sink Faucets, SF-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Chicago Faucets; Model 305-VBCP.
c. Delta Faucet Company; Model 28C2083.

d. Kohler Co.
e. Moen Commercial.
f. Speakman Company; SC5821-PC-LEV-5H-WH.
g. T & S Brass and Bronze Works, Inc.
h. Zurn Plumbing Products Group.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
d. Mixing Valve: Two handle.
e. Centers: 8 inches.
f. Mounting: Back/wall.
g. Handle(s): Lever.
h. Inlet(s): NPS 1/2.
i. Spout Type: Rigid, solid brass with pail hook.
j. Spout Outlet: Hose thread.
k. Vacuum Breaker: Required.
l. Operation: Noncompression, manual.

C. Sink Faucets, SF-7:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. American Standard Companies, Inc.
b. Chicago Faucets; Model 897.
c. Delta Faucet Company; Model 28C2383.
d. Ferguson Enterprises, Inc.; ProFlo PF1118.
e. Kohler Co.
f. Moen Commercial.
g. Speakman Company; SC5811-RCP-LEV-5H-WHK.
h. Symmons Industries, Inc.
i. T & S Brass and Bronze Works, Inc.
j. Zurn Plumbing Products Group.

2. Description: Service sink faucet with stops in shanks, vacuum breaker, hose-thread outlet, and pail hook. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor. Include 5 foot rubber hose and wall mounted hose clamp.
a. Body Material: Commercial, solid brass.
b. Finish: Polished chrome plate.
c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
d. Mixing Valve: Two handle.
e. Centers: 8 inches.
f. Mounting: Back/wall.
g. Handle(s): Lever.
h. Inlet(s): NPS 1/2.
i. Spout Type: Rigid, solid brass with wall brace and pail hook.
j. Spout Outlet: Hose thread.
k. Vacuum Breaker: Required.
l. Operation: Noncompression, manual.

2.13 INDIVIDUAL SHOWERS

A. Individual Showers; SH-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acryline USA, Inc.
b. Aker Plastics Co., Inc.
c. Aqua Bath Company, Inc.
d. Aqua Glass Corporation.
e. Aquatic Industries, Inc.
f. Clarion Bathware.
g. Crane Plumbing, L.L.C./Fiat Products.
h. Jacuzzi, Inc.
i. Kohler Co.
j. LASCO Bathware.
k. Praxis Industries, Inc.; Aquarius Products.
l. Sterling Plumbing Group, Inc.

2. Description: Accessible, PMMA shower enclosure with slip-resistant bathing surface and shower rod with curtain.
a. Size: 60 by 36 inches.
b. Surround: One piece.
c. Color: White.
d. Drain Location: Center.
e. Accessibility Options: Include grab bar and bench.
f. Faucet: Shower SH-1.
g. Drain: Grid, NPS 2.

B. Individual Showers; SH-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acryline USA, Inc.
b. Aker Plastics Co., Inc.
c. Aqua Bath Company, Inc.
d. Aqua Glass Corporation.
e. Aquatic Industries, Inc.
f. Clarion Bathware.
g. Crane Plumbing, L.L.C./Fiat Products.
h. Jacuzzi, Inc.
i. Kohler Co.
j. LASCO Bathware.
k. Praxis Industries, Inc.; Aquarius Products.
l. Sterling Plumbing Group, Inc.

2. Description: Accessible, PMMA shower enclosure with slip-resistant bathing surface and shower rod with curtain.
a. Size: 36 by 36 inches.
b. Surround: One piece.
c. Color: White.
d. Drain Location: Center.
e. Accessibility Options: Include grab bar and bench.
f. Faucet: Shower SH-1.
g. Drain: Grid, NPS 2.

2.14 SHOWER FAUCETS

A. Shower Faucets SH-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Acorn Controls; Morris Group International; SV16.
b. American Standard Companies, Inc.
c. Bradley Corporation.
d. Chicago Faucets.
e. Delta Faucet Company.

f. Kohler Co.; KP15611-4-CP w K304-KS-NA valve.
g. Lawler Manufacturing Co., Inc.
h. Leonard Valve Company.
i. Moen Commercial.
j. Powers; a Watts Water Technologies Co.
k. Speakman Company.
l. Symmons Industries, Inc.
m. Zurn Plumbing Products Group.

2. Description: Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
   a. Body Material: Solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 1.5 gpm, unless otherwise indicated.
   d. Diverter Valve: Not required.
   e. Mounting: Concealed.
   f. Backflow Protection Device for Hand-Held Shower: Required.
   g. Operation: Noncompression, manual.
   h. Antiscald Device: ASSE 1016, integral with mixing valve.
   i. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
   j. Supply Connections: NPS 1/2.
   k. Shower Head Type: Hand held, slide-bar mounted.
   l. Shower Head Material: Metallic with chrome-plated finish.
   m. Spray Pattern: Fixed.
   n. Integral Volume Control: Required.
   o. Temperature Indicator: Integral with faucet.

B. Shower Faucets SH-2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Controls; Morris Group International; SV16.
   b. American Standard Companies, Inc.
   c. Bradley Corporation.
   d. Chicago Faucets.
   e. Delta Faucet Company.
   f. Kohler Co.; KP15611-4-CP w K304-KS-NA valve.
   g. Lawler Manufacturing Co., Inc.
   h. Leonard Valve Company.
   i. Moen Commercial.
   j. Powers; a Watts Water Technologies Co.
   k. Speakman Company.
   l. Symmons Industries, Inc.
   m. Zurn Plumbing Products Group.
2. Description: Single-handle thermostatic and pressure-balance valve. Include hot- and cold-water indicators; check stops; and shower head, arm, and flange. Coordinate faucet inlets with supplies and outlet with diverter valve.
   a. Body Material: Solid brass.
   b. Finish: Polished chrome plate.
   c. Maximum Flow Rate: 2.5 gpm, unless otherwise indicated.
   d. Diverter Valve: Not required.
   e. Mounting: Concealed.
   f. Operation: Noncompression, manual.
   g. Antiscald Device: ASSE 1016, integral with mixing valve.

h. Check Stops: Check-valve type, integral with or attached to body; on hot- and cold-water supply connections.
i. Supply Connections: NPS 1/2.
j. Shower Head Type: Ball joint and head integral with mounting flange.
k. Shower Head Material: Metallic with chrome-plated finish.
l. Spray Pattern: Fixed.
m. Integral Volume Control: Required.
n. Shower-Arm Flow-Control Fitting: 1.5 gpm.
o. Temperature Indicator: Integral with faucet.

2.15 **FIXTURE SUPPLIES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. BrassCraft; a Masco Company.
2. McGuire Mfg. Co., Inc.
3. Any of the approved plumbing fixture manufacturers.

B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.16 **PROTECTIVE SHIELDING GUARDS**

A. Protective Shielding Pipe Covers (PSG-1):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Engineered Brass Co.
b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
c. McGuire Manufacturing Co., Inc.
d. Oatey; Dearborn Safety Series.
e. Plumberex Specialty Products Inc.
f. TCI Products; SG-200BV.
g. TRUEBRO, Inc.
h. Zurn Plumbing Products Group; Z8946-3-NT.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.17 **FIXTURE SUPPORTS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Urinal Supports:
1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

C. Lavatory Supports:
1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Sink Supports:
1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
a. Type I, sink carrier with exposed arms and tie rods.
b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
c. Type III, sink carrier with hanger plate and exposed arms.

2.18 **INTERCEPTORS**

A. Sediment Interceptors:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB Manufacturing Inc.
      c. Smith, Jay R. Mfg. Co.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Description: Manufactured unit with removable screens or strainer and removable cover; designed to trap and retain waste material.
      a. Material: Cast-iron or steel body with acid-resistant lining and coating; or stainless-steel.
      b. Pipe Connections: NPS 1-1/2.

B. Small Capacity Sediment Interceptors:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Josam Company.
      b. MIFAB Manufacturing Inc.
      c. Smith, Jay R. Mfg. Co.; Fig. 8714.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Description: Manufactured unit with removable sediment bucket and removable cover; designed to trap and retain waste material; suitable for installation within casework.
      a. Material: Cast-iron or steel body with acid-resistant lining and coating; or stainless-steel.
      b. Pipe Connections: NPS 1-1/2.

2.19 **DISPOSERS**

A. Disposers, D-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. In-Sink-Erator; a div. of Emerson Electric Co.; Badger 5XP.
   2. Description: Continuous-feed, household type food-waste disposer. Include reset button; wall switch; corrosion-resistant chamber with jam-resistant, cutlery- or stainless-steel grinder or shredder; NPS 1-1/2 outlet; quick-mounting, stainless-steel sink flange; anti-splash guard; and combination cover/stopper. Include cord with grounded plug.
      a. Motor: 115-V ac, 1725 rpm, 3/4 hp with overload protection.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
E. Install wall-mounting fixtures with tubular waste piping attached to supports.
F. Install wall-mounting urinals with PVC-DWV piping from urinal outlet to first change in piping direction.
G. Install counter-mounting fixtures in and attached to casework.
H. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.
I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
    1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.
J. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 20 Section “Domestic Water Piping Specialties.”
K. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
L. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
M. Install protective shielding guards PSG-1 on exposed traps and supplies of lavatories, and sinks used for hand washing.
N. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
O. Install toilet seats on water closets.
P. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
Q. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
R. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
S. Install shower flow-control fittings with specified maximum flow rates in shower arms.
T. Install traps on fixture outlets.
    1. Exception: Omit trap on fixtures with integral traps.
    2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
U. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.
V. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."
W. Set service basins in leveling bed of cement grout. Grout is specified in Division 20 Section "Basic Mechanical Materials and Methods."
X. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.
D. Ground equipment according to Division 26 Section "Grounding and Bonding."
E. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 **FIELD QUALITY CONTROL**

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.05 **ADJUSTING**

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

D. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

E. Install fresh batteries in sensor-operated mechanisms.

3.06 **CLEANING**

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.07 **PROTECTION**

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 22 4500 - EMERGENCY PLUMBING FIXTURES

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 Specialties" for backflow preventers and water filters.
4. Division 22 Section "Drainage Piping Specialties" for floor drains and cleanouts.
5. Division 22 Section "Plumbing Fixtures" for laboratory faucets with integral eyewash.

1.02 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Tepid: Moderately warm.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For emergency plumbing fixtures to include in 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. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. ASSE Standard: Comply with ASSE 1071 “Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment” for emergency mixing valves.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

PART 2 PRODUCTS

2.01 **EYEWASH EQUIPMENT**

A. Eyewash Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Bradley Corporation.
    b. Chicago Faucets.
    c. Encon Safety Products.
    d. Guardian Equipment Co.
    e. Haws Corporation.
    f. Sellstrom Manufacturing Co.
2. Description: Plumbed, adjacent-to-sink, swivel, counter-mounting eyewash equipment.
    a. Capacity: Deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.
    b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open ball valve.
    c. Valve Actuator: Paddle.

B. Eyewash Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Bradley Corporation; Model S19-200B.
    b. Guardian Equipment Co.; G1101.
2. Description: Faucet mounted, chrome-plated brass eyewash unit with twin sprayheads, high-visible plastic pop-off dust caps, faucet adapter, and diverter.
    a. Capacity: Deliver potable water at rate not less than 0.4 gpm for at least 15 minutes.
    b. Valve Actuator: Actuator pin.

2.02 **EYE/FACE WASH EQUIPMENT**

A. Eye/Face Wash Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Bradley Corporation: S19-260.
    b. Encon Safety Products.
    c. Guardian Equipment Co.

d. Haws Corporation.

e. Speakman Company; SE-460.

f. WaterSaver Faucet Co.

2. Description: Plumbed, counter-mounting eye/face wash equipment.

a. Capacity: Deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.

b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.

c. Control-Valve Actuator: Paddle.

d. Receptor: Stainless-steel bowl.

B. Eye/Face Wash Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Encon Safety Products.

b. Guardian Equipment Co.

c. WaterSaver Faucet Co.

2. Description: Plumbed, adjacent-to-sink, swivel, counter-mounting eye/face wash equipment.

a. Capacity: Deliver potable water at rate not less than 3.0 gpm for at least 15 minutes.

b. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.

c. Control-Valve Actuator: Paddle.

2.03 WATER-TEMPERING EQUIPMENT

A. Water-Tempering Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Acorn Controls; Morris Group International; ET71 Series.

b. Armstrong International, Inc. (RADA)

c. Bradley Corporation.

d. Guardian Equipment Co.

e. Haws Corporation.

f. Lawler Manufacturing Co., Inc.; Model 911 E/F.

g. Leonard Valve Company.

h. Powers, a Watts Industries Co.; Model ES 150.

i. Speakman Company.

2. Description: Factory-fabricated, hot- and cold-water-tempering equipment with thermostatic mixing valve.

a. Thermostatic Mixing Valve: Designed to provide 85 deg F tepid, potable water at a single emergency eyewash or eye/face wash fixture, to maintain temperature at plus or minus 5 deg F throughout required 15-minute test period, and in case of unit failure to continue cold-water flow, with union connections, controls, metal piping, and corrosion-resistant enclosure.

2.04 **SOURCE QUALITY CONTROL**

A. Certify performance of emergency plumbing fixtures by independent testing agency acceptable to authorities having jurisdiction.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in for piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **EMERGENCY PLUMBING FIXTURE INSTALLATION**

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Valves are specified in Division 22 Section "General Duty Valves for Plumbing."

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency plumbing fixture.

2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.

E. Install dielectric fitting in supply piping to fixture if piping and fixture connections are made of different metals. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Thermometers are specified in Division 20 Section "Meters and Gages."

G. Install trap and waste to wall on drain outlet of fixture receptors that are indicated to be directly connected to drainage system.

H. Install indirect waste piping to wall on drain outlet of fixture receptors that are indicated to be indirectly connected to drainage system. Drainage piping is specified in Division 22 Section "Sanitary Waste and Vent Piping."

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

J. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment. Identification materials are specified in Division 20 Section "Mechanical Identification."

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment.

C. Connect hot- and cold-water-supply piping to hot- and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

D. Connect cold-water and steam supply and condensate return piping to steam and cold-water-tempering equipment. Connect output from water-tempering equipment to emergency plumbing fixtures.

E. Connect cold water and electrical power to electric heating water-tempering equipment.

F. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary drainage and vent piping.

G. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary or storm drainage piping.

3.04 **FIELD QUALITY CONTROL**

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities and temperatures.

B. Electrical-Component Testing: After electrical circuitry has been energized, test for compliance with requirements.

1. Test and adjust controls and safeties.

C. Repair or replace malfunctioning units. Retest as specified above after repairs or replacements are made.

D. Report test results in writing.

3.05 **ADJUSTING**

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

SECTION 22 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. TDS: Total dissolved solids.

H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.03 ACTION SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For fixtures 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 a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities for fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

E. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 PRODUCTS

2.01 **PRESSURE (ELECTRIC) WATER COOLERS**

A. Water Coolers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Elkay Manufacturing Co.; EZH2O.
    b. Haws Corporation.
    c. Murdock Manufacturing; A Member of Morris Group International.
    d. Oasis Corporation.
2. Description: Accessible, AHRI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult and child mounting height, with bottle filling station.
    a. Cabinet: Single, all stainless steel.
    b. Bubbler: One, flexible or elastomeric overmolded, with adjustable stream regulator, located on each cabinet deck.
    c. Control: Push bar.
    d. Supply: NPS 3/8 with isolation valve.
    e. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
    f. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
        1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
        2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.

g. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:

1) Electronic sensor for no-touch activation.

2) Automatic 20-second shut-off timer.

3) 1.1 gpm flow rate

4) Anti-microbial protected plastic components.

h. Support: Refer to "Fixture Supports" Article.

2.02 **FIXTURE SUPPORTS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **APPLICATIONS**

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 **INSTALLATION**

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.04 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **FIELD QUALITY CONTROL**

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.

2. Report test results in writing.

3.06 **ADJUSTING**

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.07 **CLEANING**

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

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 23 Section “Testing, Adjusting, and Balancing.”

1.02 SUMMARY

A. This Section includes common requirements for fans and air moving equipment.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Fan bearings.
2. V-belt fan drives.
3. Direct drive couplings.

1.04 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. Fan Performance Data: AMCA Standard 210.

C. Sound Power Level Ratings:

1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.

2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.05 **ENVIRONMENTAL REQUIREMENTS**

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

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 **FAN SHAFTS**

A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.03 **FAN POWER TRANSMISSION**

A. V-Belt Type Fan Drives: In accordance with Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer's Association.

B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.

C. Base horsepower rating of drive on minimum pitch diameter of small sheave.

D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.

E. Adjust belt tension in accordance with the manufacturer's recommendations.

F. Perform alignment and final belt tensioning in the presence of the Architect.

2.04 **SHEAVES**

A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.

B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.

C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.

D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.

E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.

F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.05 **V-BELT FAN DRIVES**

A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.

B. Manufacturers:

1. Emerson Power Transmission; Browning.
2. Rockwell Automation; Dodge.
3. T.B. Wood's Incorporated.

2.06 **FAN DRIVE, SHAFT, AND COUPLING GUARDS**

A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.

B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and supplemented. Requirements specified apply to all types of fans.

C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.

D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

E. Centrifugal exhaust fans shall be provided with shaft seals.

2.07 **BELT DRIVE GUARDS**

A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.

B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.08 **V-BELTS**

A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than 0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.

B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.

C. Manufacturers:

1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.

3. T.B. Wood's Incorporated; Classical Cog and Narrow Cog V-Belts.

2.09 V-BELT DRIVE MOTOR BASES

A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.

B. Provide for adjustment of both belt tension and alignment.

2.10 FLEXIBLE COUPLINGS (DIRECT DRIVE)

A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.

B. Manufacturer:

1. Falk Corporation (The).

2.11 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 20 Section "Motors."

2.12 FAN BEARINGS

A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L_{10} minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.

2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L_{10} life requirements.

2.13 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.14 ACCESSORIES

A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.

2.15 AIR INTAKE PROTECTION SYSTEM

A. Provide custom heavy duty commercial grade air intake protection system including mesh filter fabric, fasteners, and installation on equipment.

B. Mesh fabric constructed with one layer of black PVC-coated polyester high-abrasion media, encased in sewn vinyl edge with single or double stitching and attached via stainless steel grommets. Media shall meet NFPA-701 Flame Resistance.

C. Filter shall have less than 0.05 inch wg initial resistance to air flow, depending on filter media and number of layers required.

D. Filter media shall be heat stabilized, shall not shed fibers, absorb moisture or promote bacterial growth.

E. Inherent electrostatic charge of woven polypropylene (BHC) media shall deliver higher particle arrestance efficiency and enhanced ability to capture and hold smaller particles.

F. Customizable to meet equipment air intake, or ventilation inlet and outlet configuration including those requiring pipe and electrical cut-outs, special shapes, and skirting where grommet attachment to the metal enclosure is not possible. Hook and loop, or magnets shall be added to completely seal air bypass.

G. Suppliers:

1. Permatron Corporation; PreVent System Filter Screen (800-882-8012)
2. Air Solution Company; Cottonwood Filter Screens (800-819-2869)
3. Aero Filter, Inc. (248-837-4100)

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.

B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.

C. Refer to individual Division 23 HVAC equipment Sections for additional requirements.

END OF SECTION

SECTION 23 0523 - GENERAL-DUTY VALVES FOR HVAC

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 Section “General-Duty Valves for Plumbing” for plumbing valves.
4. Division 23 Section "Temperature Controls" for control valves and actuators.

1.02 SUMMARY

A. This Section includes valves for general HVAC 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.

1.05 **QUALITY ASSURANCE**

A. ASME Compliance: ASME B31.9 for building services piping valves.

B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

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 HVAC valve applications, use the following:
   1. Throttling Service: Angle, ball, butterfly, or globe valves.
   2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:
   1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for condenser water, heating hot water, steam, and steam condensate services.
   2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
   3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
   4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
   5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
   6. For Steel Piping, NPS 5 and Larger: Flanged ends.
   7. For Grooved-End Systems: Valve ends may be grooved. Do not use for steam or steam condensate piping.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

G. Valve Actuators:
   1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
   2. Gear Drive Operator: For quarter-turn valves NPS 8 anad larger.

3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

H. Extended Valve Stems: On insulated valves.

I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

2.02 **BRONZE BALL VALVES**

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 70-140.
b. Crane Co.; Crane Valves.
c. Hammond Valve.
d. Kitz Corporation; Kitz Valves.
e. Milwaukee Valve Company; Model BA100S.
f. NIBCO INC.; Models S-580-70-66 or T-580-70-66.
g. Watts Water Technologies, Inc.

2.03 **GENERAL SERVICE BUTTERFLY VALVES**

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:
1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.

B. Lug-Style (Single-Flange) Size NPS 2-1/2 through NPS 12, 200-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, Type 416 stainless-steel stem, copper bushing, aluminum-bronze disc, and molded-in EPDM seat (liner).
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
b. Bray International, Inc.
c. DeZurik.
d. Emerson Automation Solutions; Keystone.
e. Forum Energy Technologies; ABZ Valve.
f. Hammond Valve.
g. Milwaukee Valve Company.
h. NIBCO INC.; LD-2000-3/5.
i. Tyco Flow Control; Grinnell Flow Control.
j. Watts Water Technologies.

C. Grooved-End Butterfly Valves with EPDM-Encapsulated, or Electroless Nickel Coated 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. Valve design shall provide bi-directional, bubble tight seal from full vacuum to 300 psig.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ASC Engineered Solutions.
   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 150, 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 300 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model 515.
   f. NIBCO INC.; Models S-433-B or T-433-B.
   g. Watts Water Technologies.

2.05 **IRON SWING CHECK VALVES**

A. Iron Swing Check Valves, General: MSS SP-71.

B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model F-2974.
   f. NIBCO INC.; Model F-918-B.
   g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model F-2970.
   f. NIBCO INC.; Model F-968-B.
   g. Watts Water Technologies.

D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Victaulic Co. of America; 716/716H/779.
b. NIBCO, INC.; Model G-917-W.
c. ASC Engineered Solutions.

2.06 **BRONZE OR STAINLESS STEEL LIFT CHECK VALVES**

A. Class 125, Lift Check Valves with Nonmetallic Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bonomi USA, Inc.; Series S800.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.; Model S-480-Y or T-480-Y.
e. The Wm. Powell Company.
2. Description:
a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 250 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 584 Alloy C844 bronze; or ASTM A351-CF8M stainless steel.
e. Ends: Threaded or Solder.
f. Disc: PTFE, or TFE.

2.07 **SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES**

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.
B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model W-910-B.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.
C. Class 250, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 400 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model W-960-B.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.
D. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 200 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. NIBCO INC.; Model F-910-B.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.
E. Class 250, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 400 psig CWP rating.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-960-B.
b. Mueller Steam Specialty.
c. Milwaukee Valve Company.
d. Hammond Valve.

2.08 **BRONZE GLOBE VALVES**

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 150, 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 300 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company; Model 590.
   e. NIBCO INC.; Models S-235-Y or T-235-Y.
   f. Watts Water Technologies, Inc.

2.09 **CAST-IRON GLOBE VALVES**

A. Cast-Iron Globe Valves, General: MSS SP-85 with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

B. Class 125, Metal Seat, Cast-Iron Globe Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Valves.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model F-2981.
   f. NIBCO INC.; Model F-718-B.
   g. Watts Water Technologies, Inc.

2.10 **BRONZE ANGLE VALVES**

A. Bronze Angle Valves, General: MSS SP-80, with silicon bronze stem, non-asbestos packing and malleable-iron handwheel.

B. Class 150, Bronze Angle Valves: ASTM B 62 bronze body with TFE disc, union-ring bonnet, threaded ends, and having 300-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Crane Co.; Crane Valves.
   b. Crane Co.; Stockham Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company; Model 595T.
   e. NIBCO INC.; Model T-335-Y.
   f. The Wm. Powell Company.

2.11 **CAST-IRON ANGLE VALVES**

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. NIBCO INC.; Model F-818-B.
b. Crane Co.; Stockham Valves.
c. Crane Co.; Crane Valves.

2.12 **DRAIN VALVES**

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Bronze ball valve as specified in this Section.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.13 **CHAINWHEEL ACTUATORS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

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 23 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 4and 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

SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

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. Hydronic Piping Systems:
   a. Constant-flow systems.
   b. Variable-flow systems.
   c. Primary-secondary systems.

3. HVAC equipment quantitative-performance settings.
4. Kitchen hood airflow balancing.
5. Exhaust hood airflow balancing.
6. Space pressurization testing and adjusting.
7. Verifying that automatic control devices are functioning properly.
8. Reporting results of activities and procedures specified in this Section.

B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 **DEFINITIONS**

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
B. AHJ: Authority having jurisdiction.
C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
F. NC: Noise criteria.
G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
H. RC: Room criteria.
I. Report Forms: Test data sheets for recording test data in logical order.
J. 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 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set system controls so automatic valves are wide open to heat exchangers.
   6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.08 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.

G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

H. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

3.09 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance variable-flow hydronic systems by following the “Proportional Balancing Procedure” in accordance with NEBB.

B. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR HEAT EXCHANGERS

A. Measure water flow through all circuits.

B. Adjust water flow to within specified tolerances.

C. Measure inlet and outlet water temperatures.

D. Record inlet steam pressure.

E. Record settings of safety and relief valves.

3.12 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
2. Motor horsepower rating.
3. Motor rpm.
4. Efficiency rating.
5. Power factor.
6. Nameplate and measured voltage, each phase.
7. Nameplate and measured amperage, each phase.
8. Starter size.
9. Starter thermal-protection-element rating.
10. Fuse number and size.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

A. Electric-Heating Coils: Measure the following data for each coil:
   1. Nameplate data.
   2. Airflow.
   3. Entering- and leaving-air temperature at full load.
   4. Voltage and amperage input of each phase at full load and at each incremental stage.
   5. Calculated kilowatt at full load.
   6. Fuse or circuit-breaker rating for overload protection.

3.14 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.

3.15 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.

B. After balancing is complete, do the following:
   1. Measure and record the static pressure at the hood exhaust-duct connection.
   2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
   3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
   1. Check duct slopes as required.
   2. Verify that duct access is installed as required.
   3. Verify that point of termination is as required.
   4. Verify that duct air velocity is within the range required.
   5. Verify that duct is within a fire-rated enclosure.

D. Report deficiencies.

3.16 PROCEDURES FOR EXHAUST HOODS

A. Measure, adjust, and record the airflow of each exhaust hood. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, explain why, in the report, and explain the test method used.

B. After balancing is complete, do the following:
   1. Measure and record the static pressure at the hood exhaust-duct connection.
   2. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to achieve optimum results.

3.17 **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.

3.18 **TOLERANCES**

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Air handling equipment and outlets: Plus or minus 5 percent.
    a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
2. Heat Pump Loop-Water Flow Rate: 0 to plus 5 percent.

3.19 **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.

3.20 **FINAL REPORT**

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
   1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:
   1. Pump curves.
   2. Fan curves.
   3. Manufacturers' test data.
   4. Field test reports prepared by system and equipment installers.
   5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
   1. Title page.
   2. Name and address of TAB firm.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB firm who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
   11. Summary of contents including the following:
      a. Indicated versus final performance.
      b. Notable characteristics of systems.
      c. Description of system operation sequence if it varies from the Contract Documents.
   12. Nomenclature sheets for each item of equipment.
   13. Notes to explain why certain final data in the body of reports varies from indicated values.
   14. Test conditions for fans and pump performance forms including the following:
      a. Settings for outside-, return-, and exhaust-air dampers.
      b. Conditions of filters.
      c. Cooling coil, wet- and dry-bulb conditions.
      d. Face and bypass damper settings at coils.
      e. Fan drive settings including settings and percentage of maximum pitch diameter.
      f. Inlet vane settings for variable-air-volume systems.
      g. Settings for supply-air, static-pressure controller.
      h. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
   1. Quantities of outside, supply, return, and exhaust airflows.
   2. Water flow rates.
   3. Terminal units.
   4. Balancing stations.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
   1. Unit Data: Include the following:
      a. Unit identification.
      b. Location.
      c. Make and type.
      d. Model number and unit size.
      e. Manufacturer's serial number.

f. Unit arrangement and class.
g. Discharge arrangement.
h. Sheave make, size in inches, and bore.
i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
j. Number of belts, make, and size.
k. Number of filters, type, and size.

2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Power factor efficiency.

3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Preheat coil static-pressure differential in inches wg.
g. Cooling coil static-pressure differential in inches wg.
h. Heating coil static-pressure differential in inches wg.
i. Outside airflow in cfm.
j. Return airflow in cfm.
k. Outside-air damper position.
l. Return-air damper position.
m. Vortex damper position.

G. Apparatus-Coil Test Reports:
1. Coil Data:
a. System identification.
b. Location.
c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft.
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Average face velocity in fpm.
c. Air pressure drop in inches wg.
d. Outside-air, wet- and dry-bulb temperatures in deg F.
e. Return-air, wet- and dry-bulb temperatures in deg F.
f. Entering-air, wet- and dry-bulb temperatures in deg F.
g. Leaving-air, wet- and dry-bulb temperatures in deg F.
h. Water flow rate in gpm.
i. Water pressure differential in feet of head or psig.
j. Entering-water temperature in deg F.

k. Leaving-water temperature in deg F.

H. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Make and type.
   d. Model number and unit size.
   e. Manufacturer's serial number.
   f. Fuel type in input data.
   g. Output capacity in Btuh.
   h. Ignition type.
   i. Burner-control types.
   j. Motor horsepower and rpm.
   k. Motor volts, phase, and hertz.
   l. Motor full-load amperage and service factor.
   m. Sheave make, size in inches, and bore.
   n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
   a. Total airflow rate in cfm.
   b. Entering-air temperature in deg F.
   c. Leaving-air temperature in deg F.
   d. Air temperature differential in deg F.
   e. Entering-air static pressure in inches wg.
   f. Leaving-air static pressure in inches wg.
   g. Air static-pressure differential in inches wg.
   h. Low-fire fuel input in Btuh.
   i. High-fire fuel input in Btuh.
   j. Manifold pressure in psig.
   k. High-temperature-limit setting in deg F.
   l. Operating set point in Btuh.
   m. Motor voltage at each connection.
   n. Motor amperage for each phase.
   o. Heating value of fuel in Btuh.

I. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:
   a. System identification.
   b. Location.
   c. Coil identification.
   d. Capacity in Btuh.
   e. Number of stages.
   f. Connected volts, phase, and hertz.
   g. Rated amperage.
   h. Airflow rate in cfm.
   i. Face area in sq. ft.
   j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
   a. Heat output in Btuh.
   b. Airflow rate in cfm.
   c. Air velocity in fpm.

d. Entering-air temperature in deg F.
e. Leaving-air temperature in deg F.
f. Voltage at each connection.
g. Amperage for each phase.

J. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Motor Data:
a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

K. 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.

L. 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.

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:
a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.

2. Test Data (Indicated and Actual Values):
a. Inlet-duct static pressure in inches wg.
b. Outlet-duct static pressure in inches wg.
c. Entering-air, dry-bulb temperature in deg F.
d. Leaving-air, dry-bulb temperature in deg F.
e. Condenser entering-water temperature in deg F.
f. Condenser leaving-water temperature in deg F.
g. Condenser-water temperature differential in deg F.
h. Condenser entering-water pressure in feet of head or psig.
i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Voltage at each connection.
m. Amperage for each phase.
n. Kilowatt input.
o. Crankcase heater kilowatt.
p. Number of fans.
q. Condenser fan rpm.
r. Condenser fan airflow rate in cfm.
s. Condenser fan motor make, frame size, rpm, and horsepower.
t. Condenser fan motor voltage at each connection.
u. Condenser fan motor amperage for each phase.

N. Heat-Exchanger/Converter Test Reports: For steam and hot-water heat exchangers, include the following:

1. Unit Data:
a. Unit identification.
b. Location.
c. Service.
d. Make and type.
e. Model and serial numbers.
f. Ratings.

2. Steam Test Data (Indicated and Actual Values):

a. Inlet pressure in psig.
b. Condensate flow rate in lb/h.

3. Primary Water Test Data (Indicated and Actual Values):
   a. Entering-water temperature in deg F.
   b. Leaving-water temperature in deg F.
   c. Entering-water pressure in feet of head or psig.
   d. Water pressure differential in feet of head or psig.
   e. Water flow rate in gpm.
4. Secondary Water Test Data (Indicated and Actual Values):
   a. Entering-water temperature in deg F.
   b. Leaving-water temperature in deg F.
   c. Entering-water pressure in feet of head or psig.
   d. Water pressure differential in feet of head or psig.
   e. Water flow rate in gpm.

O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and size.
   e. Model and serial numbers.
   f. Water flow rate in gpm.
   g. Water pressure differential in feet of head or psig.
   h. Required net positive suction head in feet of head or psig.
   i. Pump rpm.
   j. Impeller diameter in inches.
   k. Motor make and frame size.
   l. Motor horsepower and rpm.
   m. Voltage at each connection.
   n. Amperage for each phase.
   o. Full-load amperage and service factor.
   p. Seal type.
2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

P. Air-to-Air Heat-Recovery Unit Reports:
1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and type.

e. Model and serial numbers.

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.
3. If fans are an integral part of the unit, include the following for each fan:
   a. Make and type.
   b. Arrangement and size.
   c. Sheave make, size in inches, and bore.
   d. Sheave dimensions, center-to-center, and amount of adjustments in inches.
4. Test Data (Indicated and Actual Values):
   a. Total exhaust airflow rate in cfm.
   b. Purge exhaust airflow rate in cfm.
   c. Outside airflow rate in cfm.
   d. Total exhaust fan static pressure in inches wg.
   e. Total outside-air fan static pressure in inches wg.
   f. Pressure drop on each side of recovery wheel in inches wg.
   g. Exhaust air temperature entering in deg F.
   h. Exhaust air temperature leaving in deg F.
   i. Outside-air temperature entering in deg F.
   j. Outside-air temperature leaving in deg F.
   k. Calculate sensible and total heat capacity of each airstream in MBh.

3.21 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.

3.22 **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

SECTION 23 0933 - TEMPERATURE CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

3. Division 23 Section “Testing, Adjusting, and Balancing.”

1.02 **SUMMARY**

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.03 **DEFINITIONS**

A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012.

B. BAS: Building Automation System

C. CAD: Computer Aided Design.

D. DDC: Direct-digital controls.

E. TC: Temperature Control.

1.04 **SYSTEM DESCRIPTION**

A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc., and all associated control wiring and raceway systems.

B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller or at the remote operator workstation (when applicable for project).

C. Electric thermostats, control valves, dampers, operators, control wiring, etc.

D. Indicating devices, electric and electronic control accessories, and other control system devices.

1.05 **SEQUENCE OF OPERATION**

A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.06 **SUBMITTALS**

A. Submit under Division 20 and 23 provisions of respective project and as supplemented in this section.

B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valves and automated dampers shall be incorporated with the complete temperature controls submittal.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

E. Shop Drawings:

1. Shop drawings shall be done on CAD. Minimum size 11” x 17”.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
3. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.
5. Written sequence of operation for each controlled system.
6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).
7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).
8. Complete bill of materials to identify and quantify all control components.

9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.
10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.
11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.

F. Graphic Displays: One month after TC Shop Drawing submittal, TC Contractor shall submit graphical display backgrounds for preliminary Engineer review. Concept for each floor plan, each system, each terminal unit template. Engineer understands that final representation of graphics may not be available until BAS database is established during course of construction. Thorough graphics review will be conducted by Engineer as part of the TC/BAS acceptance procedure.

G. Design Data: Provide indicated component selection and sizing criteria for the following component categories:

1. Control valves:
    a. Component tag.
    b. Equipment served/function.
    c. Media type.
    d. Design flow rate (GPM).
    e. Design pressure drop (psi), where applicable.
    f. Calculated valve Cv, where applicable.
    g. Selected valve Cv, where applicable.
    h. Resultant pressure drop (psi) with selected valve.
    i. Valve size.
    j. Line size to valve connection (excluding reducers).
    k. Type (ball, butterfly, globe, etc.).
    l. Configuration (2-way, 3-way mixing, 3-way diverting).
    m. Normal position (normally open, normally closed, floating).
    n. Actuator spring range (where applicable).
    o. Actuator power requirement.
    p. Valve shut-off rating (psi)
    q. Valve body pressure/temperature rating.
    r. Valve manufacturer/model number.
    s. Actuator manufacturer/model number.
2. Dampers:
    a. Component tag.
    b. Equipment served/function.
    c. Overall damper size (inch width x inch height).
    d. Quantity of damper sections with respective size(s):
    e. Material and gauge of thickness.
    f. Mounting orientation (horizontal or vertical).
    g. Blade configuration (parallel or opposed)
    h. Pressure drop (in. w.g.).
    i. Shut-off rating/differential pressure rating (in. w.g.).
    j. Leakage rating (CFM/sq. ft. at 4 in. w.g.).
    k. Normal position (normally open, normally closed, floating).
    l. Actuator spring range (where applicable).
    m. Actuator power requirement.
    n. Actuator torque requirement.
    o. Actuator quantity.

p. Damper manufacturer/model number.
q. Actuator manufacturer/model number.

3. Flow measuring probes - Air:
   a. Component tag.
   b. Equipment served/function.
   c. Duct dimension (inch width x inch height) if applicable.
   d. Fan inlet diameter (inch) if applicable)
   e. Probe quantity.
   f. Probe length (inch).
   g. Flow rate (CFM).
   h. Flow velocity (FPM).
   i. Probe manufacturer/model number.
   j. Transmitter manufacturer/model number.
4. Flow measuring meters - Water:
   a. Component tag.
   b. Equipment served/function.
   c. Pipe size/inside diameter (inch)
   d. Probe length.
   e. Flow rate (GPM).
   f. Flow velocity (FPS).
   g. Probe manufacturer/model number.
   h. Transmitter manufacturer/model number.
5. Flow measuring stations - Air:
   a. Component tag.
   b. Equipment served/function.
   c. Duct dimension (inch width x inch height).
   d. Station dimension (inch width x inch height).
   e. Flow rate (CFM).
   f. Flow velocity (FPM).
   g. Pressure drop (in. w.g.).
   h. Station manufacturer/model number.
   i. Transmitter manufacturer/model number.

H. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

J. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.

K. Project Record Documents: Include the following:
   1. Revise Shop Drawings to reflect actual installation and operating sequences.
   2. Record actual locations of control components, including control units, thermostats, and sensors.
   3. Submit three (3) the electronic files for all as-built shop drawings in pdf format on USB Flash Drives.

L. Software and Firmware Operational Documentation: Include the following:
   1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
   2. Device address list.

3. Program Software Backup: On a magnetic media or compact disc, complete with data files.

M. Maintenance Manuals: Include the following:
1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.07 **REFERENCES**

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
C. ANSI/ASTM B32 - Solder Metal.
D. ANSI/NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
E. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
F. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.
G. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.
H. ASTM E1 - Specification for ASTM Thermometers.
I. MMC – Michigan Mechanical Code, version applicable for project.
J. NEMA DC 3 - Low-Voltage Room Thermostats.
K. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.08 **QUALITY ASSURANCE**

A. Installer Qualifications: An experienced installer who is an authorized representative and certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.
B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.
C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
D. Comply with all applicable code requirements for project.

1.09 **DELIVERY, STORAGE, AND HANDLING**

A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 **COORDINATION**

A. Coordinate work under Division 20 and 23 provisions and as supplemented in this section.
B. Coordinate location of space temperature sensors, space humidity sensor, thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.
D. Ensure installation of components is complementary to installation of similar components in other systems.
E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.
F. Coordinate equipment with Division 26 Section "Lighting Controls" to achieve compatibility with equipment that interfaces with that system.
G. Coordinate equipment with Division 28 Section "Fire Alarm" to achieve compatibility with equipment that interfaces with that system.

H. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.

I. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 23 Section "Testing, Adjusting and Balancing."

1.11 **WARRANTY**

A. Provide warranty per Division 20 Section "Mechanical General Requirements" and as supplemented in this section.

B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.

C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make one eight-hour service call each month. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 **POSTED OPERATING INSTRUCTIONS**

A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 **SPECIAL TOOLS**

A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, excluding PC laptop.

1.14 **PROTECTION OF PROPRIETARY INFORMATION**

A. Non-disclosure agreement(s) that may be subject to proprietary manuals and software shall be submitted by the proprietary equipment manufacturer to the Owner for approval and signature during the warranty period.

PART 2 PRODUCTS

2.01 **DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)**

A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either through web-browser direct or through server application software (when applicable) or through local or remote Operator Workstation (when applicable to project).

B. Approved Manufacturer – System / Approved Installer (Locations) as listed:

1. Schneider Corp. / Mechanical Controls & Maintenance, Inc. aka MCMI (Sterling Heights, MI).

2.02 **BAS BUILDING NETWORK SUPERVISORY CONTROLLER (PROPRIETARY PLATFORMS)**

A. The Building Network Supervisory Controller shall provide the interface between the Owner's Ethernet and the field control devices and provide global supervisory control functions over the control devices connected to the NSC.

B. The network supervisory controller shall be sized appropriately per building to handle the required quantity of connected controllers and devices.

C. Manufacturers: As listed for in Building Automation System.

2.03 **DDC CONTROLLER SOFTWARE**

A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.

B. Input/Output point processing shall include the following:
   1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
   2. Assignment of proper engineering units and status condition identifiers to all points.
   3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC Input/Output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

C. Command control software shall manage the receipt of commands from control panels, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
   1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
   2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
   3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.
   4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.

D. Provide self-test procedure. Notify remote Operator Workstation (when applicable for project) for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.

E. Alarm Processing
   1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.
   2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.
   3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.
   4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.

5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization
1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.
3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration
1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote, or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.
2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.
3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.
4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:
    a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
    b. Logic: OR, AND, compare, negate.
    c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
    d. Data Manipulation: Store, file and set.
    e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/ software interlock.

H. Building Automation System program applications (as required for controllers)
1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program

shall also work in conjunction with the optimum start and optimum stop application software.

2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.
3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.
4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.
5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.
6. Optimum Start: Warm-Up or Cool-down as required with air terminal units at their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), provide occupancy operation. When occupancy time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program shall work in conjunction with the time scheduling program and/or the optimum start program as required.
7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.
8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50°F, the space temperature is above 75°F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60°F. Purging shall stop when outdoor air is below 50°F, or space temperature is below 75°F, or outdoor temperature is less than 5°F cooler than space temperature, or outdoor air dew point is greater than 60°F.
9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:
    a. By sensing the worst case requirements (E.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.
    b. Adjusting the setpoint in direct proportion to another sensed variable (E.g., reset supply water temperature based on outside temperature).

2.04 **DDC AIR TERMINAL UNIT CONTROLLERS**

A. Microprocessor based controllers capable of stand-alone operation for control of pressure independent air terminal units. Controllers shall be networked together and connected to the building's BAS/DDC network.

B. Controllers shall have separate adjustable minimum and maximum airflow setpoints. Controllers shall work in conjunction with the air handling unit's DDC panel to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal.

C. Provide electronic type air terminal unit damper operators compatible with the controller and the air terminal units provided.

D. Each controller shall have an internal differential pressure transducer capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Velocity sensor shall be furnished by air terminal unit manufacturer.

E. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable

F. TC contractor shall provide 24 VAC power requirements including transformers.

G. If coordinated with mechanical contractor. Controllers and damper operators shall be furnished to the air terminal unit manufacturer for factory mounting by the air terminal unit manufacturer; otherwise, controls shall be field installed.

H. Room temperature sensors for the DDC air terminal unit controllers:

1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be+/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.
2. Cover: with tamper-proof fasteners.
3. Provide with exposed setpoint adjustment dial and exposed temperature reading.
4. Provide with exposed override switch to allow an occupant to reset the space to occupied control during the unoccupied cycle for a predetermined time period.
5. Provide with portable operator unit plug-in port.

2.05 **DDC INPUT/OUTPUT SENSORS**

A. Air Static/Differential Pressure Transmitters:

1. Variable capacitance type with ranges not exceeding 150 percent of maximum expected input. Transmitter shall have zero and span adjustments.
2. Safe overpressure rating shall be minimum 5 times the range.
3. Temperature compensated with thermal error of not greater than 0.04 percent of full scale in temperature range of 40 to 100 deg F.
4. Accuracy: +/- 0.5% of full scale including calibration error, repeatability, hysteresis, and yearly drift.
5. Manufacturers:
   a. Air Monitor.
   b. Belimo.
   c. Dwyer.
   d. Modus.
   e. Setra.

B. Carbon Dioxide Sensors:

1. Carbon dioxide sensing cell shall consist of a nondispersive infrared carbon dioxide gas cell that uses a pulsed source and has no free air optical path. Output shall be linearized 4-20 mA with the 24 VDC input. In addition, the unit shall be capable of providing SPDT switching of an external low voltage circuit at an adjustable setpoint. The unit shall be specifically designed for the wall or duct application specified. Return air aspiration boxes shall be designed by and approved by the manufacturer. Unit shall have single point setpoint and span adjustment. The unit shall have no moving parts.
2. Power for the sensor shall be extended from a transformer or adaptor installed adjacent to the DDC controller enclosure panel, and shall be run parallel to the 4-20 mA signal cable.

3. Minimum sensing range shall be 0-2,000ppm.
4. Overall Accuracy shall be 3% of full scale including calibration error, repeatability, hysteresis and yearly drift.
5. Minimum calibration interval shall be 5 years.
6. Contractor shall provide all necessary equipment and test gas for calibration and shall calibrate all CO_2 sensors in accordance with the manufacturer's recommendations.
7. Manufacturer:
   a. Specified BAS product where available that meets the requirements herein.
   b. Belimo.
   c. TelAire.
   d. Vaisala.
   e. Veris.

C. Current Switches:
1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. For Electronically Commutated Motor (ECM) applications: Current switch shall be rated for ECM operation with amperage trip setting higher than trickle/idle/standby amperage with ECM off and amperage trip setting lower than minimum speed setting. Verify minimum amperage expectation for equipment with equipment suppliers to select appropriate current switch from list of approved manufacturers as their minimum trip settings vary from 0.15A to 0.5A.
3. For induction motor applications (as applicable): Current switch shall have adjustable trip setting to accommodate VFC minimum speed settings, to detect fan belt loss, or to detect pump coupling detachment. Set trip setting at approximately 90% of normal motor operating amperage.
4. Manufacturers:
   a. ACI.
   b. Senva.
   c. Veris Industries.

D. Differential Pressure Transmitters:
1. Transmitters used for measuring differential pressure only:
   a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
   b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
   c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
   d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
   e. Span and zero shall be individually adjustable.
   f. With LCD Display.
   g. Manufacturers:
      1) Belimo.
      2) Dwyer.
      3) Setra.
      4) Veris Industries.

2. Transmitters used for measuring differential pressure only:
   a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches W.C. (for spans less than 200" W.C.) or to the nearest 5 psi for larger spans. Calibration date shall be included on an embossed tag attached to each transmitter.
   b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.
   c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.
   d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.
   e. Span and zero shall be individually adjustable.
   f. Manufacturers:
      1) Tobar.
      2) ITT Barton.
      3) Yokogawa.
      4) Taylor.
      5) Rosemount.
      6) Honeywell Industrial Division.
      7) Foxboro.
      8) SOR.
3. Indication Gauges for Differential Pressure Transmitters:
   a. Each transmitter shall come with an indicating gauge which reads in gpm or inches of water (whichever is the final value desired). The gauge may be either an analog differential pressure gauge piped in parallel to the transmitter or a digital display wired directly to the output of the transmitter.
   b. The analog pressure gauge shall be selected and calibrated for the same span as the transmitter it serves.
   c. The accuracy, including linearity, hysteresis and repeatability, of the gauge for measuring differential pressure shall be better than 3% of the span stated above throughout its span. Calibration data shall be included on an embossed tag attached to each gauge.
   d. The gauge shall not be damaged by pressures of up to 500 psig on either side of the gauge and all wetted parts shall be essentially inert in the presence of up to 40% concentration of ethylene or propylene glycol in water.
   e. Scale shall be a minimum of 4.5" long. Furnish and install two bleed fittings for each gauge and mounting brackets appropriate for the installation location.
4. Three Valve Manifold:
   a. Provide a three-valve manifold for each transmitter. The manifold shall not be damaged by pressures of up to 500 psig and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene glycol in water.
   b. The manifold shall be designed for direct mounting on the transmitter it serves and utilize quarter-turn valves to provide zeroing, blocking and normal service modes.
5. Installation by mechanical contractor: Only hard copper per schedule is allowed for piping.

E. Humidity Sensors:
1. Elements: Thin film or polymer capacitive type or bulk polymer resistance type with linear output, accurate within ± 2% RH throughout the range of 10-95% RH and drift to be less than +/-0.25%.
2. Humidity sensors shall be resistant to chlorine and other cleaning agents.
3. Room Sensors: With locking cover matching space temperature sensors used.

4. Duct Sensors: With duct probe and mounting plate.
5. Manufacturers:
   a. Specified BAS product where available that meets the requirements herein.
   b. Belimo.
   c. GE Industrial, Sensing (formerly General Eastern)
   d. Rotronic.
   e. Vaisala.
   f. Veris – HD/HO Series.

F. Outside Air Temperature/Humidity Combination Transmitters:
1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.
2. Temperature sensor: Refer to Temperature Sensors specifications. Range of operation shall be -25 degrees F to 125 degrees F.
3. Humidity sensor: Refer to Humidity Sensors specifications. Range of operation shall be 0-100% RH.
4. Manufacturer:
   a. Belimo.
   b. Vaisala.
   c. Veris.

G. Temperature Sensors:
1. Resistance temperature detectors (RTD) with 1000 ohm, thin-filmed platinum, nickel or Balco element having 0.000385 temperature coefficient meeting the input requirements of the DDC controller.
2. Thermally sensitive resistors (thermistor) shall be 10k-type, epoxy or glass coated, having NTC characteristic, meeting the input requirements of the DDC controller.
3. Initial calibration accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.
4. Additional error such as repeatability, stability, tolerance, linearity and hysteresis shall not exceed an additional +/- 0.5 deg F additive (using RMS method) throughout the selected operating range for the application.
5. Temperature sensors shall be resistant to chlorine and other cleaning agents
6. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.
7. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.
8. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F
9. Room sensors shall have locking cover and a minimum span of 40 - 90°F.
10. Outside air temperature (only) sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.
11. Manufacturers:
    a. Specified BAS product where available that meets the requirements herein.
    b. ACI – except PT1000 averaging sensor.
    c. BAPI – Basys Series.
    d. Belimo.
    e. MAMAC
    f. Minco.

g. TCS.

2.06 **DDC DATA COMMUNICATIONS NETWORK**

A. Data communication to large equipment controllers shall be by BACnet over IP where possible.

B. Where IP is not available or provided by 3rd party suppliers, data communication network with RS-485 BACnet MS/TP wiring shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.

C. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network though the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

D. Data communications media shall be twisted pair wires.

E. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.

F. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

G. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.

H. Error recovery and communication initialization routines shall be resident in each network connected device.

2.07 **AIRFLOW MEASURING PROBES – DUCT MOUNTED**

A. Duct airflow measuring probes shall contain multiple total and static pressure sensors located along the exterior surface of the probe, designed to compensate for non-axial or turbulent flow.

B. Thermal Dispersion type technology may be used in-lieu of static pressure measurement.

C. Probes shall be constructed of extruded aluminum. Probes shall be provided with mounting plate, gasket, and static and total pressure fittings. Probe and mounting hardware shall facilitate easy removal and reinstallation of the probes.

D. The number of sensors on each probe, and the quantity of probes provided at each location, shall comply with ASHRAE standards for duct traversing. Multiple probes provided at a single location shall be interconnected external to the duct to produce an average signal.

E. For each airflow measurement location, the measured velocity pressure shall have accuracy within ± 2% of the full scale throughout the velocity range of 300-4000 fpm.

F. Each airflow measurement location shall be provided with an air volume gauge, dial and pointer type with diaphragm element. Black letters on white background, 4" diameter, with scale calibrated to permit direct reading of the airflow (in cfm) of the connected airflow measuring station. LCD readout with associated transmitter is acceptable.

G. Manufacturers:

1. Air Monitor Corporation.
2. Farr.
3. Ultratech Industries, Inc.
4. Brandt.
5. Tek-Air Systems, Inc.
6. Ramsey Ventures.
7. Ebtron.

2.08 **CONTROL AND INSTRUMENTATION TUBING**

A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
   1. Fittings: ANSI/ASME B16.22, wrought copper.
   2. Joints: ANSI/ASTM B32, 95-5 tin antimony.

B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
   1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
   2. Joints: Ball Sleeve compression type.

C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.
   1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
   2. Joints: Compression or barbed type.

2.09 **CONTROL VALVES AND VALVE OPERATORS**

A. Pressure Dependent Characterized Ball Valves (2-way & 3-way):
   1. Up to 2 inches: Bronze body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.
   2. Manufacturers:
      a. Belimo.
      b. Bray / Delta Control Products.
      c. Honeywell.
      d. Schneider Electric Controls.
      e. Johnson Controls.
      f. Siemens

B. Globe Valves (2-way & 3-way):
   1. Up to 2 inches: Bronze body, bronze trim, rising stem, renewable composition disc, single seated, screwed ends with backseating capability, repackable under pressure.
   2. Over 2 inches: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, renewable seat and disc, repackable under pressure.
   3. Valve stem packing shall be tetrafluorethylene, spring loaded and self-adjusting. Packless construction is acceptable.
   4. Manufacturers:
      a. Belimo.
      b. Bray / Delta Control Products.
      c. Dodge Engineering & Controls, Inc.
      d. Honeywell.
      e. Schneider Electric Controls.
      f. Johnson Controls.
      g. Siemens.

C. Electric Operators:
   1. Operators shall be electronic type to accept signals from direct digital controller or modulating thermostat for proportional control.
   2. Valves shall spring return to normal position as indicated. Terminal unit tempering coil control valve operators are not required to be spring return.
   3. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.
   4. Select to provide smooth proportioning control under operating conditions normal to the system.

D. Hydronic Systems:
   1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 20 Section “Valves,” and in Division 23 Section “Hydronic Piping.”
   2. Valve minimum temperature ratings shall be 250 deg F.

3. For globe valves: Replaceable plugs and seats of stainless steel or brass, selected for maximum lift under application conditions.
4. Two-way and three- way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.
5. Pressure independent control valves shall be used for 2-way applications unless otherwise indicated. Select to achieve scheduled flow rate of the associated heat transfer device. If the scheduled flow rate is too high to achieve with one valve, provide multiple valves sized at flow divided equally of the scheduled flow rate and control all valves in unison - coordinate control valve quantity and the need for parallel piping of control valves with mechanical contractor.
6. Pressure Drop for pressure dependent characterized ball and globe valves: Select Control valves that result in a pressure drop at or as close as possible to scheduled information. If not scheduled, primary HVAC equipment and terminal equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head (5 psig). TC Contractor shall use control valves that meet the pressure drop requirements from manufacturers listed above.

E. General Service Solenoid Valves:
1. Solenoid valves for reheat coils, radiant ceiling panels and unit heaters shall be 24 VDC, electronic-type, for two-position operation.

F. Natural Gas Solenoid Shutoff Valves:
1. Operation: Direct acting, electric solenoid operated, gas shutoff valve rated to be energized open when in service and closed (de-energized) when the EPO pushbutton is activated. Select valve solenoid coil electrical characteristics based on circuit power being provided. Valve shall be UL recognized component to Standard 429 – Electrically Operated Valves.
2. Description:
   a. Action: Normally closed – energize to open.
   b. Sizing: To close against the system pressure at “line-size.”
   c. Coordinate pipe connection style with the installation contractor.
   d. Heavy-duty assembly.
   e. Body: Brass for copper pipe and stainless steel for ferrous pipe.
   f. Seats and Discs: NBR or PTFE.
   g. Solenoid Enclosure: NEMA 250, Type 4.
3. Manufacturers:
   a. ASCO 2/2 Series Model 200-series Modular.
   b. Honeywell V4295 Series.

2.10 DAMPERS - AUTOMATED

A. Performance: Test in accordance with AMCA 500.
B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.
C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.
D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.
E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.
F. Jamb Seals: Stainless steel.
G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.
I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.
J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
L. Temperature Limits: -40 to 200 deg F.
M. Manufacturers:
1. American Warming & Ventilating.
2. Arrow United Industries.
3. Greenheck.
4. Honeywell.
5. Johnson Controls.
6. Louvers & Dampers, Inc.
7. Ruskin.
8. Tamco.
9. Vent Products.

2.11 **DAMPERS, INSULATED OUTDOOR AIR / RELIEF AIR / EXHAUST AIR - AUTOMATED**

A. Performance: AMCA certified for Air Performance and Air Leakage.
B. Frames: Extruded aluminum, .080-inch thickness minimum, 4 inches deep minimum, thermally broken, and insulated with polystyrene or polyurethane foam insulation.
C. Blades: Extruded aluminum, internally insulated, and thermally broken. Maximum blade size 8 inches wide, 60 inches long.
D. Shafts: Minimum 7/16 inch hexagonal or square corrosion resistant zinc plated steel.
E. Blade Seals: Extruded EPDM, silicone, or synthetic elastomeric, mechanically attached.
F. Jamb Seals: Silicone, or synthetic elastomeric, mechanically attached.
G. Bearings: Dual bearing assembly of durable synthetic polymer resulting in no metal-to-metal contact. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.
H. Linkage: Linkage shall be installed in the frame side and shall be constructed of aluminum and/or corrosion resistant zinc plated steel.
I. Leakage: Less than 3 CFM per square foot at 1 inch W.G. pressure differential at minus 40 deg F.
J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4 inches W.G.
K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.
L. Temperature Limits: Minus 40 to 155 deg F.
M. Manufacturers:
1. Greenheck ICD-45.
2. Ruskin TED50 Series.
3. Tamco Series 9000 BF.

2.12 **DAMPER OPERATORS - ELECTRIC**

A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.
B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.
C. Manufacturers:
1. Belimo.
2. Delta Control Products.
3. Honeywell.
4. Schneider Electric Controls.
5. Johnson Controls.

6. Siemens.

2.13 **DIFFERENTIAL PRESSURE SWITCHES**

A. Shall provide electrical switching action upon a sensed pressure differential increase between two sensed points. Sensitivity shall be suitable for the application. Setpoint shall be adjustable over the full range of the device. Switching action shall open or close two independent single-pole, double-throw (SPDT) switches. Electrical switch rating shall be based on the application and circuit voltage.

B. Pressure rating of switch/connecting tubing and reset type:
   1. Filter pressure drop - Rated for 2 inches w.g. Provide automatic reset type.
   2. Duct static pressure - Rated for 10 inches w.g. Provide manual reset type when used for high limit cutout safety.

2.14 **ELECTRICAL REQUIREMENTS FOR CONTROLS WORK**

A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the requirements of the Division 26 Specifications of respective project.

B. Electrical wiring and conduit shall meet the requirements of the Division 26 Specifications.

C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.

E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.

F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

H. TC Contractor shall provide 24V power supply transformers for TC Contractor provided controllers. Maximum Transformer circuit for controls shall be 100VA serving controllers within mechanical room control panels or for remote terminal unit controllers served from common 24V power supply circuit. Transformers shall be located within enclosures provided by TC Contractor.

2.15 **EMERGENCY POWER-OFF (EPO) PUSH-BUTTON**

A. ADA compliant, push-button switch with clear cover to prevent inadvertent closure. Push-to-activate push-button, and providing two SPDT contacts rated 10 Amps at 120 VAC.

B. Manufacturers:
   1. Safety Technology International – model SS-2212PO
   2. Alarm Controls Corporation – model ADC-100.

2.16 **LIMIT SWITCHES**

A. Oil tight type with operator as required providing required function. Limit switches used on dampers should be set at approximately 75% of full stroke.

B. Manufacturers:
   1. Allen-Bradley.
   2. General Electric.
   3. Square D.
   4. Westinghouse.
   5. Micro-switch.

2.17 **LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS**

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.

B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.

C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.18 **REFERENCE PROBE - DUCT STATIC PRESSURE**

A. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.

B. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.

C. Manufacturers:
1. MAMAC # A-520.
2. Dwyer # A-305.
3. Tek-Air # T-SPP 7100/7200.

2.19 **REFERENCE PROBE - INDOOR STATIC PRESSURE**

A. Indoor pressure reference probe shall be a shielded static pressure sensor suitable for flush mounting in the ceiling, complete with multiple sensing ports, pressure impulse suppression chamber, airflow shielding, control tubing take-off fitting, and brush finish on exposed surface. Probe shall be capable of sensing the static pressure in the proximity of the sensor to within 1% of the actual pressure value while being subjected to a maximum airflow of 1000 fpm from a radial source.

B. Manufacturers:
1. Air Monitor Corporation.
2. Tek-Air.

2.20 **REFERENCE PROBE - OUTDOOR STATIC PRESSURE**

A. Outdoor pressure reference probe shall be constructed of anodized aluminum, with control tubing take-off fitting, which shall be capable of sensing the outside ambient air pressure to within 2% of the actual value when subjected to radial wind velocities up to 80 miles per hour with approach angles up to 30 degrees to the horizontal.

B. Manufacturers:
1. Air Monitor Corporation.
2. Tek-Air.

2.21 **THERMOSTATS – ELECTRONIC & ELECTRIC**

A. Line Voltage Room Thermostats: Adjustable single setpoint with exposed setpoint indicator and exposed thermometer for a range of 55 deg F to 85 deg F with maximum dead band of 1-1/2 degrees F, and locking cover. Contacts shall be rated for load, single-pole or two-pole as required. Provide with integral manual On/Off/Auto selector switch where indicated on control details. Power Requirement: 24 V, ac or 120 V, ac as required.

B. Room Thermostat Accessories:
1. Thermostat Covers: Manufacturers standard with finish as selected by Architect.
2. Insulating Bases: Provide one inch insulating base for thermostats located on exterior walls.
3. Adjusting Key: As required for device.

C. Electric Low Limit Duct Thermostat (freezestat): Snap acting which trips if temperature sensed across any 12 inches of bulb length is equal to or below setpoint, fixed 5 deg F differential, range 30 deg F to 60 deg F, requiring minimum 20 feet length of bulb. Manual-reset unless indicated on drawings to be auto-reset type. Provide one thermostat for every 20 sq ft of coil surface. Switch shall be UL listed and rated for 10 amps at 120 VAC. Provide additional switch or contacts for connection to monitoring system.

D. Electric; strap-on piping type thermostat for control of fans with hot water heating coils. Operation of fan to be Off when temperature is below setpoint as required per control details. Contacts shall be rated for load. Provide transformer for 24 Vac or 120 Vac duty as required

E. Manufacturers for listed Thermostat Types:
1. Honeywell International, Inc.
2. Johnson Controls, Inc.

3. Schneider Electric USA, Inc.
4. Siemens Industry, Inc.; Building Technologies Division.
5. White-Rodgers Div.; Emerson Electric Co.

2.22 **WATER FLOW SWITCHES**

A. UL listed, suitable for all service application conditions. Body minimum working pressure rating shall equal or exceed system pressure rating as noted for each system in Division 22 and 23 piping sections.

B. Manufacturers:
1. ITT.
2. Honeywell.
3. Johnson Controls.

PART 3 EXECUTION

3.01 **INSTALLATION - CONTROL SYSTEMS**

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.

C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.

D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.

E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.

F. Provide conduit and electrical wiring where required.

G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize “wiremold” routing.

H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.

I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.

J. Coil and conceal excess capillary on remote element instruments.

K. Install thermometers in air duct systems on flanges.

L. Install all gauges and thermometers in locations where they are easily read from normal floor level. Provide tubing or wiring as required.

M. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.

N. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.

O. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.

P. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.

Q. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.

R. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.

S. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.

T. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

U. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.02 **TC CONTRACTOR DESIGN & INSTALLATION COORDINATION MEETINGS**

A. Temperature Controls Shop Drawing Pre-submittal Meeting: TC Contractor's option to schedule a meeting at the Engineer's Office to review project design documentation for clarification purposes to aide in the TC Contractor development of TC/BAS shop drawings. For simple clarification items, TC Contractor may contact Engineer via telephone to discuss. For project scope questioning items, TC Contractor shall utilize the formal Request of Information (RFI) process.

B. Temperature Controls Shop Drawing Submittal Meeting: Project Design Engineer's option to schedule a meeting at the Engineer's Office to review the TC Contractor's formally submitted drawings to address Engineer's comments and concerns that indicate TC Contractor's shop drawings vary from project design intent. This meeting can be avoided if TC Contractor's shop drawing submittal is complete and Engineer is confident that documents are going to lead to an installation that meets project design intent.

C. Temperature Controls Installation Technician Meeting: Project Design Engineer's option to schedule a meeting at the project site to meet and discuss project expectations with the TC Contractor's field installation technician and/or project manager. Discussion may include

1. Shop drawing review comments to ensure installation technician has the most up-to-date TC submittal.
2. Graphics generation requirements including special Owner requirements and schedule for completion.
3. Owner training agenda and scheduling.
4. TC/BAS system acceptance procedures.

3.03 **IDENTIFICATION AND MARKING**

A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.

C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.

D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached on the front exterior with panel identification to match details of temperature control submittals and include system(s) served and area(s) served on the labeling. Include labeling near 120VAC terminations within panel identifying power source panel ID and specific circuit breaker used.

3.04 **GRAPHIC DISPLAY GENERATION**

A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:

1. Overall campus layout which shows all of the buildings on the Owner's campus.
2. Individual building layout or isometric for each building connected to the system.
3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler

associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.

4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
   a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
   b. System name.
   c. Area served.
   d. Present value or status of all inputs, along with present setpoint.
   e. Present percent open for each damper, valve, etc. based on commanded position.
   f. Reset schedule parameters for all points, where applicable.
   g. Present occupancy mode.
   h. Present economizer mode, where applicable.
   i. Present outside air temperature.
   j. Associated space conditions and setpoints, where applicable.
   k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
   l. Color coding to indicate normal and abnormal values, alarms, etc.
5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc.) shall be provided. Graphic display of output point auto or manual override status shall be provided.
6. Sequence of operation in written (text) format for each HVAC system.
7. Overall BAS system schematic.
8. System management graphic for each network device and/or DDC controller.

3.05 **OWNER INSTRUCTION AND TRAINING**

A. Provide a minimum of forty (40) hours of combined on-site and classroom instruction and training to the Owner on the operation of the control systems for the initial installation.

B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.

C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

D. Provide 5 sets of computer training & tutorial material on USB Flash Drives describing operator's BAS graphical interface capabilities and functions.

E. Provide 5 sets of literature pertaining to the operation and maintenance of the DDC system components provided.

3.06 **CALIBRATION AND START-UP**

A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.

B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.07 **ACCEPTANCE PROCEDURE**

A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.

B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.

D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION

SECTION 23 1123 - FUEL GAS PIPING

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 SUMMARY

A. This Section includes facility fuel gas piping.

B. Service meter assemblies will be furnished and installed by utility company.

1.03 **DEFINITIONS**

A. Gas Main: Utility's natural gas piping.

B. Gas Distribution: Piping from gas main to individual service-meter assemblies.

C. Service-Meter Assembly: Piping, valves, service regulator, service meter, and specialties.

D. Point of Delivery: Piping outlet from service-meter assembly.

E. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices.

F. PE: Polyethylene.

1.04 **PERFORMANCE REQUIREMENTS**

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: Performance requirements are scheduled on the Drawings.

2. Exception: Fuel Gas Piping Installed within Ceilings Used as Plenums: 150 psig.

1.05 **SYSTEMS DESCRIPTIONS**

A. Fuel gas piping system materials are scheduled on the Drawing.

1.06 **ACTION SUBMITTALS**

A. Product Data: For the following:

1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.

2. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

1.07 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: For fuel gas piping. Include plans and attachments to other work. Show different pressure zones and indicate pressure for each zone.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

1.08 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For natural gas specialties and accessories to include in operation and maintenance manuals.

1. Lubricated Plug Valves: Installation, operation, lubrication, and leak testing procedures.

1.09 **QUALITY ASSURANCE**

A. Electrical Components and Devices: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. NFPA Standard: Comply with NFPA 54, "National Fuel Gas Code."

1.10 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

C. Protect stored PE pipes and valves from direct sunlight.

1.11 **PROJECT CONDITIONS**

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Gas System Pressure: Not more than 5.0 psig.

C. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft.

2. Nominal Specific Gravity: 0.6.

1.12 **COORDINATION**

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's written permission.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

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 **CORRUGATED, STAINLESS-STEEL TUBING SYSTEMS**

A. Description: Comply with ANSI LC 1b/CSA 6.26b and include the following:

1. Tubing: Corrugated stainless steel with plastic jacket or coating.

2. Fittings: Copper alloy with ends made to fit corrugated tubing. Include ends with threads according to ASME B1.20.1 if connection to threaded pipe or fittings is required.

3. Striker Plates: Steel, designed to protect tubing from penetrations.

4. Manifolds: Malleable iron or steel with protective coating. Include threaded connections according to ASME B1.20.1 for pipe inlet and corrugated tubing outlets.

5. Manufacturers:

a. Titeflex Corp.

b. OmegaFlex, Inc.

c. Ward Industries, Inc.

2.03 **BLACK STEEL PIPE AND FITTINGS**

A. Black Steel Pipe: ASTM A 53/A 53M or ASTM A 106; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.

2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.

3. Steel Welding Fittings: ASME B16.9, wrought steel or ASME B16.11, forged steel.
4. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.
5. Cast-Iron Flanges and Flanged Fittings: ASME B16.1, Class 125.
6. Joint Compound and Tape: Suitable for natural gas.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.04 **PE PIPE AND FITTINGS**

A. Manufacturers:
1. Chevron Phillips Chemical Company LLC; Performance Pipe Division; Driscopipe and Driscoflex.
2. Endot Industries, Inc.
3. Mexichem Datacom & Infrastructure; DuraLine; PolyPipe.
4. Oil Creek Plastics.

B. PE Pipe: ASTM D 2513, PE2708 or PE4710, SDR 11.
1. PE Fittings: ASTM D 2683, socket type or ASTM D 3261, butt type with dimensions matching ASTM D 2513, SDR 11, PE pipe.

C. Transition Fittings: Manufactured pipe fitting with one PE pipe end for heat-fusion connection to PE pipe and with one ASTM A 53/A 53M, Schedule 40, steel pipe end for threaded connection to steel pipe.

D. Service-Line Risers: Manufactured PE pipe fitting with PE pipe inlet for heat-fusion connection to underground PE pipe; PE pipe riser section with protective-coated, anodeless, steel casing and threaded outlet for threaded connection to aboveground steel piping.

2.05 **PIPING SPECIALTIES**

A. Flexible Connectors: ANSI Z21.24, copper alloy.

B. Quick-Disconnect Devices: ANSI Z21.41, convenience outlets and matching plug connector.

C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.06 **JOINING MATERIALS**

A. Refer to Division 20 Section “Basic Mechanical Materials and Methods.”

2.07 **SPECIALTY VALVES**

A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 4: Threaded ends according to ASME B1.20.1 for pipe threads; or flanged ends according to ASME B16.5 for steel flanges.

C. Valves, NPS 6 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

D. Natural Gas Valves, NPS 3 and Smaller: Use the following:

1. Ball Valves: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, with chrome-plated brass ball and lever handle; 125-psig minimum pressure rating.
    a. Manufacturers:
        1) Apollo Valve; Conbraco Industries, Inc.
        2) Jomar International Ltd.
        3) Legend Valve and Fitting, Inc.
        4) Milwaukee Valve Company.
        5) NIBCO INC.
        6) Watts Water Technologies, Inc.; Watts Regulator Co.
    b. Tamperproof Feature: Include design for locking.

E. Natural Gas Valves, NPS 4: Use any of the following:

1. Cast-Iron, Eccentric Plug Valves:
    a. Manufacturers:
        1) Homestead Valve; a division of Olson Technologies, Inc.; Keycentric Series 300.
        2) Milliken Valve Company; Mueller Water Products; Model 625.
    b. Approvals: UL approved.
    c. Body: Cast iron, complying with ASTM A 126, Class B.
    d. Plug: Bronze or nickel-plated cast iron.
    e. Stem Seal: Compatible with natural gas.
    f. Resilient Plug Seal: Compatible with natural gas.
    g. Operator: Square head or lug type with tamperproof feature where indicated.
    h. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
    i. Pressure Class: 125 psig.
2. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
    a. Manufacturers:
        1) Flowserve Nordstrom.
        2) Homestead Valve; a division of Olson Technologies, Inc.
        3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.
    b. Body: Cast iron, complying with ASTM A 126, Class B.
    c. Plug: Bronze or nickel-plated cast iron.
    d. Seat: Coated with thermoplastic.
    e. Stem Seal: Compatible with natural gas.
    f. Operator: Square head or lug type with tamperproof feature where indicated.
    g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
    h. Pressure Class: 125 psig.

F. Natural Gas Valves, NPS 6 and Larger: Use any of the following:

1. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
    a. Manufacturers:
        1) Flowserve Nordstrom.
        2) Homestead Valve; a division of Olson Technologies, Inc.
        3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.
    b. Body: Cast iron, complying with ASTM A 126, Class B.
    c. Plug: Bronze or nickel-plated cast iron.
    d. Seat: Coated with thermoplastic.
    e. Stem Seal: Compatible with natural gas.
    f. Operator: Square head or lug type with tamperproof feature where indicated.
    g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
    h. Pressure Class: 125 psig.
2. Class 150, Full-Port, Carbon-Steel Ball Valves:
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Apollo Valve; Conbraco Industries, Inc.; 88A-200-UL Series.
        2) Metso Automation; Jamesbury Valves.
    b. UL listed.
    c. Split-body construction.
    d. Chrome-plated carbon steel ball.
    e. Reinforced PTFE seats.
    f. Lever actuation.

2.08 MOTORIZED GAS VALVES

A. Electrically Operated Gas Valves: UL 429, bronze, aluminum, or cast-iron body solenoid valve; 120-V ac, 60 Hz, Class B, continuous-duty molded coil. Include NEMA ISC 6, Type 4, coil enclosure and electrically opened and closed dual coils. Valve position shall normally be closed.

1. Manufacturers:
    a. ASCO General Controls.
    b. ASCO Power Technologies, LP; Division of Emerson.
    c. Dungs, Karl, Inc.
    d. Eclipse Combustion, Inc.
    e. Goyen Valve Corp.; Tyco Environmental Systems.
    f. Magnatrol Valve Corp.
    g. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
    h. Watts Water Technologies, Inc.

2.09 PRESSURE REGULATORS

A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. Manufacturers:
    a. Line Pressure Regulators:
        1) Elster Gas North America; Elster American Meter.
        2) Fisher Controls International, Inc.; Division of Emerson Process Management.
        3) Itron Gas.
    b. Appliance Pressure Regulators:
        1) Elster Gas North America; Elster American Meter.
        2) Elster Gas North America; Elster Canadian Meter.
        3) Fisher Controls International, Inc.; Division of Emerson Process Management.
        4) Maxitrol Company; 325 Series.
2. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
3. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges.
4. Service Pressure Regulators: ANSI Z21.80. Include 100-psig- minimum inlet pressure rating.
5. Line Pressure Regulators: ANSI Z21.80/GCA 6.22 or ANSI B109.4/CGA 6.18, with inlet pressure rating as scheduled on the Drawings.
    a. Regulators for Generator Sets: Direct operated, fast acting type.
6. Appliance Pressure Regulators: ANSI Z21.18. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 EXECUTION

3.01 EXCAVATION

A. Refer to Division 31 Section “Earthwork” for excavating, trenching, and backfilling.

3.02 EXAMINATION

A. Examine roughing-in for fuel gas piping system to verify actual locations of piping connections before equipment installation.
    1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 PREPARATION

A. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

B. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.

3.04 SERVICE-METER ASSEMBLY INSTALLATION

A. Service meter assembly will be installed by the fuel gas utility company.

3.05 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.
    1. Exterior fuel gas distribution system piping, service pressure regulator, and service meter will be provided by gas utility.

2. Refer to Article entitled “Codes, Permits and Fees” in Division 20 Section “Mechanical General Requirements” for additional requirements.

B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."

3.06 **PIPING SYSTEM INSTALLATION**

A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Basic piping installation requirements are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.

E. Concealed Locations:

1. Above Inaccessible Ceiling Locations: Gas piping with welded joints may be installed in inaccessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above inaccessible ceilings.

2. Above Accessible Ceiling Locations: Gas piping with welded joints may be installed in accessible ceiling spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above ceilings used as plenums.

3. In Floor Channels: Gas piping may be installed in floor channels, subject to approval of authorities having jurisdiction. Channels must have cover and be open to space above cover for ventilation.

4. Underground Beneath Building: Gas piping may be installed in protective conduit in accordance with Chapter “Gas Piping Installations” in the International Fuel Gas Code.

5. In Partitions: Do not install concealed piping in solid partitions, unless installed in a chase or casing.

   a. Exception: Piping passing through partitions or walls.

6. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.

7. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

F. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

G. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.

H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

I. Connect branch piping from top or side of horizontal piping.

J. Install strainer on inlet of each automatic and electrically operated valve.

K. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 20 Section "Meters and Gages."

L. Locate valves for easy access.

M. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.

N. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.

O. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.

P. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

Q. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.07 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 20 Section "Basic Mechanical Materials and Methods."

B. Use materials suitable for fuel gas.

3.08 POLYETHYLENE PIPE INSTALLATION

A. Install underground, PE, natural gas distribution piping according to ASTM D 2774.

B. Install underground, PE, natural gas distribution piping at entrance to and under part of building in steel piping protective conduit that is vented to outside.

3.09 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 20 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

3.10 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

1. Do not use gas pipe as grounding electrode.

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.11 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

2. Nameplates, pipe identification, and signs are specified in Division 20 Section "Mechanical Identification."

3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.

3.12 PAINTING

A. Use materials and procedures in Division 09 painting Sections.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.

a. Prime Coat: Alkyd anticorrosive metal primer.

b. Intermediate Coat: Exterior alkyd enamel matching topcoat.

c. Topcoat: Exterior alkyd enamel semigloss.

d. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.13 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, 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. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03.

3.14 **FIELD QUALITY CONTROL**

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Additional Testing: Subject welded fuel gas piping installed within ceiling spaces used as plenums to test pressure of 150 psig for a minimum of 2 hours.

D. Natural-gas piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.15 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, and maintain lubricated plug valves.

END OF SECTION

SECTION 23 2113 - HYDRONIC PIPING

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 07 Section "Penetration Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 20 Section “Mechanical General Requirements.”
4. Division 20 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
5. Division 20 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
6. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”
7. Division 20 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.
8. Division 20 Section "Mechanical Identification" for labeling and identifying hydronic piping.
9. Division 23 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 23 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 23 Section “Piping Systems Flushing and Chemical Cleaning.”

13. Division 23 HVAC water treatment sections.

1.02 **DEFINITIONS**

A. CPVC: Chlorinated polyvinyl chloride.
B. HDPE: High density polyethylene.
C. PP: Polypropylene.
D. PVC: Polyvinyl chloride.
E. PTFE: Polytetrafluoroethylene.
F. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
G. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.03 **PERFORMANCE REQUIREMENTS**

A. Where not indicated on the Drawings, hydronic piping components and installation shall be capable of withstanding the following minimum working pressures and temperatures:
   1. Heat Pump Loop Piping: 125 psig at 150 deg F.
   2. Condensate-Drain Piping: 150 deg F.
   3. Air-Vent Piping: 200 deg F.
   4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.04 **SYSTEMS DESCRIPTIONS**

A. Hydronic piping system materials are scheduled on the Drawings.
B. Refer to Application Schedule 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.

1.05 **ACTION SUBMITTALS**

A. Product Data: For each type of the following:
   1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
   2. Air control devices.
   3. Chemical treatment.
   4. Hydronic specialties.
   5. Pressure-seal fittings.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Detail, at minimum 1/4scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
B. Qualification Data: For Installer.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.
B. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.

1.08 **QUALITY ASSURANCE**

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
B. Installer Qualifications:
   1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

C. 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.

PART 2 PRODUCTS

2.01 **COPPER TUBE AND FITTINGS**

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. DWV Copper Tubing: ASTM B 306, Type DWV.
C. Wrought-Copper Socket Fittings: ASME B16.22.
D. Wrought-Copper Unions: ASME B16.22.
E. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASC Engineered Solutions; Gruvlok; CTS Copper System.
      b. Victaulic Company; Style 606 and Style 607.
   2. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
   3. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
F. Copper or Bronze Pressure-Seal Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. ASC Engineered Solutions; Anvil Press.
      b. Apollo Valves; by Conbraco Industries; ApolloXpress.
      c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
      d. NIBCO Inc.; Press System.
      e. Viega North America; ProPress System.
   2. Housing: Copper.
   3. O-Rings and Pipe Stops: EPDM.
   4. Tools: Manufacturer's special tools.
   5. Minimum 200-psig working-pressure rating at 250 deg F.
G. 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.

2.02 **STEEL PIPE AND FITTINGS**

A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.
   1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe. Include ends matching joining method.
   2. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body, with ball-and-socket, metal-to-metal, bronze seating surface and female threaded ends.
   3. Gray-Iron, Threaded Fittings: ASME B16.4, Class 125, standard pattern.
   4. Cast-Iron Flanges: ASME B16.1, Class 125.
   5. Cast-Iron, Flanged Fittings: ASME B16.1, Class 125.
B. Grooved Mechanical-Joint Fittings and Couplings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. ASC Engineered Solutions; Gruvlok; Model 7401 Rigid, Model 74 SlideLOK, and Fig. 7400 Rigidlite.
      b. Victaulic Company; Style 107 QuickVic Rigid Coupling and W07 AGS Rigid Coupling.

2. Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 53/A 53M, Type F, E, or S, Grade B fabricated steel; or ASTM A 234, Grade WPB steel fittings with grooves or shoulders constructed to accept grooved-end couplings; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
4. Couplings: Ductile-iron housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
    a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.03 **SCHEDULE 10S STAINLESS-STEEL PIPE AND FITTINGS**

A. Stainless-Steel Pipe: Schedule 10S, ASTM A 312/A 312M, Type 304/304L, seamless or electric resistance welded pipe.
B. Fittings: ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.
C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 304L stainless steel.
D. Grooved-Joint Systems:
    1. Manufacturers:
        a. ASC Engineered Solutions; Gruvlok Manufacturing; Model 7400SS.
        b. Victaulic Company; Style 489.
    2. Grooved-End, Stainless Steel-Piping Fittings: Schedule 10S, Type 304L or 316L stainless steel from material conforming to ASTM A 403 or pipe conforming to ASTM A 312, or sheet conforming to ASTM A 240; with dimensions matching stainless steel pipe.
    3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
    4. Grooved-End, Stainless Steel-Piping Couplings: ASTM A 743, cast Type 316L stainless steel, and stainless steel bolts and nuts.
        a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.04 **SCHEDULE 40 STAINLESS-STEEL PIPE AND FITTINGS**

A. Stainless-Steel Pipe: Schedule 40, ASTM A 312/A 312M, Type 316L, seamless or electric resistance welded pipe.
B. Fittings: ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.
C. Flanges: ASME B16.1, Classes 125 and 250, constructed of ASTM A 351, Type 316L stainless steel.
D. Grooved Mechanical-Joint Fittings and Couplings:
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. ASC Engineered Solutions; Gruvlok; Fig. 472 and Fig. 770.
        b. Victaulic Company; Style 489.
    2. Joint Fittings: Schedule 40S, Type 304L or Type 316L conforming to ASTM A 403/A 403M with grooves or shoulders constructed to accept grooved-end couplings.
    3. Gaskets: Synthetic rubber gasket of central cavity pressure-responsive design suitable for temperatures from minus 30 deg F to 230 deg F.
    4. Couplings: ASTM A 351, A 743 and A 744 Grade CF8M Type 316 stainless steel housing with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
        a. Rigid Type: To provide rigidity and system support and hanging in accordance with ANSI B31.1 and B31.9.

2.05 **JOINING MATERIALS**

A. Refer to Division 20 Section “Basic Mechanical Materials and Methods.”

2.06 **VALVES**

A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.07 **SPECIALTY VALVES**

A. Balance Valves:
   1. Balance Valves NPS 6 and Larger: Lug type butterfly valves with aluminum bronze disc, AISI 300 Series stainless steel stem, resilient replaceable seat for service at not less than 250 deg Fand memory stops. Refer to Division 23 Section “General-Duty Valves for HVAC” for additional requirements.
      a. Provide lubricated enclosed screw or worm gear operator with handwheel for sizes 6 inches and larger.
      b. Pressure rating shall meet or exceed system minimum pressure rating.
   2. Flow Measuring: Use Flow Measuring Devices as specified in Division 20 Section “Meters and Gages.”
   3. Balance Valves for Sizes Less than NPS 6 Combination balance valve and flow measuring device as specified in this Section.

B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Griswold Controls.
      b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
      c. IMI Flow Design; IMI Hydronic Engineering Inc.
      d. Jomar Hydronics.
      e. Macon Balancing; Tunstall Corporation.
      f. Nexus Valve.
      g. PRO Hydronic Specialties, LLC.
   2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
      a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
      b. ASC Engineered Solutions; Gruvlok; Model CBV.
   3. Body: Brass or bronze, ball or plug type with calibrated orifice or venturi.
   4. Ball: Plated brass, or stainless steel.
   5. Plug: Resin.
   6. Seat: PTFE.
   7. End Connections: Threaded or socket.
   8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
   9. Handle Style: Lever, with memory stop to retain set position.
   10. WOG Rating: Minimum 400 psig.
   11. Maximum Operating Temperature: 250 deg F.

C. Combination, Balancing Valves and Flow Measuring Devices NPS 2-1/2 through NSP 4:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Griswold Controls.
      b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
      c. IMI Flow Design; IMI Hydronic Engineering Inc.
      d. Jomar Hydronics.
      e. Macon Balancing; Tunstall Corporation.
      f. Nexus Valve.
      g. PRO Hydronic Specialties, LLC.

2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
   a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
   b. ASC Engineered Solutions; Gruvlok; MBV Series, CSV Series.
3. Body: Cast-iron or steel body, ball, plug, butterfly, or globe pattern with calibrated orifice or venturi.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. WOG Rating: Minimum 200 psig.
11. Maximum Operating Temperature: 225 deg F.

D. Contractor Option for Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller: Preassembled coil hook up kits may be used.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Griswold Controls.
   b. Hydronic Components, Inc. (HCi); a Jomar Group Company.
   c. IMI Flow Design; IMI Hydronic Engineering Inc.
   d. Jomar Hydronics.
   e. Macon Balancing; Tunstall Corporation.
   f. Nexus Valve.
   g. PRO Hydronic Specialties, LLC.
2. Manufacturers: Subject to compliance with requirements, use products by one of the following:
   a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
   b. ASC Engineered Solutions; Gruvlok.

E. Diaphragm-Operated, Pressure-Reducing Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; Xylem Inc.
   d. Conbraco Industries, Inc.
   e. Spence Engineering Company, Inc.
   f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Assist Operated Relief Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Anderson Greenwood & Co.; Kunkle Valve Division.
   c. Armstrong Pumps, Inc.
   d. Bell & Gossett; Xylem Inc.; Models 790 and 1170.
   e. Conbraco Industries, Inc.; Apollo Valve.
   f. Spence Engineering Company, Inc.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: EPDM.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPDM.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Relief Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Anderson Greenwood & Co.; Kunkle Valve Division.
   c. Armstrong Pumps, Inc.
   d. Bell & Gossett; Xylem Inc.; 3301 and 4100.
   e. Conbraco Industries, Inc.; Apollo Valve.
   f. Spence Engineering Company, Inc.
   g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Body: Cast iron.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: EPDM.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPDM.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Valve Seat and Stem: Noncorrosive.
9. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Griswold Controls.
   b. IMI Flow Design; IMI Hydronic Engineering Inc.
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.

8. Minimum Pressure Rating: 300 psig.
9. Maximum Operating Temperature: 250 deg F.

2.08 **STAINLESS-STEEL VALVES**

A. Ball Valves, NPS 2 and Smaller: MSS SP-110, 600-psig minimum CWP, 2-piece, with stainless-steel body, conventional-port stainless-steel ball, PTFE seals, and threaded or weld ends.
   1. Manufacturers:
      a. Apollo Valves; by Conbraco Industries.
      b. Metso Automation, Inc.; Jamesbury.
      c. NIBCO INC.
      d. Velan Valve Corp. USA.

B. Ball Valves, NPS 3 and Larger: MSS SP-72, Class 150, 2 piece, with stainless-steel body, stainless-steel ball, PTFE seals, and flanged or butt-welding ends.
   1. Manufacturers:
      a. Apollo Valves; by Conbraco Industries.
      b. Metso Automation, Inc.; Jamesbury.
      c. NIBCO INC.
      d. Velan Valve Corp. USA.

C. Stainless Steel, Dual-Plate Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. DeZurik/APCO/Hilton; APCO Willamette Valve and Primer Corporation.
      b. Champion Valves, Inc.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Mueller Steam Specialty; a division of SPX Corporation.
      e. Val-Matic Valve & Manufacturing Corp.
   2. Description:
      a. ASME Pressure Class: Class 150.
      b. Body Design: Lug type, with spring-loaded plates.
      c. Body and Disc Material: Type 316 stainless steel.
      d. Spring Material: Type 316 stainless steel.
      e. Seat: EPDM.

2.09 **CONTROL VALVES**

A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Temperature Controls."

B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV's) are installed.

2.10 **AIR CONTROL DEVICES**

A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 23 Section "General-Duty Valves for HVAC."

B. Automatic Air Vents:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Amtrol, Inc.
      b. Armstrong Pumps, Inc.
      c. Bell & Gossett; Xylem Inc.
      d. Spirotherm, Inc.
      e. Taco, Inc.
   2. Body: Bronze or cast iron.
   3. Internal Parts: Nonferrous.
   4. Operator: Noncorrosive metal float.
   5. Inlet Connection: NPS 1/2.

6. Discharge Connection: NPS 1/4.
7. Maximum Operating Pressure: 150 psig.
8. Maximum Operating Temperature: 240 deg F.

C. Bladder-Type Expansion Tanks:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.
e. Wessels Co.
2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

D. Combination Air and Dirt Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Bell & Gossett; Xylem Inc.; Model CRS.
b. Spirotherm, Inc.
c. Taco, Inc.; Series 4900-AD
d. Wessels Company; Wess-Vent Air & Dirt Separator.
2. Body: Fabricated steel; constructed for 125-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation.
3. Air and Dirt Separation Mechanism: Internal stainless steel coalescing medium; or copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed; or PALL ring technology.
4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.
5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.
6. Blowdown Connection: Threaded.
7. Size: Match system flow capacity.

E. In-Line Air Separators:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.
2. Tank: One-piece cast iron with an integral weir constructed to decelerate system flow to maximize air separation.
3. Maximum Working Pressure: Up to 175 psig.
4. Maximum Operating Temperature: Up to 300 deg F.

F. Air Purgers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.

b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.

2. Body: Cast iron with internal baffles that slow the water velocity to separate the air from solution and divert it to the vent for quick removal.
3. Maximum Working Pressure: 150 psig.
4. Maximum Operating Temperature: 250 deg F.

2.11 **HYDRONIC PIPING SPECIALTIES**

A. Flexible connectors and expansion fittings are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

B. Waterless Condensate Trap:
1. Meet standard building code requirements.
2. Predesigned to prevent:
a. Possibility of frozen or broken pipes.
b. Standing water within trap.
c. Sludge buildup in trap.
d. Geyser effect or blowout.
3. Manufacturers:
a. Des Champs Technologies; HVAC Air Trap; P-Series, N-Series, and RLC Series.

2.12 **HYDRONIC PIPING STRAINERS**

A. Manufacturers:
1. Apollo Valves; Conbraco Industries, Inc.
2. Griswold Controls.
3. Keckley Company.
4. Metraflex Company.
5. Mueller Steam Specialty; a Watts Brand.
6. NIBCO, Inc.
7. Sure Flow Equipment Inc.
8. Titan Flow Control, Inc.
9. Watts.
10. Yarway; Emerson Automation Solutions.
11. ASC Engineered Solutions; Gruvlok Manufacturing (for grooved piping).
12. Victaulic Company (for grooved piping).

B. Y-Pattern Strainers, Bronze:
1. CWP: 200 psig minimum, unless otherwise indicated.
2. SWP: 125 psig minimum, unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller.
4. End Connections: Threaded or soldered.
5. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
6. Drain:
a. Pipe plug for sizes NPS 2 and smaller.
b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

C. Y-Pattern Strainers, Cast and Ductile Iron:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger; grooved ends may be used on grooved piping.
3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain:
a. Pipe plug for sizes NPS 2 and smaller.

b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

D. Basket Strainers, Cast Iron:
1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: Stainless steel, 40-mesh unless otherwise noted or scheduled.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain: Pipe plug.

2.13 **STAINLESS STEEL STRAINERS**

A. Manufacturers:
1. Apollo Valves; Conbraco Industries, Inc.
2. Keckley Company.
3. Metraflex Company.
4. Mueller Steam Specialty; a Watts Brand.
5. NIBCO, Inc.
6. Sure Flow Equipment Inc.
7. Titan Flow Control, Inc.
8. Watts.
9. Yarway; Emerson Automation Solutions.

B. Y-Pattern Strainers:
1. Body: ASTM A 351, Type 316 stainless steel, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. Tapped blowoff plug.
5. SWP Rating: 250-psig steam working pressure.

C. Basket Strainers:
1. Body: ASTM A 351, Type 316 stainless steel, with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for strainers NPS 2 and smaller; flanged ends for strainers NPS 2-1/2 and larger.
3. Strainer Screen: Stainless-steel, 20 mesh strainer, and perforated stainless-steel basket with 50 percent free area.
4. SWP Rating: 250-psig steam working pressure.

PART 3 EXECUTION

3.01 **PIPING SYSTEMS INSTALLATION**

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Select system components with pressure rating equal to or greater than system operating pressure.
K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
M. Install piping, other than drain piping, at a uniform grade of 0.2 percent upward in direction of flow.
N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.
P. Install valves according to Division 23 Section "General-Duty Valves for HVAC."
Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
R. Install calibrated balancing valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.
S. Install check valves at each pump discharge and elsewhere as required to control flow direction.
T. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.
U. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.
V. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
W. Install flanges or grooved mechanical couplings in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.
X. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.
Y. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."
Z. Identify piping as specified in Division 20 Section "Mechanical Identification."

3.02 **HANGERS AND SUPPORTS**

A. Hanger, support, and anchor devices are specified in Division 20 Section "Hangers and Supports." Comply with the following requirements for maximum spacing of supports.
B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
   2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
   1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.

2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.
9. NPS 8: Maximum span, 19 feet; minimum rod size, 5/8 inch.
10. NPS 10: Maximum span, 20 feet; minimum rod size, 3/4 inch.
11. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
12. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
13. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
14. NPS 18: Maximum span, 28 feet; minimum rod size, 1-1/4 inches.
15. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
7. NPS 4 to NPS 5: Maximum span, 10 feet minimum rod size, 1/2-inch.
8. NPS 6: Maximum span, 10 feet minimum rod size, 5/8-inch.
9. NPS 8: Maximum span, 10 feet minimum rod size, 3/4-inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.03 **PIPE JOINT CONSTRUCTION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.04 **HYDRONIC SPECIALTIES INSTALLATION**

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Glycol Systems:
1. Install automatic air vents on expansion tanks and install high capacity automatic air vents on air separators. Route vent piping to spill over glycol fill station.
2. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.

E. Install expansion tanks as indicated in piping diagrams. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
1. Install tank fittings that are shipped loose.
2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.
3. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.05 **FIELD QUALITY CONTROL**

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 2 hours, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:
1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Remove disposal fine-mesh strainers in pump suction diffusers.
4. Set makeup pressure-reducing valves for required system pressure.
5. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 23 2123 - HYDRONIC PUMPS

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. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

C. PEI: Pump Energy Index as defined by the Department of Energy.

D. PEI_{CL}: Pump Energy Index – Constant Load, as defined by the Department of Energy.

E. PEI_{VL}: Pump Energy Index – Variable Load, as defined by the Department of Energy.

1.03 ACTION SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For all pumps and accessories to include in Operation and Maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Department of Energy Requirements: Pumps supplied that are regulated by the Department of Energy pump standards shall bear the acceptable PEI index.

1. Constant load pumps supplied shall bear the acceptable PEI_{CL} index.

2. Variable load pumps supplied with variable speed controls shall bear the acceptable $PEIv_L$ index.

3. Submittals for approval shall clearly identify the applicable PEI index and affirm that that index meets the DOE pump standards.

C. 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.

D. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.08 **COORDINATION**

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 PRODUCTS

2.01 **GENERAL PUMP REQUIREMENTS**

A. Pump Units: Factory assembled and tested.

B. Motors: Comply with requirements in Division 20 Section “Motors”.

C. Selection:

1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.

2. Shaft first critical speed shall not be less than 25 percent greater than operating speed.

3. Maximum impeller diameter shall not be greater than 90 percent of “cut water” diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.

4. Pump speed shall be limited to 1800 RPM except as scheduled.

5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side

of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.

6. Select pump at a point no greater than 85 percent of end of curve flow.
7. Maximum pump suction velocity:
   a. In-line: 12 fps.
   b. End suction: 13 fps.
   c. Double suction: 15 fps.

2.02 **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.

2.03 **SMALL CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS**

A. Manufacturers:

1. Armstrong Pumps Inc.
2. Bell & Gossett; Xylem Inc.; Series e-90.
3. Grundfos Pumps Corporation.
4. Taco, Inc.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel with copper-alloy shaft sleeve, or stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.

D. Motor: Single speed, with permanently or grease lubricated ball bearings, unless otherwise indicated; and rigidly mounted to pump casing. Comply with requirements in Division 20 Section "Motors."

2.04 **FLEXIBLY COUPLED, BASE-MOUNTED, DOUBLE-SUCTION CENTRIFUGAL PUMPS**

A. Casing Style

1. Vertical Split Case Double Suction Pumps
   a. Horizontal split case pumps are not acceptable where vertical split case pumps are specified, unless prior written approval is obtained from the Engineer.
   b. Manufacturers:
      1) Bell & Gossett; Xylem Inc.; VSC and VSCS.
      2) Taco, Inc.; TC Series.

B. Description: Factory-assembled and tested, centrifugal, impeller-between-bearings, separately coupled, double-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Cast iron with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and ASME B16.1, Class 125 flanges. Casing supports shall allow removal and replacement of impeller without disconnecting piping. Provide replaceable bronze wear rings for all horizontal split case pumps with pump shaft L/D ratios greater than 9.0.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.

3. Pump Shaft: Stainless steel.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.

5. Pump Bearings: Grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Flexible Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be center drop-out type to allow disassembly and removal without removing pump shaft or motor. Provide EPDM coupling sleeve for all motors 40 HP and below and all variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, with grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 20 Section "Motors".

H. Capacities and Characteristics: Refer to Schedule on Drawings.

2.05 AUTOMATIC CONDENSATE PUMP UNITS (PLENUM APPLICATIONS)

A. Manufacturers:

1. Hartell Pumps Div.; Milton Roy Co.; Model A2-X-1965.

B. Description: Packaged units with corrosion-resistant pump, dual-voltage thermally protected motor, cast aluminum tank with cover, and automatic controls. Include auxiliary safety switch and factory- or field-installed check valve.

2.06 PUMP SPECIALTY FITTINGS

A. Contractor Option for Pump Suction and Discharge Connections NPS 3 through NPS 12: Preassembled vibration isolation pump drop kits may be used.

1. Manufacturers:

a. Victaulic Company; Suction Series 381/382, and Discharge Series 383 with TA Hydronics Series balance valve and 716H/779 check valve..

2. Description:

a. Suction: Class 150, factory assembled grooved-end vibration pump suction drop consisting of wye strainer, flexible couplings, pipe spool with thermometer and pressure ports, and butterfly isolation valve.

b. Discharge: Class 150, factory assembled grooved-end vibration pump discharge drop consisting of straight line with concentric reducer for vertical pump connections, flexible couplings, pipe spool with thermometer and pressure ports, spring check valve, balance valve, and butterfly isolation valve.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Support in-line centrifugal pumps greater than 1/2 HP independent of piping. Use continuous-thread hanger rods and hangers of sufficient size to support pump weight. Do not support pump from motor housing plate.

E. Refer to Division 20 Section “Mechanical Vibration Controls” for vibration isolation devices.

F. Refer to Division 20 Section “Hangers and Supports” for hanger and support materials.

G. Set base-mounted pumps on concrete bases. Disconnect flexible coupling before setting. Do not reconnect flexible couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular stainless steel blocks and shims, or on wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3. Install pumps on inertia bases where required. Refer to Division 20 Section “Mechanical Vibration Controls” for vibration isolation devices.

H. Automatic (Cooling Coil) Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.03 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation." Laser align to a tolerance of 0.0005 inches maximum.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly.

E. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install check valve and throttling valve on discharge side of pumps. Triple-duty valves are not allowed.

E. Install Y-type strainer or suction diffuser and shutoff valve on suction side of pumps as indicated on drawings.

F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tappings, or install single gage with multiple-input selector valve.

H. Install check valve and gate or ball valve on each condensate pump unit discharge.

I. Install electrical connections for power, controls, and devices.

J. Ground equipment according to Division 26 Section "Grounding and Bonding."

K. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service for each pump supplied. Written report of the start-up shall be provided to the Owner and Engineer upon completion of services.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.
5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

3.06 DEMONSTRATION

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

END OF SECTION

SECTION 23 2510 - PIPING SYSTEMS FLUSHING AND CHEMICAL CLEANING

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 disinfection of potable water piping.
4. Division 23 Section "Hydronic Piping.”
5. Division 23 water treatment sections.

1.02 SUMMARY

A. This Section includes chemical cleaning for the following piping systems:

1. Heat Pump Loop Water

1.03 DEFINITIONS

A. Cleaning: Recirculating water containing chemical cleaning and passivation compounds.

B. Flushing: Using approved water on a once through basis.

1.04 PERFORMANCE REQUIREMENTS

A. Furnish the services of a firm specializing in piping system chemical cleaning and water treatment work.

1. For chemical cleaning: This firm shall select the required type and quantity, based on system volume, of cleaning compound, and method of application.

B. Passivation for Galvanized Steel: Open loop only, for the first two weeks of operation.

1.05 **ACTION SUBMITTALS**

A. Product Data:

1. Proposed cleaning chemicals and quantities.

2. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

1.06 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Reduced scale plans indicating locations of velocity measurements.

B. Other Informational Submittals:

1. Proposed, step-by-step, chemical cleaning procedure.

2. Circulation pump suction and discharge pressure at start and completion of chemical cleaning operations.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

1.08 **QUALITY ASSURANCE**

A. Service Provider Qualifications: An experienced piping systems cleaning service provider capable of applying cleaning compounds as specified in this Section.

B. Conduct safety meetings with Owner's Representative and personnel involved in the cleaning process.

C. Assume responsibility for damage, necessary subsequent cleaning, flushing, and inspection of Work under the Contract which results from improper flushing and cleaning operations including failure to flush all dead-ends.

1.09 **COORDINATION**

A. Schedule flushing and chemical cleaning activities immediately after piping system pressure testing and immediately prior to piping system chemical treatment work to minimize internal oxidization or flash corrosion of piping systems.

B. Coordinate chemical cleaning work with other work to avoid accidental chemical discharge, spillage, or spray out, and electrolytically originated system damage resulting from concurrent chemical cleaning and arc welding.

C. Coordinate with work performed under other Sections to provide in-place temporary strainers, spool pieces, flushing hose connections, cross-over piping, and isolation and drain valves.

D. Chillers shall not be cleaned with any chloride component.

E. Boilers shall be flushed and cleaned to remove rust and oil deposits.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. System Cleaning Chemicals: Subject to compliance with requirements, provide products by one of the following:

1. H-O-H Chemicals, Inc.

2.02 **MATERIALS**

A. Cleaning chemicals shall be as recommended by manufacturer and compatible with piping system components and connected equipment.

B. Cleaning and passivation chemical shall consist of an inorganic phosphate, yellow metal corrosion inhibitor (Tolytriazole), dispersant, and oil emulsifier.

C. Provide additional temporary and permanent piping, equipment, and materials required for chemical cleaning work.

D. Use potable water for flushing and cleaning operations, unless directed otherwise by the Architect.

2.03 **GEOTHERMAL LOOP FLUSHING EQUIPMENT**

A. Manufacturer/Supplier: Subject to compliance with requirements, provide products by one of the following:

1. Geothermal Supply Company; Purge Pro Max.

B. Furnish trailer-mounted commercial flushing and purging system designed for geothermal applications and having the following capabilities:

1. Flush and filter debris from system.
2. Purge trapped air bubbles.
3. Reverse flow.
4. Hydrostatically pressure test.
5. Flow test.

PART 3 EXECUTION

3.01 **ACCEPTABLE SERVICE PROVIDER**

A. Subject to compliance with requirements, provide chemical cleaning service by one of the following:

1. H-O-H Chemicals, Inc. David Burton/H.V. Burton Co, 734-261-4220.

3.02 **PREPARATION**

A. Prior to flushing and cleaning activities, drain the system of all water used for hydrostatic testing.

B. Temporarily connect dead-end supply and return piping as necessary to result in recirculating system in which no lines are left static for purposes of flushing and cleaning. Refer to System Piping Diagrams on the Drawings for suggested locations of temporary connections for flushing and cleaning purposes.

C. Select three locations for monitoring flow rates.

3.03 **INITIAL FLUSHING**

A. Remove loose dirt, mill scale, metal chips, weld beads, rust and other deleterious substances without damage to system components.

B. Bypass factory cleaned equipment, unless acceptable means of protection are provided and subsequent inspection of water boxes and other "hide-out" areas takes place.

C. Isolate or protect clean system components including pumps and pressure vessels and remove components which may be damaged.

D. Open valves, drains, vents and strainers at all system levels.

E. Remove plugs, caps, spool pieces and components to facilitate early discharge from system.

F. Sectionalize system if possible to obtain debris carrying velocity of 6 FPS.

G. Connect dead-end supply and return headers as necessary or provide terminal drains in end caps.

H. Install temporary strainers where necessary to protect down-stream equipment.

I. Supply and remove flushing water and drainage by fire hoses, garden hoses, temporary and permanent piping and Contractor's booster pumps.

J. Flush for not less than one hour.

K. Inspect system including basins to determine if debris accumulation requires dewatering and cleaning prior to next phase work.

3.04 FLUSHING AND CHEMICAL CLEANING PROCEDURES

A. Remove without chemical or mechanical damage to system components adherent dirt (organic soil), oil and grease (hydrocarbons), welding and soldering flux, mill varnish, pipe compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing. Removal of tightly adherent mill scale is not required.

B. Fill system with fresh water and add manufacturer's recommended volume of system cleaner to remove grease and petroleum products from piping. Circulate solution for 48 hours at a minimum velocity of 6 fps.

1. Utilize defoamers to preclude damage to existing work and adjacent electrical equipment.
2. Utilize heat to maximize effectiveness of compounds or use live steam injection where practical and safe. Do not raise cleaning water temperature in excess of controlled limits.

C. Monitor flow rates and clean strainers as required to maintain minimum specified velocity during the entire circulation and chemical cleaning period.

D. Install temporary strainer screens between pipe flange faces where necessary to protect primary system from branch connections during chemical cleaning procedures.

E. Following chemical cleaning:

1. Remove, clean, and reinstall strainer baskets.
2. Blow down and clean low points, dirt legs, and traps.

F. Drain systems:

1. Check with local authorities concerning discharge requirements and submit copies of letters or reports.
2. If acceptable, drain system to sanitary drainage system.
3. Do not under any circumstances drain to storm drainage system or open drainage ditch.
4. If discharge requirements do not allow discharge to sanitary sewer, secure the services of a licensed disposal Contractor.
5. Disposal Contractors:
    a. Dynecol.
    b. SQS Environmental.

G. Perform final flush to remove any remaining debris and chemical from the system:

1. Flush dead ends and isolated pre-cleaned equipment.
2. Operate valves to dislodge debris in valve body.
3. Flush for not less than 1 hour.

3.05 PLACING INTO OPERATION

A. Clean strainers.

B. Dewater and clean new sumps, basins, storage vessels and pressure vessels.

C. Disassemble, inspect, clean, repair, replace and reassemble any critical component or questionable item. Bellows style, and hose and braid flexible connectors left in place shall be removed and cleaned.

D. Preliminarily adjust control valves.

E. Install clean primary filter elements, if necessary, as determined by both pressure differential across filter and visual inspection of filter elements.

F. Close-up and fill system as soon as possible to minimize corrosion of untreated surfaces.

G. Vent air from system and adjust fill valve.

H. Immediately after completion of flushing and chemical cleaning, fill systems with potable water and make ready for chemical treatment as specified in Division 23 Section “HVAC Water Treatment.”

3.06 **FIELD QUALITY CONTROL**

A. Tests and Inspections:

1. Withdraw, inspect, and test samples of water from each system after flushing and chemical cleaning is completed, to ensure system is free of contaminants.

2. If loose debris or contaminants are still present, repeat final flushing procedures until test samples and strainers remain free of debris and contaminants.

END OF SECTION

SECTION 23 2513 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

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 23 Section "Piping Systems Flushing and Chemical Cleaning."

1.02 DEFINITIONS

A. CPVC: Chlorinated Polyvinyl Chloride.

B. EEPROM: Electrically erasable, programmable read-only memory.

C. EPDM: Ethylene-propylene-diene monomer.

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

E. RO: Reverse osmosis.

F. TDS: Total dissolved solids.

G. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

H. PTFE: Polytetrafluoroethylene.

I. UV: Ultraviolet.

1.03 **PERFORMANCE REQUIREMENTS**

A. Furnish the services of a firm specializing in hydronic piping system water treatment work.

1. This firm shall furnish and administer glycol for systems using glycol/water mix.

B. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

C. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

D. Base chemical quantities on estimated system size.

E. Closed hydronic systems shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.

2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.

3. Boron: Maintain a value within 100 to 200 ppm.

4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.

5. Soluble Copper: Maintain a maximum value of 0.20 ppm.

6. TDS: Maintain a maximum value of 5000 mmhos.

7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.

8. Scale Control: Provide sufficient scale inhibitors to prevent formation of scale and maintain all scale-forming material in solution.

9. Microbiological Limits:

a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.

b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.

c. Ammonia: Maintain a maximum value of 20 ppm.

d. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.

e. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.

f. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

g. Total Hardness: Maintain a value less than ?.? ppm.

1.04 **ACTION SUBMITTALS**

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.

2. Water meters.

3. Inhibitor injection timers.

4. pH controllers.

5. TDS controllers.

6. TSS controllers.

7. Chemical solution tanks.

8. Injection pumps.
9. UV-irradiation units.
10. Chemical test equipment.
11. Chemical material safety data sheets.
12. Water softeners.
13. RO units.

1.05 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power and control wiring.

B. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment required to achieve water quality defined in the "Performance Requirements" Article above.
2. An analytical review of make-up water characteristics for each treated system operating conditions, including such items as Langlier/Ryzner Indexes. Based on this review, provide a definitive description of treatment system developed to achieve specified objectives and include generic terms to describe product formulation content and function. Detailed proprietary formulation data is not required. However, manufacturer's standard published literature is not usually acceptable.
3. A step-by-step procedure to be followed by the Contractor during flushing, purging, disinfecting, draining, disposal, pretreatment and treatment operations. The intent of the step-by-step procedure is two-fold.
    a. To assure that all essential permanent provisions to accomplish the above work are included during the course of construction.
    b. To allow the Owner to accomplish the source procedures as subsequent maintenance operations.

C. Provide OSHA equivalent materials form for hazardous substances.

1.06 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports including final water quality test reports:

1. Boiler water samples taken at one-week intervals after boiler startup for a period of five weeks, and test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Boiler water taken at eight-week intervals following the testing noted above to show that heating systems are maintaining water quality within performance requirements specified in this Section.
2. Samples taken at eight -week intervals following Substantial Completion, on hydronic systems to show that systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

B. Operation and Maintenance Data: For sensors, injection pumps, and controllers to include in operation and maintenance manuals.

1. Submit under provisions of Division 20 Section “Mechanical General Requirements” and as supplemented in this Section.
2. Submit following operation and maintenance data as minimum for purified water system.

a. Furnish complete instruction manuals for installation, operation, maintenance, and lubrication requirements for each component of mechanical and electrical equipment or system.

b. Each instruction manual shall include, but not be limited to, the following:

1) Diagrams and illustrations.

2) Detailed description of the function of each principal component of the system.

3) Performance and nameplate data.

4) Installation instructions.

5) Procedures for starting.

6) Proper adjustment.

7) Test procedures and recording of operation data.

8) Procedures for operating.

9) Shutdown and restart instructions.

10) Emergency operating instructions and trouble-shooting guide.

11) Safety precautions.

12) Maintenance and overhaul instructions which shall include detailed assembly drawings with part numbers, recommended spare parts list, instructions for ordering spare parts (including suppliers names), and complete preventive maintenance instructions required to ensure satisfactory performance and longevity of the equipment.

13) Lubrication instructions, which shall list points to be greased or oiled, shall recommend type, grade, and temperature range of lubricants, and shall recommend frequency of lubrication.

14) List of electrical relay settings and control and alarm contact settings.

15) Electrical interconnection wiring diagram for equipment furnished, including all control.

c. Manual shall be complete in all respects for all equipment, controls, accessories, and associated appurtenances.

d. Each O&M Manual shall be transmitted to the Owner's representative and Architect prior to installation of the equipment and all equipment shall be serviced by the manufacturer in accordance with the manufacturer's recommendations prior to operation. A service record shall be maintained on each item of equipment and shall be delivered to the Owner's representative and Architect prior to final acceptance of the project.

1.07 **QUALITY ASSURANCE**

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Conform to applicable codes for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.

1.08 **OWNER'S INSTRUCTIONS**

A. Provide a coordinated water treatment training program oriented to the needs common to operating personnel and maintenance personnel and to the needs of maintenance personnel only, sufficiently prior to acceptance of the work, upon mutually satisfactory arrangement with the Architect.

B. Provide a total of not less than eight "field" hours encompassing mechanical, electrical, chemical, pollution and safety aspects, sufficient for personnel to operate and maintain systems and consistently achieve specified objectives, with subsequently scheduled guidance by the water treatment laboratory.

C. Water treatment laboratory chemical engineer, complemented by instrument engineer, supplemented by Contractor's staff, shall comprise the training staff.

D. Training materials shall include "survey," limits control program, shop drawings, operating and maintenance manuals, safe handling of chemicals, chemical testing, use of log sheets and demonstrations of installed and functioning systems.

E. On completion of the installation of the entire purified water system, conduct a thorough check and test of all components in the system. During this period, instruct the Owner's personnel in the theory, operation, and maintenance of the system. When this work is finished, start up the system and operate it for as long as necessary to complete two consecutive days of operation at the specified performance levels. During this period, continue to instruct the Owner's personnel.

1.09 **MAINTENANCE SERVICE**

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for Heat Pump Loop Piping, Cooling Tower Spray Water, and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:

1. Provide piping/plumbing recommendation to optimize chemical program results.
2. Initial water analysis and HVAC water-treatment recommendations.
3. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
4. Quarterly field service and consultation.
5. Customer report charts and log sheets.
6. Laboratory technical analysis.
7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

B. Glycol manufacturer shall provide testing services every six months of samples submitted by the Owner. Fluid shall be tested at no charge for: glycol percent, pH, reserve alkalinity, dissolved metals, magnesium, calcium, chlorides, acidity, and inhibitor components. Testing service shall be for the life of the fluid.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers/Suppliers: Unless otherwise specified, and subject to compliance with requirements, provide products by one of the following:

1. Ashland Specialty Chemical Company; Drew Industrial Div.
2. Enerco Corporation.
3. SUEZ Water Technologies & Solutions

4. DuBois Chemicals.
5. NALCO Water, an Ecolab Company.
6. H-O-H Chemicals, Inc.

2.02 **MANUAL CHEMICAL-FEED EQUIPMENT**

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

1. Capacity: 2 gal.
2. Minimum Working Pressure: 125 psig.

2.03 **AUTOMATIC CHEMICAL-FEED EQUIPMENT**

A. Chemical Solution Tanks:

1. Tanks: Chemical-resistant reservoirs fabricated from high-density opaque polyethylene.
    a. Molded cover with recess for mounting pump.
    b. Capacity: 30 gal..
2. Containment: Low profile, forkliftable, spill pallet or containment basin with volume large enough to hold contents of largest tank.
    a. Construction: High-density polyethylene.
    b. Grates: Removable with non-slip surface.
    c. Include work ramp for facilitating loading of tanks onto spill pallet or containment basin.

B. Chemical Solution Injection Pumps:

1. Self-priming, positive-displacement; rated for intended chemical with minimum 25 percent safety factor for design pressure and temperature.
2. Adjustable flow rate.
3. Metal and thermoplastic construction.
4. Built-in relief valve.
5. Fully enclosed, continuous-duty, single-phase motor. Comply with requirements in Division 20 Section "Motors."

C. Chemical Solution Tubing: Polyethylene tubing with compression fittings and joints except ASTM A 269, Type 304, stainless steel for steam boiler injection assemblies.

D. Injection Assembly:

1. Corporation-stop injectors on piping mains in locations identified by water treatment specialist.
2. Assembly Pressure/Temperature Rating: Minimum 600 psig at 200 deg F.

2.04 **GLYCOL FEED SYSTEM**

A. Manufacturers:

1. Armstrong Pumps Inc.; GLA Series.
2. Bell & Gossett; Xylem Inc.; GMU.
3. H.V. Burton Co.; J.L. Wingert Co.
4. John Wood Company (The); Automatic Glycol Make-Up System JWGP-54-055.

5. Advantage Controls inc.; AGF Series.
6. Skidmore Pump.

B. Description: Pre-piped and pre-wired system, consisting of a glycol pump, tank, adjustable differential pressure switch, pressure gage, and control panel.

C. Chemical Tank Assembly:

1. Tank: Industrial grade polyethylene with removable cover.
2. Tank Capacity: 50 to 55 gallons.
3. Support Frame: Welded steel.
4. Discharge Piping: ASTM A53 black or galvanized steel, or Type L copper. PVC or CPVC discharge piping is unacceptable.
5. Include suction strainer, drain fitting, and interconnecting suction piping to the chemical pump.
6. Containment: Low profile, forkliftable, spill pallet or containment basin with volume large enough to hold contents of largest tank.
   a. Construction: High-density polyethylene.
   b. Grates: Removable with non-slip surface.

D. Glycol Pump: Positive displacement type with capacity adjustable through 100 percent of range by means of an easily accessible control. The pump shall be adjustable while running, and the pumped fluid shall not contact any metals of the drive assembly. Pump motor maximum 1/2 horsepower, 115 volts/single-phase/60 hertz, with a minimum capacity of 1.5 GPH at discharge pressure minimum 20 percent greater than the indicated system pressure at point of fill,

E. Hand/Off/Auto Motor Starters: Mounted on skid for glycol pump.

F. Control Panel: Furnished with the chemical tank assembly. Control panel shall be the master control center for all electrical equipment associated with the chemical tank assembly and shall include:

1. Hand/Off/Auto Switch: For the glycol pump. The pump shall run continuously while the switch is in the HAND position.
2. LED Indicator: For loss of pressure.
3. Enclosure: NEMA 250 Type 4X, with all controls, switches, and indicating lights mounted on the front.
4. Power Connection: Minimum 6-foot power cord and cap.
5. Low Tank Level Interlock Alarm Circuit: To prevent the glycol pump from running dry. Circuit shall include pump lockout, tank level detector, visual alarm, audible alarm, and alarm silence button. Interlock circuit shall automatically reset when tank is refilled.

2.05 CHEMICAL FEED PIPE AND FITTINGS

A. CPVC Piping:

1. CPVC Schedule 80 Pipe: ASTM F 441/ F 441M.
2. CPVC Schedule 80 Fittings: ASTM F 439, socket type or ASTM F 437, threaded type.
3. Isolation Valves: Three-piece true union style ball valve constructed of CPVC with TFE seats, and FPM or EPDM o-ring seals.

B. Stainless-Steel Pipes And Fittings:

1. Stainless-Steel Tubing: Comply with ASTM A 269, Type 316.

2. Stainless-Steel Fittings: Complying with ASTM A 815/A 815M, Type 316, Grade WP-S.

3. Two-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, carbon-filled TFE seats, threaded body design with adjustable stem packing, threaded ends, and 250-psig SWP and 600-psig CWP ratings.

4. Three-Piece, Full-Port, Stainless-Steel Ball Valves: ASTM A 351, Type 316 stainless-steel body; ASTM A 276, Type 316 stainless-steel stem and vented ball, threaded body design with adjustable stem packing, threaded ends, and 150-psig SWP and 600-psig CWP rating.

2.06 CHEMICAL TREATMENT TEST EQUIPMENT

A. Test Kit: Manufacturer-recommended equipment and chemicals in a wall-mounting cabinet for testing pH, TDS, inhibitor, chloride, alkalinity, and hardness; sulfite and testable polymer tests for high-pressure boilers, and oxidizing biocide test for open cooling systems.

B. Corrosion Test-Coupon Assembly (Corrosion Racks): Constructed of corrosive-resistant material, complete with piping, valves, and mild steel and copper coupons. Locate copper coupon downstream from mild steel coupon in the test-coupon assembly.

1. Two-station rack for closed-loop systems.

2. Include three feet per second flow control valve.

2.07 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

B. Water Softener Chemicals:

1. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock. Resin exchange capacity minimum 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.

2. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

C. Inhibited Propylene Glycol: Single nationally marketed brand of propylene glycol, inhibited for industrial applications, and readily available in bulk quantities from a firm offering free testing and advisory service to bulk users as to inhibitor replenishment needs. Premix inhibited glycol solution and deionized water to specified concentration. Automotive anti-freeze is unacceptable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Dow Chemical; Dowfrost HD.

b. Houghton Chemical Corporation.

c. Interstate Chemical Company; Intercool P300.

d. NALCO Water, an Ecolab Company.

e. PVS-Nolwood Chemicals, Inc.; Chill PGHD.

PART 3 EXECUTION

3.01 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.02 **INSTALLATION**

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install meters and equipment requiring service at a maximum 60 inches above finished floor.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.

F. Bypass Feeders Install in closed hydronic systems, and equipped with the following:

1. Install bypass feeder in a bypass circuit on main header having pressure differential greater than or equal to 20 psig, unless otherwise indicated on Drawings.

2. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.

3. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.

4. Install a swing check on inlet after the isolation valve.

G. Install glycol feed system in accordance with manufacturer’s instructions.

3.03 **CHEMICAL INSTALLATION**

A. Utilize softened or reverse osmosis water for initial system fill

B. Add specified chemicals to meet performance requirement specified in Part 1 of this Section.

3.04 **GLYCOL INSTALLATION**

A. Clean and flush glycol system before adding premixed glycol solution.

B. Fill systems indicated to have antifreeze or glycol solutions with the following premixed concentrations. Batch feeding of glycol is prohibited.

1. Heat Pump Loop Piping: Minimum 30 percent propylene glycol.

C. Perform tests determining strength of glycol and water solution and submit written test results.

3.05 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 20 Section "Basic Mechanical Materials and Methods."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 20 Section "Valves."

E. Confirm applicable electrical requirements in Division 26 Sections for connecting electrical equipment.

F. Ground equipment according to Division 26 Section "Grounding and Bonding."

G. Connect wiring according to Division 26 Section "Conductors and Cables."

3.06 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.
2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.
3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.
4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.
5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.
8. Repair leaks and defects with new materials and retest piping until no leaks exist.

C. Equipment will be considered defective if it does not pass tests and inspections.

D. Remove and replace malfunctioning units and retest as specified above.

E. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each required characteristic. Sample boiler water at eight-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

F. At eight-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

G. Comply with ASTM D 3370 and with the following standards:

1. Steam System: ASTM D 1066.
2. Acidity and Alkalinity: ASTM D 1067.
3. Iron: ASTM D 1068.
4. Water Hardness: ASTM D 1126.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.

END OF SECTION

SECTION 23 3113 - METAL DUCTS

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.

	Sound absorption coefficients at octave band center frequencies, Hz						
Thickness Inches	125	250	500	1000	2000	4000	NRC
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.

2.11 DOUBLE-WALL ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Ducts: Fabricate double-wall (insulated) ducts with an outer shell and an inner duct. Dimensions indicated are for inner ducts.

1. Outer Shell: Base metal thickness on outer-shell dimensions. Fabricate outer-shell lengths 2 inches longer than inner duct and insulation and in metal thickness specified for single-wall duct.

2. Insulation: 1-inch- thick fibrous glass, unless otherwise indicated. Terminate insulation where double-wall duct connects to single-wall duct or uninsulated components, and reduce outer shell diameter to inner duct diameter.
    a. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
3. Solid Inner Ducts: Use the following sheet metal thicknesses and seam construction:
    a. Ducts 3 to 8 Inches in Diameter: 0.019 inch with standard spiral-seam construction.
    b. Ducts 9 to 42 Inches in Diameter: 0.019 inch with single-rib spiral-seam construction.
    c. Ducts 44 to 60 Inches in Diameter: 0.022 inch with single-rib spiral-seam construction.
    d. Ducts 62 to 88 Inches in Diameter: 0.034 inch with standard spiral-seam construction.
4. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.
    a. Provide 1 mil mylar liner between acoustical insulation and perforated inner liner.
5. Maintain concentricity of inner duct to outer shell by mechanical means. Prevent dislocation of insulation by mechanical means.

B. Fittings: Fabricate double-wall (insulated) fittings with an outer shell and an inner duct.
1. Solid Inner Ducts: Use the following sheet metal thicknesses:
    a. Ducts 3 to 34 Inches in Diameter: 0.028 inch.
    b. Ducts 35 to 58 Inches in Diameter: 0.034 inch.
    c. Ducts 60 to 88 Inches in Diameter: 0.040 inch.
2. Perforated Inner Ducts: Fabricate with 0.028-inch- thick sheet metal having 3/32-inch-diameter perforations, with overall open area of 23 percent.

PART 3 EXECUTION

3.01 DUCTWORK APPLICATION SCHEDULE

A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.02 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

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.

d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.

e. Duct security bars.

f. Wiring Diagrams: Power, signal, and control wiring.

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 **FIRE DAMPERS (CURTAIN STYLE)**

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.

D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Fusible Links: Replaceable, 212 deg F rated.

2.08 **SMOKE DAMPERS**

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. General Description: Smoke dampers with airfoil blades, labeled according to UL 555S, with minimum Class II leakage rating.

C. Frame and Blades: 16 gage, galvanized sheet steel.

D. Mounting Sleeve: Factory-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

E. Rated pressure and velocity to exceed design airflow conditions.

F. Damper Actuators: Electric modulating or two-position action as required.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
2. Size for torque required for damper seal at load conditions.

3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (coordinate with Controls contractor).
6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.
7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.
8. Actuator timing shall meet 15 sec.
9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.

G. Damper blade position end switches: Factory installed damper position switch package for both full open and full closed indication (equivalent to Ruskin SP100 switch package).

H. Test Switch: Damper mounted momentary “test” push-button switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.

1. Include damper mounted “open” and “closed” indication lights on switch plate for connection to factory installed damper blade position end switches.

2.09 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Air Balance, Inc.; Mestek, Inc
2. Greenheck Fan Corporation.
3. NCA; a brand of Metal Industries Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. General Description: Combination fire and smoke dampers shall be labeled according to UL 555 and UL 555S. Leakage shall not exceed 10 cfm per square foot at 1 inch WG differential pressure (Leakage Class II).

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.

D. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.

E. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.

F. Mounting Sleeve: Factory-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

G. Rated pressure and velocity to exceed design airflow conditions.

H. Damper Actuators: Electric modulating or two-position action as required.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.

2. Size for torque required for damper seal at load conditions.

3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.

4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (coordinate with Controls contractor).

6. Power Requirements (Proportional): Maximum (running) 12 VA at 24-V ac or 8 W at 24-V dc. Maximum (holding) 5VA at 24-V ac or 3 W at 24-V dc holding.

7. Proportional Actuators (24V ac/dc): Control signal shall be 0-10vdc, 2-10vdc or 4-20mA as required to operate with associated controller. Include position feedback signal for 0-10vdc, 2-10vdc or 4-20mA as required to be monitored by associated controller.

8. Actuator timing shall meet 15 sec.

9. Temperature Rating: Actuator shall have a UL555S listing by the damper manufacturer for 250 deg F.

I. Manual Heat Responsive Fuse Link with Reset and Damper Blade Position End Switches: Factory installed manual heat responsive fuse link with reset switch / damper position switch package for both full open and full closed indication (equivalent to Ruskin TS150 switch package).

J. Test Switch: Damper mounted momentary “test” push-button switch rated for 24V or 120V as required to allow testing and/or maintenance of motorized dampers.

1. Include damper mounted “open” and “closed” indication lights on switch plate for connection to factory installed damper blade position end switches.

2.10 DUCT SILENCERS (FIBERGLASS FILL)

A. Manufacturers:

1. IAC Acoustics; a Division of Sound Seal.

2. Price Industries.

3. Ruskin Company.

4. VAW Systems Ltd.

5. Vibro-Acoustics; A Swegon Group Company.

B. General Requirements:

1. Factory fabricated.

2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.

C. Rectangular Units: Unless otherwise scheduled on the Drawings, fabricate casings with a minimum of 20 gage, solid galvanized sheet metal for outer casing and 22 gage, ASTM A 653/A 653M, G90, perforated galvanized sheet metal for inner casing.

D. Round Units: Unless otherwise scheduled on the Drawings:

1. Outer Casings:

a. ASTM A 653/A 653M, G90, galvanized sheet steel.

b. Up to 8 Inches in Diameter: 24 gage.

c. 9 through 22 Inches in Diameter: 22 gage.

d. 24 through 36 Inches in Diameter: 20 gage.

e. 38 through 50 Inches in Diameter: 18 gage.

f. 52 through 60 Inches in Diameter: 16 gage.

g. Casings fabricated of spiral lock-seam duct may be one gage thinner than that indicated.

2. Interior Casing, Partitions, and Baffles:

a. ASTM A 653/A 653M, G90, galvanized sheet steel, or aluminum to match duct system material.

b. At least 24 gage thick and designed for minimum aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

F. Fill Material: Inert and vermin-proof fibrous glass material, packed under not less than 5 percent compression.

G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.

1. Do not use nuts, bolts, or sheet metal screws for unit assemblies.

2. Lock form and seal or continuously weld joints.

3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.

4. Reinforcement: Cross or trapeze angles for rigid suspension.

H. Source Quality Control:

1. Acoustic Performance: Test according to ASTM E 477.

a. Tests performed in NVLAP accredited laboratory.

b. Include accreditation certificate with submittals.

c. Submittals from non-NVLAP accredited facilities will not be accepted.

2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.

3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.11 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.

2.12 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.

2.13 GREASE DUCT ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Flame Gard Inc.
3. 3M.

B. Description: Factory-fabricated, -listed, and -labeled, double-wall personnel and maintenance access doors 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.

1. Construction: 0.0625 inch ASTM A 666, Type 304 stainless-steel inner shell; and aluminized-steel indoor or stainless-steel outdoor outer cover with two handles.
2. Fasteners: Stainless-steel bolts and wing nuts.
    a. Ensure that bolts do not penetrate interior of duct space.
3. Maintenance Access Door Dimensions: Minimum 7 x 7 inches.
4. Personnel Access Door Dimensions: Minimum 24 x 24 inches.
5. Door Label: Mark door with uppercase lettering as follows: "ACCESS PANEL. DO NOT OBSTRUCT."

C. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

D. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.14 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.

2.15 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.

2.16 **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.

2.17 **DUCT ACCESSORY HARDWARE**

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.18 **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 heal 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

SECTION 23 3423 - POWER VENTILATORS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Motors.”
3. Division 20 Section “Variable Frequency Controllers.”
4. Division 23 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air moving equipment.

1.02 PERFORMANCE REQUIREMENTS

A. Classify according to AMCA 99.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.

6. Roof curbs.
7. Fan speed controllers.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

B. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For power ventilators to include in 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 **COORDINATION**

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."

1.09 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-drive unit.

PART 2 PRODUCTS

2.01 **CEILING-MOUNTING VENTILATORS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent.
2. Greenheck Fan Corporation; Models SP and CSP.
3. Loren Cook Company.
4. PennBarry.
5. Soler & Palau.

B. Description: Centrifugal fans designed for installing in ceiling or wall or for concealed in-line applications.

C. Housing: Steel, lined with acoustical insulation.

D. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

E. Grille: Aluminum, louvered grille with flange on intake and thumbscrew attachment to fan housing.

F. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Motion Sensor: Motion detector with adjustable shutoff timer.
3. Filter: Washable aluminum to fit between fan and grille.
4. Isolation: Rubber-in-shear vibration isolators.
5. Manufacturer's standard roof jack, or brick, vent, and transition fittings.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.02 **IN-LINE CENTRIFUGAL FANS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing.
2. Aerovent.
3. Greenheck Fan Corporation; SQ/BSQ Series.
4. Loren Cook Company.
5. Moffitt Corporation.
6. PennBarry.

7. Soler & Palau.

B. Description: In-line, direct-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Casing: Rectangular or cylindrical, flanged.

D. Throat and Mounting Assembly: One-piece spun aluminum or continuously welded assembly.

1. Stiffeners: Continuously welded.

2. Bolts, nuts, rivets, and washers: Cadmium plated.

3. Nuts: Self-locking type, vibration proof.

E. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

F. Fan Wheels: Aluminum, backward curved airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”

2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.

3. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

4. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

I. Vibration Isolators: Refer to Division 20 Section “Mechanical Vibration Controls.”

2.03 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing; Acme Fan Group; Models PRN and PV.

2. Twin City Fan Company.

3. Greenheck Fan Corporation; Models G.

4. Loren Cook Company; Models ACED and ACES.

5. Moffitt Corporation.

6. PennBarry; Domex.

7. Soler & Palau.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.

3. Sheaves: Cast-iron, adjustable-pitch motor sheave.

4. Fan and motor isolated from exhaust airstream.

5. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

F. Accessories:

1. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

G. Provide prefabricated roof curbs for each fan.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.04 **UPBLAST CENTRIFUGAL ROOF VENTILATORS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing.
2. Twin City Fan Company.
3. Greenheck Fan Corporation; CUBE Series.
4. Loren Cook Company.
5. Moffitt Corporation.
6. PennBarry; Fumex.
7. Soler & Palau.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Sheaves: Cast-iron, adjustable-pitch motor sheave.
4. Fan and motor isolated from exhaust airstream.
5. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

F. Accessories:

1. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

G. Provide prefabricated roof curbs for each fan.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.05 KITCHEN HOOD EXHAUST FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Manufacturing; Models PDURG and PNURG.
2. Twin City Fan Company.
3. Greenheck Fan Corporation; CUBE Series.
4. Soler & Palau.
5. Loren Cook Company.
6. Moffitt Corporation.
7. PennBarry; Fumex with Fatrap.
8. CaptiveAire

B. Description: UL 762 labeled belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, heat baffle, curb base, and accessories.

C. Housing: Spun-aluminum construction with square, one-piece, aluminum base with venturi inlet cone. Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains, grease collector, and drain connection.

1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Sheaves: Cast-iron, adjustable-pitch motor sheave.
4. Fan and motor isolated from exhaust airstream.
5. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

F. Accessories:

1. Variable Frequency Controller: Refer to Division 20 Section “Variable Frequency Controllers.”
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

G. Provide prefabricated roof curbs for each fan. Provide vented curb extension as required to locate fan discharge at a minimum of 40 inches above the roof.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.06 ROOF CURBS AND ACCESSORIES

A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:

a. Creative Metals.

b. The Pate Company.

c. Roof Products & Systems.

d. Thybar Corporation.

e. Any of the approved roof mounted exhaust fan manufacturers.

2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.

3. Height: Curb shall extend a minimum 8 inches above top surface of roof insulation.

4. Sound Curb: Curb with sound-absorbing insulation matrix.

5. Metal Liner: Galvanized steel.

6. Burglar Bars: Minimum 1/2-inch- thick steel bars welded in place to form 6-inch squares.

7. Mounting Pedestal: Galvanized steel with removable access panel.

B. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:

a. Creative Metals.

b. The Pate Company.

c. Roof Products & Systems.

d. Thybar Corporation.

e. Any of the approved roof mounted exhaust fan manufacturers.

2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.

3. Height: Curb shall extend a minimum 8 inches above top surface of roof insulation.

4. Sound Curb: Curb with sound-absorbing insulation matrix.

5. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.

6. Metal Liner: Galvanized steel.

7. Burglar Bars: Minimum 1/2-inch- thick steel bars welded in place to form 6-inch squares.

8. Mounting Pedestal: Galvanized steel with removable access panel.

2.07 **MOTORS**

A. Comply with requirements in Division 20 Section "Motors."

2.08 **SOURCE QUALITY CONTROL**

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install power ventilators level and plumb.

B. Install floor-mounting units as specified in Division 20 Section "Mechanical Vibration Controls."

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 20 Section "Mechanical Vibration Controls."

F. Install units with clearances for service and maintenance.

G. Label units according to requirements specified in Division 20 Section "Mechanical Identification."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor sheaves as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 23 3600 - AIR TERMINAL UNITS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Metal Ducts.”
3. Division 23 Section “Temperature Controls.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Liners and adhesives.
2. Sealants and gaskets.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
2. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.

3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

1.04 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For air terminal units to include in operation and maintenance manuals. Include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.05 **QUALITY ASSURANCE**

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.06 **COORDINATION**

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.07 **EXTRA MATERIALS**

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan-Powered-Unit Filters: Furnish one spare filter(s) for each filter installed.

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 **SINGLE-DUCT AIR TERMINAL UNITS**

A. Manufacturers:

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. Configuration: Variable and constant volume, medium pressure terminal units with casing, 24 volt control transformer, electrical service disconnect switch, 100 percent tight shutoff volume regulator, velocity sensor, and sound attenuating thermal insulation.

C. Casing: Constructed of 0.034-inch mill galvanized steel or 0.032-inch aluminum.

1. Casing Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.

2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Velocity Sensor: Multipoint averaging array. Sensor located in air inlet.

F. Attenuator Section: 0.034-inch mill galvanized steel or 0.032-inch aluminum sheet metal.
1. Lining: 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.

G. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:
1. Primary and secondary overtemperature protection.
2. Nickel chrome 80/20 heating elements.
3. Airflow switch.
4. Noninterlocking disconnect switch.
5. Fuses (for coils more than 48 A).
6. SCR power controller.

H. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Temperature Controls."

I. Control Sequence: Refer to Temperature Control Diagrams on Drawings.

2.03 PARALLEL FAN-POWERED AIR TERMINAL UNITS

A. Manufacturers:
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. Configuration: Parallel-Variable volume, medium pressure fan powered terminal units with casing, volume regulator, internally vibration isolated fan and motor, inlet and discharge connections, 100 percent tight shutoff, fan anti-backward rotation feature, and sound attenuation thermal insulation.

C. Casing: 0.034-inch mill galvanized steel or 0.032-inch aluminum.
1. Casing Lining: Adhesive attached, 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
a. Cover liner with nonporous foil.
2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.

5. Fan: Forward-curved centrifugal, located at plenum air inlet.

D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

E. Velocity Sensor: Multipoint averaging array. Sensor located in air inlet.

F. Fan Section: Galvanized-steel plenum, with direct-drive, forward-curved fan with air filter and backdraft damper.

1. Lining: Minimum 1-inch- thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.

2. Motor: Multispeed, permanently lubricated, ECM motor.

a. Speed Control: Compatible with fan motor provided, infinitely adjustable with pneumatic-electric and electronic controls. Do not adjust below manufacturer recommended minimum rpm.

b. Fan-Motor Assembly Isolation: Rubber isolators.

G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Material: Polyurethane foam having 70 percent arrestance and 3 MERV.

2. Material: Glass fiber treated with adhesive; having 80 percent arrestance and 5 MERV.

3. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.

H. Electric Heating Coil: Slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:

1. Primary and secondary overtemperature protection.

2. Nickel chrome 80/20 heating elements.

3. Fan interlock contacts.

4. Noninterlocking disconnect switch.

5. Fuses (for coils more than 48 A).

6. SCR power controller.

I. Factory-Mounted and -Wired Controls: Electrical components shall be mounted in control box with removable cover. Incorporate single-point electrical connection to power source.

1. Control Transformer: Factory mounted for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.

2. Wiring Terminations: Fan and controls to terminal strip, and terminal lugs shall match quantities, sizes, and materials of branch-circuit conductors. Enclose terminal lugs in terminal box that is sized according to NFPA 70.

J. Control Panel Enclosure: NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

K. DDC Controls: Single-package unitary controller and actuator specified in Division 23 Section "Temperature Controls."

L. Control Sequence: Refer to Temperature Control Diagrams on Drawings.

2.04 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Steel Cables: Galvanized steel complying with ASTM A 603.

C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.05 **SOURCE QUALITY CONTROL**

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

B. Verification of Performance: Rate air terminal units according to AHRI 880.

C. Acoustical Applications and Sound Evaluation: Based on AHRI Standard 885-98, “Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.”

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.02 **HANGER AND SUPPORT INSTALLATION**

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached. Refer to Division 20 Section “Hangers and Supports” for additional information.

1. Where practical, install concrete inserts before placing concrete.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot Water Piping: Unless otherwise indicated:

1. Install union and isolation valve on supply-water connection.

2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.

3. Hydronic specialties are specified in Division 23 Section "Hydronic Piping."

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Ground units with electric heating coils according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

G. 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. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
2. Verify that controls and control enclosure are accessible.
3. Verify that control connections are complete.
4. Verify that nameplate and identification tag are visible.
5. Verify that controls respond to inputs as specified.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

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 23 3716 - FABRIC AIR-DISTRIBUTION DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section "Metal Ducts.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For fabric air-distribution devices.

1. Include plans, elevations, sections, and suspension and attachment details.

B. Samples for Initial Selection: For diffusers with factory-applied color finishes.

C. Samples for Verification: For diffusers, in manufacturer's standard sizes to verify color selected.

D. Diffuser Schedule: Use same designations indicated on Drawings. Indicate room location, quantity, model number, size, and accessories furnished.

E. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

F. Source quality-control reports.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductsox Corporation.
2. FabricAir, Inc.

3. KE Fibertec.

2.02 **FABRIC DUCTS**

A. Performance Requirements: Classified by UL in accordance with the 25/50 flame spread/smoke developed requirements of NFPA 90A.

B. Material: Air diffusers shall be constructed of a woven fire retardant fabric complying with the following physical characteristics:

1. Fabric: Polyester, treated with machine wash-able anti-microbial agent by the fabric manufacturer, of a non-linting filament yarn to meet the requirements of ISO Class 3 environment, and flame retardant.

a. Fire Retardancy: Classified by Underwriters Laboratories in accordance with the flame spread/smoke developed requirements NFPA 90, and UL 2518.

b. Weight: 6.8 oz./sq yd in accordance with ASTM D3776

c. Color: Color as selected by Architect.

d. Fabric Porosity: 2 (+2/-1) cfm/sq ft in accordance with ASTM D737, Frazier.

e. Temperature Range: 0 deg F to 180 deg F.

f. Antimicrobial agent shall be proven 99 percent effective after 10 laundry cycles in accordance with AATCC Test Method 100.

2. Shape: Round.

C. System Fabrication Requirements:

1. Textile system constructed in modular lengths (zippered) with proper securing clips, inlets, end caps, and mid-sections.

2. Integrated air dispersion shall be:

a. Linear Vents:

1) Air dispersion accomplished by linear vent and permeable fabric. Linear vents must be sized in 1 CFM per linear foot increments (based on 0.5 inch static pressure), starting at 1 CFM through 90 CFM per linear foot. Linear vent is to consist of an array of open orifices rather than a mesh style vent to reduce maintenance requirements of mesh style vents. Linear vents should also be designed to minimize dusting on fabric surface.

2) Size of vent openings and location of linear vents to be specified and approved by manufacturer.

3. Inlet connection to metal duct via fabric draw band with anchor patches as supplied by manufacturer. Anchor patches shall be secured to metal duct via. zip screw fastener (supplied by contractor).

4. Inlet Connection: Include zipper for easy removal and maintenance.

5. Lengths shall include required intermediate zippers as specified by manufacturer.

6. System shall include adjustable flow devices to balance turbulence, airflow and distribution as needed. Flow restriction device shall include ability to adjust the airflow resistance from 0.06 to 0.60 in wg static pressure.

7. End Cap: Include zipper for easy maintenance.

8. Each section of fabric duct shall include identification labels documenting order number, section diameter, section length, piece number, code certifications and other pertinent information.

D. Design Requirements:

1. Designed for 0.5 inch water gage, yielding maximum operating pressure of 3.1 inches water gage.
2. Fabric diffusers limited to design temperatures between 10 deg F and 180 deg F.
3. Design cfm, static pressure, and diffuser length shall be designed or approved by manufacturer.
4. Do not use fabric diffusers in concealed locations.
5. Use fabric diffusers for positive pressure air distribution components of the mechanical ventilation system only.

E. Suspension Hardware:

1. Internal Hoop System and Extruded Track Suspension System: (Available for duct diameters from 8-inches to 60 inches). System consists of metallic internal hoops spaced 5 feet apart and attached to the interior of the fabric duct. Suspension system consists of 8 foot sections of extruded track, couplers, end caps, locking cable drop supports or surface mount clips, and gliders spaced every 24 inches. Extruded track sections bent to follow centerline radius of radius elbows as required.

PART 3 EXECUTION

3.01 INSTALLATION

A. Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

3.02 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3723 - AIR INTAKE AND RELIEF HOODS

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 ventilator assemblies provided as part of the general construction.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Power Ventilators" for roof-mounting exhaust fans.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads, and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.

B. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which roof curbs and ventilators will be attached.
2. Sizes and locations of roof openings.

C. Samples for Verification: For each type of exposed finish required for intake and relief ventilators.

D. Welding certificates.

1.05 **QUALITY ASSURANCE**

A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."

2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.06 **COORDINATION**

A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

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 **MATERIALS**

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.

2. Use Phillips flat, hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.

E. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.03 **FABRICATION, GENERAL**

A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.04 **GRAVITY INTAKE AND RELIEF HOODS (ALUMINUM ROUND MUSHROOM STYLE)**

A. Manufacturers:

1. Acme Engineering & Manufacturing.
2. Greenheck Fan Corporation; Model GRS.
3. Loren Cook Company.
4. PennBarry; Division of Air System Components.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and spun aluminum hood; suitably reinforced.

D. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire or flattened, expanded aluminum, 3/4 by 0.050 inch thick.

2.05 **GRAVITY INTAKE AND RELIEF HOODS (RECTANGULAR)**

A. Manufacturers:

1. Acme Engineering & Manufacturing.
2. Greenheck Fan Corporation; Fabra-Hood.
3. Loren Cook Company.
4. Moffitt Corporation.
5. PennBarry; Division of Air System Components.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

C. Materials: Aluminum sheet, minimum 0.063-inch- thick base and 0.050-inch- thick hood; suitably reinforced.

D. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

2.06 **GOOSENECKS**

A. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 5-5; with a minimum of 0.052-inch- thick, galvanized-steel sheet.

B. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

C. Galvanized-Steel Sheet Finish:

1. Surface Preparation: Clean surfaces of dirt, grease, and other contaminants. Clean welds, mechanical connections, and abraded areas and repair galvanizing according to

ASTM A 780. Apply a conversion coating suited to the organic coating to be applied over it.

2. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply an air-dried primer immediately after cleaning and pretreating.

3. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat and an overall minimum dry film thickness of 2 mils.

   a. Color and Gloss: As indicated by manufacturer's designations.

2.07 **ACCESSORIES**

A. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inchchemically treated wood nailer. Size as required to suit roof opening and hood base.

1. Manufacturers: Roof curbs shall be provided by the hood manufacturer, or one of the following:

   a. Creative Metals.

   b. Pate.

   c. Roof Products & Systems.

   d. ThyCurb.

   e. Any of the listed hood manufacturers.

2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.

3. Height: Curb shall extend a minimum 9-1/2 inches above top surface of roof insulation.

B. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and hood base.

1. Manufacturers: Roof curbs shall be provided by the hood manufacturer, or one of the following:

   a. Creative Metals.

   b. The Pate Company.

   c. Roof Products & Systems.

   d. Thybar Corporation.

   e. Any of the listed hood manufacturers.

2. Configuration: Built-in raised cant with step dimension matching insulation thickness, with mounting flange, and suitable for sloped roofs with uniform insulation thickness.

3. Height: Curb shall extend a minimum 9-1/2 inches above top surface of roof insulation.

4. Pitch Mounting: Manufacture curb for roof slope, top of curb shall be level.

C. Motorized Backdraft Damper: Refer to DAMPERS – AUTOMATED in Division 23 Section “Temperature Controls.”

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install intake and relief hoods level, plumb, and at indicated alignment with adjacent work.

B. Secure intake and relief hoods to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible.

C. Install goosenecks on curb base where throat size exceeds 9 by 9 inches.

D. Install intake and relief hoods with clearances for service and maintenance.

E. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

F. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.

G. Label intake and relief hoods according to requirements specified in Division 20 Section "Mechanical Identification."

H. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

I. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.02 **CONNECTIONS**

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.

3.03 **ADJUSTING**

A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 23 5100 - BREECHING, CHIMNEYS, AND STACKS

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 23 Section “Metal Ducts” for double-wall factory fabricated grease duct.

1.02 ACTION SUBMITTALS

A. Product Data: For the following:

1. Type B and BW vents.
2. Listed double-wall stacks.
3. Special gas vents.
4. Guy wires and connectors.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For vents, breeching, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
2. Provide engineered sizing data.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.

B. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.05 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 MATERIALS

A. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.02 LISTED SPECIAL GAS VENT

A. Manufacturers:

1. Cleaver-Brooks, Inc.; CBHL.
2. DuraVent, Inc.; dba DuraVent/Security Chimneys.
3. Heat-Fab, Inc.; Hart & Cooley, Inc.; Model Saf-T Vent CI.
4. Metal-Fab Inc.; Model Corr/Guard.
5. Schebler Chimney Systems; eVent.
6. Selkirk Inc.; Hart & Cooley, Inc.; Selkirk Metalbestos; Model DCV.
7. Van-Packer Co.; Model CS.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 550 deg F continuously, with positive, negative, or neutral flue pressure, complying with NFPA 211 and suitable for condensing gas-fired appliances.

C. Construction: Inner shell and outer jacket separated by at least 3/32-inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, 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.

1. Termination: Round chimney top design to exclude 98 percent of rainwater. A “Pointed Hat” stack cap is not acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

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

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATION

A. Listed Special Gas Vent: Condensing gas appliances, and direct vented finned water-tube boilers and water heaters.

3.03 INSTALLATION OF LISTED VENTS, CHIMNEYS AND STACKS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing, local regulations, or NFPA 211, whichever is most stringent.

B. Seal between sections of positive-pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

C. Support vents at intervals recommended by manufacturer to support weight of vents and all accessories, without exceeding appliance loading.

D. Slope breeching down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

3.04 **CLEANING**

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breeching internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breeching, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION

SECTION 23 5216 - CONDENSING BOILERS

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 23 Section “Water Treatment for Closed-Loop Hydronic Systems” for corrosion inhibitors required for modular cast-aluminum condensing boilers.
4. Division 23 Section "Breeching, Chimneys, and Stacks.”

1.02 ACTION SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Source quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For boilers to include in operation and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.05 **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. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a NRTL acceptable to authorities having jurisdiction.

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.

1.07 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

PART 2 PRODUCTS

2.01 **STAINLESS STEEL VERTICAL FIRE-TUBE CONDENSING BOILERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AERCO International; Benchmark Series.
2. Cleaver-Brooks; CFC Series.
3. Fulton Boiler Works, Inc.; Endura Series.
4. HTP (Heat Transfer Products); UFT Series and EFT Series
5. Lochinvar Corporation; Knight KH Series Fire Tube Boilers, FTXL, and Crest Series.
6. Patterson Kelle, Solis Series.

B. Description: Factory-fabricated, -assembled, and -tested, vertical fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.

C. Heat Exchanger: Corrosion-resistant stainless steel combustion chamber.

D. Pressure Vessel: Stainless steel with welded heads and tube connections.

E. Burner: Natural gas, forced draft.

F. Blower: Centrifugal fan to operate during each burner firing sequence and to pre-purge and post-purge the combustion chamber.

1. Motors: Comply with requirements specified in Division 20 Section "Motors."
    a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

I. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures: NEMA 250, Type 1A.

3. Finish: Baked-enamel or powder-coated protective finish.
4. Insulation: Minimum 2-inch- thick, mineral-fiber or polyurethane-foam insulation surrounding the heat exchanger.
5. Combustion-Air Connections: Inlet and vent duct collars.
6. Mounting base to secure boiler.

J. Characteristics and Capacities: Refer to Schedule on Drawings.

2.02 **HOT-WATER BOILER TRIM**

A. Include devices sized to comply with ANSI B31.9, "Building Services Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.

C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Manual.

F. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.03 **CONTROLS**

A. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
4. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature.
    a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.
5. Provide contacts for connection to remote shutdown switch(es). Activation of remote shutdown switch shall cut power to the burner controls. Refer to Division 23 Section “Temperature Controls” for remote shutdown switches.

B. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.
3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

C. Building Management System Interface: Factory install hardware and software to enable building management system to monitor, control, and display boiler status and alarms.

1. A communication interface with building management system shall enable building management system operator to remotely control and monitor the boiler from an operator

workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building management system.

2.04 **ELECTRICAL POWER**

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to lockable, nonfused disconnect switch.
5. Provide branch power circuit to each motor and to controls.
6. Provide each motor with overcurrent protection.

2.05 **ACCESSORIES**

A. Flue Side Condensate Neutralizer:

1. Description: Designed to raise the PH level of flue side condensate to near neutral prior to condensate entering the sanitary drainage system.
2. Materials: Neutralizer constructed of PVC pipe and fittings mounted on channel strut base with galvanized or stainless steel clamps and hardware; and charged with calcium carbonate.
3. Manufacturers:
   a. Axion Industries Ltd.; NeutraPal and NeutraPro Series.
   b. BKI Industries, Inc.; Acid Neutralizer Kits.
   c. J.J.M. Boiler Works; JM Neutralizing Tubes.
   d. Neutrasafe Corporation; Neutra-Safe Condensate Neutralizers.
   e. Any of the approved boiler manufacturers.

2.06 **SOURCE QUALITY CONTROL**

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **BOILER INSTALLATION**

A. Install boilers level on concrete base. Concrete base is specified in Division 20 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 03.

B. Install natural gas-fired boilers according to NFPA 54.

C. Install propane-fired boilers according to NFPA 58.

D. Assemble and install boiler trim.

E. Install electrical devices furnished with boiler but not specified to be factory mounted.

F. Install control wiring to field-mounted electrical devices.

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from boiler flue gas condensate drain connection to condensate neutralizer, and from condensate neutralizer to nearest floor drain. Piping shall be PEX or CPVC at least full size of connection.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Boiler Venting:

1. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."

I. Ground equipment according to Division 26 Section "Grounding and Bonding."

J. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 **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 components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. 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 during other than normal occupancy hours for this purpose.

3.05 **DEMONSTRATION**

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

END OF SECTION

SECTION 23 6514 - CLOSED-CIRCUIT, MECHANICAL-DRAFT COOLING TOWERS

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. BAS: Building automation system.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, pressure drop, fan performance data, rating curves with selected points indicated, furnished specialties, and accessories.

1. Maximum flow rate.
2. Minimum flow rate.
3. Drift loss as percent of design flow rate.
4. Sound power levels in eight octave bands for operation with fans off, fans at minimum, and design speed.
5. Performance curves for the following:
    a. Varying entering-water temperatures from design to minimum.
    b. Varying ambient wet-bulb temperatures from design to minimum.
    c. Varying water flow rates from design to minimum.
    d. Varying fan operation (off, minimum, and design speed).
6. Fan airflow, brake horsepower, and drive losses.

7. Pump flow rate, head, brake horsepower, and efficiency.
8. Motor amperage, efficiency, and power factor at 100, 75, 50, and 25 percent of nameplate horsepower.
9. Electrical power requirements for each cooling tower component requiring power.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Complete set of manufacturer's prints of cooling tower assemblies, control panels, sections and elevations, and unit isolation. Include the following:
1. Assembled unit dimensions.
2. Weight and load distribution.
3. Required clearances for maintenance and operation.
4. Sizes and locations of piping and wiring connections.
5. Wiring Diagrams: For power, signal, and control wiring.

B. Delegated-Design Submittal: For cooling tower support structure indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of support structure.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
3. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

C. Coordination Drawings: Floor plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Structural supports.
2. Piping roughing-in requirements.
3. Wiring roughing-in requirements, including spaces reserved for electrical equipment.
4. Access requirements, including working clearances for mechanical controls and electrical equipment, and tube pull and service clearances.

D. Certificates: For certification required in "Quality Assurance" Article.

E. Source quality-control reports.

1.05 **CLOSEOUT SUBMITTALS**

A. Startup service reports.

B. Operation and Maintenance Data: For each cooling tower to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Testing Agency Qualifications: Certified by CTI.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. ASME Compliance: Fabricate and label heat-exchanger coils to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. CTI Certification: Cooling tower thermal performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

1.07 **COORDINATION**

A. Coordinate sizes, locations, and anchoring attachments of structural-steel support structures.

PART 2 PRODUCTS

2.01 **CLOSED-CIRCUIT, INDUCED-DRAFT, COUNTERFLOW COOLING TOWERS**

A. Products: Subject to compliance with requirements, provide one of the following:

1. Baltimore Aircoil Company, Inc.; AMSTED Industries.
2. EVAPCO, Inc.
3. Recold; SPX Cooling Technologies, Inc.

B. Cooling tower designed to resist wind load of 30 lbf/sq. ft.

C. Casing and Frame:

1. Casing and Frame Material: Galvanized steel, ASTM A 653/A 653M, G235 coating.
2. Fasteners: Galvanized steel.
3. Joints and Seams: Sealed watertight.
4. Welded Connections: Continuous and watertight.

D. Casing Insulation: Closed-cell, flexible elastomeric, thermal insulation complying with ASTM C 534, Type II, for sheet materials.

1. Thickness: 1 inch.
2. Adhesive: As recommended by insulation manufacturer.
3. Factory apply insulation.
   a. Apply adhesive to 100 percent of insulation contact surface.
   b. Seal seams and joints.
   c. After adhesive has fully cured, apply two coats of protective coating to insulation.

E. Collection Basin:

1. Material: Stainless steel.
2. Overflow and drain connections.
3. Makeup water connection.

F. Mechanically Operated, Collection Basin Water-Level Control: Manufacturer's standard adjustable, mechanical float assembly and valve.

G. Electric Basin Heater:

1. Stainless-Steel Electric Immersion Heaters: Installed in a threaded coupling on the side of the collection basin.
2. Heater Control Panel: Mounted on the side of each cooling tower cell.
3. Enclosure: NEMA 250, Type 4.
4. Magnetic contactors controlled by a temperature sensor/controller to maintain collection basin water-temperature set point. Water-level probe shall monitor cooling tower water level and de-energize the heater when the water reaches low-level set point.
5. Control-circuit transformer with primary and secondary side fuses.
6. Terminal blocks with numbered and color-coded wiring to match wiring diagram.

7. Single-point, field-power connection to a nonfused disconnect switch and heater branch circuiting complying with NFPA 70.
8. Factory Wiring Method: Metal raceway for factory-installed wiring outside of enclosures, except make connections to each electric basin heater with liquidtight conduit.
9. Heaters sized to maintain 40 deg F pan water temperature with fan and pump off to prevent pan freeze-up to minus 20 deg F and interlocked with spray pump so heaters are de-energized when spray pump is running.

H. Pressurized Water Distribution Piping: Main header and lateral branch piping designed for even distribution over heat-exchanger coil or fill throughout the flow range without the need for balancing valves and for connecting individual, removable, non-clogging spray nozzles.

1. Pipe Material: Schedule 40 PVC.
2. Spray Nozzle Material: ABS Plastic with internal sludge ring. Threaded into spray branches.
3. Piping Supports: Corrosion-resistant hangers and supports to resist movement during operation and shipment.

I. Recirculating Piping: Schedule 40 PVC.

J. Spray Pump: Close-coupled, end-suction, single-stage, bronze-fitted centrifugal pump; with suction strainer and flow balancing valve, and mechanical seal suitable for outdoor service.

K. General Requirements for Spray Pump Motor: Comply with NEMA designation and temperature-rating requirements specified in Division 20 Section "Motors" and not indicated below.

1. Motor Enclosure: Totally enclosed.
2. Energy Efficiency: NEMA Premium Efficient.
3. Service Factor: 1.15.

L. Heat-Exchanger Coils:

1. Tube and Tube Sheet Materials: Prime-coated steel tube and sheet with outer surface of tube and sheet hot-dip galvanized after fabrication.
2. ASME Compliance: Designed, manufactured, and tested according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1 and bearing ASME "U" stamp; and sloped for complete drainage of fluid by gravity.
3. Field Piping Connections: Vent, supply, and return suitable for mating to ASME B16.5, Class 150 flange.

M. Removable Drift Eliminator:

1. Material: PVC.
2. UV Treatment: Inhibitors to protect against damage caused by UV radiation.
3. Configuration: Multi-pass, designed and tested to reduce water carryover to achieve performance indicated.

N. Air-Intake Louvers:

1. Material: PVC.
2. UV Treatment: Treat louvers with inhibitors to protect against damage caused by UV radiation.
3. Louver Blades: Arranged to uniformly direct air into cooling tower, to minimize air resistance, and to prevent water from splashing out during all modes of operation including operation with fans off.

O. Axial Fan: Balanced at the factory after assembly.

1. Blade Material: Aluminum.
2. Hub Material: Aluminum.
3. Protective Enclosure: Removable, galvanized-steel, wire-mesh screens complying with OSHA regulations.
4. Fan Shaft Bearings: Self-aligning ball or roller bearings with moisture-proof seals and premium, moisture-resistant grease suitable for temperatures between minus 20 and plus 300 deg F. Bearings designed for an L-10 life of 75,000 hours.
5. Bearings Grease Fittings: Extended lubrication lines to an easily accessible location.

P. Belt Drive:

1. Service Factor: 1.5 based on motor nameplate horsepower.
2. Sheaves: Fan and motor shafts shall have taper-lock sheaves fabricated from corrosion-resistant materials.
3. Belt: One-piece, multi-grooved, solid-back belt.
4. Belt Material: Oil resistant, non-static conducting, and constructed of neoprene polyester cord.
5. Belt-Drive Guard: Comply with OSHA regulations.

Q. Fan Motor:

1. General Requirements for Fan Motors: Comply with NEMA designation and temperature-rating requirements specified in Division 23 Section "Motors."
2. Motor Enclosure: Totally enclosed air over (TEAO) or totally enclosed fan cooled (TEFC).
3. Energy Efficiency: Comply with ASHRAE/IESNA 90.1.
4. Service Factor: 1.15.
5. Insulation: Class H.
6. Variable-Speed Motors: Inverter-duty rated per NEMA MG-1, Section IV, "Performance Standard Applying to All Machines," Part 31, "Definite-Purpose, Inverter-Fed, Polyphase Motors."
    a. Internal heater automatically energized when motor is de-energized.
7. Motor Base: Adjustable, or having other suitable provisions for adjusting belt tension.

R. Discharge Hoods:

1. Hood Configuration: Totally surrounding drift eliminators and constructed of same material as casing; and having factory-installed insulation and access doors.
2. Discharge Dampers: Positive-closure, automatic, isolation dampers with electric actuators.
    a. Provide field power and controls to open dampers when pump is energized and close dampers when pump is de-energized.

S. Vibration Switch: For each fan drive.

1. Enclosure: NEMA 250, Type 4.
2. Vibration Detection: Sensor with a field-adjustable, acceleration-sensitivity set point in a range of 0 to 1 g and frequency range of 0 to 3000 cycles per minute. Cooling tower manufacturer shall recommend switch set point for proper operation and protection.
3. Provide switch for field connection to a BAS and hardwired connection to fan motor electrical circuit.

4. Switch shall, on sensing excessive vibration, signal an alarm through the BAS and shut down the fan.

T. Controls: Comply with requirements in Division 23 Section "Temperature Controls."

U. Personnel Access Components:

1. Doors: Large enough for personnel to access cooling tower internal components from both cooling tower end walls. Doors shall be operable from both sides of the door.

2. External Ladders with Safety Cages: Aluminum, galvanized- or stainless-steel, fixed ladders with ladder extensions to access external platforms and top of cooling tower from adjacent grade without the need for portable ladders. Comply with 29 CFR 1910.27.

3. External Platforms with Handrails: Aluminum, FRP, or galvanized-steel bar grating at cooling tower access doors when cooling towers are elevated and not accessible from grade.

4. Handrail: Aluminum, galvanized steel, or stainless steel complete with kneerail and toeboard, around top of cooling tower. Comply with 29 CFR 1910.23.

5. Internal Platforms: Aluminum, FRP, or galvanized-steel bar grating.

a. Spanning the collection basin from one end of cooling tower to the other and positioned to form a path between the access doors. Platform shall be elevated so that all parts are above the high water level of the collection basin.

b. Elevated internal platforms with handrails accessible from fixed vertical ladders to access the fan drive assembly when out of reach from collection basin platform.

V. Capacities and Characteristics: As scheduled on the Drawings.

2.02 **SOURCE QUALITY CONTROL**

A. Verification of Performance: Test and certify cooling tower performance according to CTI STD 201, "Certification Standard for Commercial Water-Cooling Towers Thermal Performance."

B. Factory pressure test heat exchangers after fabrication and prove to be free of leaks.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Before cooling tower installation, examine roughing-in for tower support, anchor-bolt sizes and locations, piping, and electrical connections to verify actual locations, sizes, and other conditions affecting tower performance, maintenance, and operation.

1. Cooling tower locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install cooling towers on support structure indicated.

B. Equipment Mounting:

1. Comply with requirements for vibration isolation devices specified in Division 20 Section "Mechanical Vibration Controls."

C. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Maintain manufacturer's recommended clearances for service and maintenance.

E. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to cooling towers to allow service and maintenance.

C. Install flexible pipe connectors at pipe connections of cooling towers mounted on vibration isolators.

D. Provide drain piping with valve at cooling tower drain connections and at low points in piping.

E. Connect cooling tower overflows and drains, and piping drains to sanitary sewage system.

F. Domestic Water Piping: Comply with applicable requirements in Division 22 Section "Domestic Water Piping." Connect to water-level control with shutoff valve and union, flange, or mechanical coupling at each connection.

G. Supply and Return Piping: Comply with applicable requirements in Division 23 Section "Hydronic Piping." Connect to entering cooling tower connections with shutoff valve, balancing valve, thermometer, plugged tee with pressure gage and drain connection with valve. Connect to leaving cooling tower connection with shutoff valve.

3.04 **STARTUP SERVICE**

A. Engage a factory-authorized service representative to perform startup service.

B. Inspect field-assembled components, equipment installation, and piping and electrical connections for proper assemblies, installations, and connections.

C. Obtain performance data from manufacturer.

1. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

a. Clean entire unit including basins.

b. Verify that accessories are properly installed.

c. Verify clearances for airflow and for cooling tower servicing.

d. Check for vibration isolation and structural support.

e. Lubricate bearings.

f. Verify fan rotation for correct direction and for vibration or binding and correct problems.

g. Adjust belts to proper alignment and tension.

h. Operate variable-speed fans through entire operating range and check for harmonic vibration imbalance. Set motor controller to skip speeds resulting in abnormal vibration.

i. Check vibration switch setting. Verify operation.

j. Verify water level in tower basin. Fill to proper startup level. Check makeup water-level control and valve.

k. Verify operation of basin heater and control.

l. Verify that cooling tower air discharge is not recirculating air into tower or HVAC air intakes. Recommend corrective action.

m. Replace defective and malfunctioning units.

D. Start cooling tower and associated water pumps. Follow manufacturer's written starting procedures.

E. Prepare a written startup report that records the results of tests and inspections.

3.05 **ADJUSTING**

A. Set and balance water flow to each tower inlet.

B. Adjust water-level control for proper operating level.

3.06 **DEMONSTRATION**

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

END OF SECTION

SECTION 23 7200 - AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

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 07 Section "Roof Accessories" for roof curb installation.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 23 Section "Temperature Controls" for control wiring and control devices connected to energy recovery units.

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other Work. For installed products indicated to comply with design loads, include structural analysis data.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Wiring Diagrams: Power, signal, and control wiring.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain air-to-air energy recovery units through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of air-to-air energy recovery units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. 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.

D. AHRI Compliance: Ratings for energy recovery devices shall comply with AHRI 1060, “Rating Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment.”

E. ASHRAE Compliance:

1. Capacity ratings for air-to-air energy recovery equipment shall comply with ASHRAE 84, "Method of Testing Air-to-Air Heat Exchangers."

F. NRCA Compliance: Roof curbs for roof-mounted equipment shall be constructed according to recommendations of NRCA.

G. UL Compliance:

1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

2. Electric coils shall comply with requirements in UL 1995, "Heating and Cooling Equipment."

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 installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

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. Filters: Furnish one set of each type of filter specified.

2. Wheel Belts: Furnish one set of belts for each heat wheel (not required for units with minimum 5-year wheel drive warranty).

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 **PACKAGED ENERGY RECOVERY UNITS**

A. Manufacturers:

1. Innovent Air Handling Equipment.

2. Nortek Air Solutions; Venmar CES Inc.

B. General: Construct unit as specified. Single wall and 1-inch double wall casing are unacceptable. Fans and coils must be removable without dismantling the structural framing of the unit. Unit shall be suitable for indoor or outdoor installation as detailed on the plan drawings.

C. Base: Construct base of minimum 10 gage welded structural steel with cross supports integral lifting lugs. Base shall be insulated and provided with a minimum 22 gage galvanized G90 steel subfloor. Coat base with 2-part epoxy primer and urethane modified enamel top coat.

D. Flooring: Provide double wall floor construction. Walk on floor material shall be a minimum of 18 gage galvanized G90 steel. Flooring sheets shall be sealed with a closed-cell neoprene gasket

material to minimize sound transmission to spaces located below the unit. Subfloor shall be welded to the base frame.

E. Framing: Frame is constructed of formed galvanized members designed to support flush-mounted double-wall panels. Framing must have gasketing between support members and panels. Casing must be thermal break construction.

F. Panels: Unit shall have non-load bearing heavy gage 2-inch double-wall panels. 22 gage galvanized perforated lining will be provided in the fan sections for additional sound attenuation.

G. Casing Ratings: Maximum casing panel deflection shall not exceed L/250 at 8 inches w.c. TSP (where L is the longest panel span on the unit). Casing shall meet a SMANCA duct class leakage rating of 5 at 8 inches w.c. TSP. The panel insertion loss, per octave band, shall not be less than the following:

Frequency:	100	125	250	500	1000	2000	4000	8000
Insertion loss, dB:	24	16	30	32	33	34	63	60

H. Insulation: Walls, floor, and roof shall be double wall and insulated. Walls and roof shall be insulated with either glass fiber or polyurethane foam insulation having minimum R-value of 8. Floors shall be insulated with polyurethane foam insulation to achieve minimum R-13. Insulation shall not be exposed to the air stream.

I. Injected Foam Housing Insulation: Comply with NFPA 90A or NFPA 90B.

1. Rated UL94 HF-1.
2. Thickness: 2 inches.
3. Polyurethane Injected Foam: 2.5 pounds per cubic foot density with an effective thermal conductivity (C) of 0.154 BTU in/hr sq. ft °F).
4. Ozone depletion potential of 0.
5. Global warming potential of 0.
6. VOC exempt.

J. Coatings: Exterior casing shall be coated with 2 part epoxy primer with urethane modified enamel top coat. Interior casing shall be galvanized G90 steel and coated with air-dried phenolic where specified for corrosive environment.

K. Access Doors: Full height. Same materials and finishes as housing, complete with stainless steel piano hinges, latches, handles, and gaskets. Doors shall be sized and located to allow periodic maintenance and inspections. Allegis corrosion resistant compression latches (tool lockable in fan sections), and minimum 24-inch clear opening width at all walk-in sections. Supply and exhaust air streams shall not be covered by a single door. Provide doors for access to areas requiring routine maintenance. Access panels in lieu of access door are unacceptable.

L. Door Accessories:

1. Access doors shall be provided with stainless steel door tie backs.
2. Door shall be thermal break design.

M. Weather hoods (for outdoor units): Provide weather hoods and bird screens over all exposed inlets and outlets. Ship hoods loose for installation in the field.

N. Roof (for outdoor units): Provide roof with standing seam construction. Pitch roof with sufficient slope to ensure water drainage. Roof overhang to be provided around complete perimeter of the unit.

O. Heat Recovery Device: Heat wheel.

P. Supply and Exhaust Blower: 12 blade aluminum airfoil plenum fan with minimum L10 200,000 hour rated bearings. Plenum fans with less than 12 blades are not acceptable due to increased noise levels. Non-airfoil blades are not acceptable due to decreased efficiency of the fan.

Q. Refer to Division 20 Section "Motors" for general requirements.

R. Isolation: Refer to Division 20 Section “Mechanical Vibration Controls.”

S. Accessories:

1. Variable Frequency Controllers: Provide variable frequency controllers for supply and exhaust fan(s) where indicated. VFCs shall be factory provided and installed.

2. Variable Frequency Controllers: Provide variable frequency controllers for heat wheel defrost control.

T. Dampers: Motorized dampers shall be low leakage type with aluminum construction, airfoil blades, vinyl edge seals, metal jamb seals, and synthetic bearings. Gravity dampers shall have aluminum frame, aluminum blades, extruded vinyl edge seals, and synthetic bearings.

1. Provide the following dampers:

a. Outside air heat exchanger damper, parallel blade type, modulating actuator.

b. Outside air and exhaust air heat exchanger bypass dampers, parallel blade type, modulating actuators.

c. Exhaust air outlet damper, parallel blade type, 2-position actuator.

d. Recirculation damper, parallel blade type, modulating actuator.

U. Filters:

1. Return Air Filter: Provide 2-inch thick, MERV 13 filter bank downstream of the heat exchanger. Mount in galvanized steel side access slide rack and size for 500 fpm maximum face velocity.

2. Aluminum Outside Air Filter: Provide 2-inch thick, washable aluminum filter bank in the location shown on unit drawing. Mount in galvanized steel front access rack and size for 650 fpm maximum face velocity.

V. Water Source Heat Pump:

1. Air/Refrigerant Coil: Provide AHRI rated coil with 0.016-inch thick seamless copper tubes, galvanized steel casing, and 0.0075-inch thick aluminum fins, pressure tested and guaranteed for 250 psi working pressure. Provide stainless steel IAQ drain pan under the coil extending past the coil to ensure condensate retention. Maximum face velocity is 500 FPM.

2. Hot Gas Reheat Coil: Provide AHRI rated coil with 0.016-inch thick copper tubes, galvanized steel casing, and rippled aluminum plate fin secondary surface with a thickness of 0.0075-inch. Coil is dehydrated with 140 deg F DB/40 deg F dew point air before shipment. Core is tested with 315-psig air pressure under warm water and guaranteed for 250 psig working pressure. Provide coil with a three-way, modulating control valve.

3. Integral Water Source Heat Pump System: Provide integral water source heat pump system factory piped, wired, charged, and tested. Entire heat pump section must be assembled by the unit manufacturer. Mounting a different manufacturer's heat pump in the casing is not acceptable.

a. Integral water source heat pump consisting of: scroll compressors, air-refrigerant coil, water-refrigerant coil, 4-way reversing valve, suction accumulator, line filter-driers, and sump heaters. Water flow valves, valve actuators, and interlocks shall be factory installed. Unit shall be factory piped for single connection. All piping required for flow and control of multiple circuits shall terminate at a single point for side or bottom connection as indicated on the Drawings.

b. Minimum number of compressors as scheduled must be used. Provide independent circuit for each compressor, tandem compressors are not acceptable in heat pump application.

c. Provide coaxial water to refrigerant heat exchangers.

d. Independent circuits shall be provided completely tested, dehydrated, and fully charged with refrigerant and oil.

e. Electric Unit Heater: Provide a 3 kW fan forced electric heater to maintain the heat pump section above freezing during winter design conditions.

W. Direct Expansion Refrigerant Coils:

1. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.

2. Minimum Working-Pressure Rating: 300 psig.

3. Source Quality Control: Factory tested to 450 psig.

4. Tubes: ASTM B 743 copper, minimum 0.020 inch wall thickness, and minimum 0.50 inch diameter.

5. Fins: Aluminum, minimum 0.010 inch thick.

6. Suction and Distributor Piping: ASTM B 88, Type L copper tube with brazed joints.

7. Frames: ASTM A 666, Type 304 stainless steel, minimum 0.0625 inch thick.

8. Drain Pans:

a. Description: For cooling coils, IAQ compliant formed to slope from all directions to the drain connection as required by ASHRAE 62.

b. Construction: Minimum 22 gage, Type 304 stainless steel with welded joints, positively sloped a minimum of 1/8 inch per foot, with threaded drain connection at lowest point of pan.

X. Hot Gas Reheat Coil: Provide AHRI rated coil with 0.016-inch thick copper tubes, galvanized casing, and rippled aluminum plate fin secondary surface with a thickness of 0.0075-inch.

1. Coil: Dehydrated with 140 deg F DB/40 deg F dew point air before shipment.

2. Source Quality Control: Tested with 315-psig air pressure under warm water and guaranteed for 250 psig working pressure.

3. Provide coil with a three-way modulating control valve.

Y. Electrical:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection.

2. House in a unit-mounted, NEMA 250, Type 3R enclosure with hinged access door with lock and key or padlock and key.

3. Wiring shall be numbered and color-coded to match wiring diagram.

4. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch.

5. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.

6. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main disconnecting means:

a. NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 60947-4-1.

b. NEMA KS 1, heavy-duty, nonfusible switch.

c. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

7. Each motor shall have overcurrent protection.

8. Factory test wiring and controls before shipment.
9. A phase/voltage protection relay shall be provided for each unit. Upon sensing a loss of phase or voltage the unit shall be de-energized.
10. A door safety kill switch shall be provided on all blower section access doors. The door safety kill switch shall de-energize the blower motor if the access door is opened. The kill switch shall prevent motor startup if the blower section access door is open.
11. Convenience Receptacles: Provide a GFCI duplex receptacle mounted near the electrical panel and wire receptacle to a terminal strip in the electrical panel. Separate 120V power must be provided to the receptacle. A transformer will be provided to provide power to the circuit.
12. Dirty filter indicators: Provide differential pressure switches across all filter racks. Wire pressure switches to terminal block in main electrical panel.

Z. Piping: Fabricate units with space within housing for piping. Refer to Piping Diagrams for extent of factory installed piping and piping specialties.

AA. DDC System:

1. Manufacturer must provide a stand-alone programmable digital control system to provide a standard sequence of operation for defrost control strategy, refrigeration system safeties, and head pressure control.
2. All other controls shall be provided and installed in the field by the Temperature Controls contractor.

2.03 **ROOF CURBS**

A. Isolation Curb: Where scheduled, refer to Division 20 Section “Mechanical Vibration Controls.”

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install heat wheels so supply and exhaust airstreams flow in opposite directions and rotation is from exhaust side to purge section to supply side.

1. Install access doors in both supply and exhaust ducts, both upstream and downstream, for access to wheel surfaces, drive motor, and seals.
2. Install removable panels or access doors between supply and exhaust ducts on building side for bypass during startup.
3. Access doors and panels are specified in Division 23 Section "Duct Accessories."
4. For outdoor units: Provide waterproof roof with standing seam construction and positive slope to ensure water drainage.

B. Install units with clearances for service and maintenance.

C. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

D. Pipe condensate drains from heat exchanger units and drain pans to nearest floor drain or roof drain. Use same size piping as condensate drain connection. For equipment located outdoors, insulate and provide electrical heat trace for condensate drains.

3.02 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Units shall be provided complete for single point connection to hydronic piping system.

B. Install piping adjacent to machine to allow service and maintenance.

C. Duct and fan installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts, fittings, and specialties.

D. Ground equipment according to Division 26 Section "Grounding and Bonding."

E. Connect wiring according to Division 26 Section "Conductors and Cables."

F. 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 **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Adjust seals and purge.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Set initial temperature and humidity set points.
5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.

C. Remove malfunctioning units, replace with new units, and retest as specified above.

3.04 **DEMONSTRATION**

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

END OF SECTION

SECTION 23 7333 - INDIRECT-FIRED MAKEUP AIR UNITS

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 “Common Work Results for HVAC” for mechanical drive requirements common to fans and air moving equipment.
3. Division 23 Section "Breeching, Chimneys, and Stacks" for vent piping.

1.02 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, and methods of field assembly, components, and location and size of each field connection.

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.

3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
4. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Roof-mounted units and roof-curb mounting details drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Size and location of rooftop unit mounting rails and anchor points and methods for anchoring units to curb.
2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

1.04 **CLOSEOUT SUBMITTALS**

A. Startup service reports.

B. Operation and Maintenance Data: For indirect-fired H&V units to include in operation and maintenance manuals.

C. Warranty: Special warranty specified in this Section.

1.05 **QUALITY ASSURANCE**

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of indirect-fired H&V units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Comply with ASHRAE Standard 90.1.

1.06 **DELIVERY, STORAGE, AND HANDLING**

A. Comply with applicable requirements in Division 20 Section “Basic Mechanical Materials and Methods.”

B. Deliver equipment in original crates, boxes, and shipping containers.

C. Do not lift air handling equipment by slings placed over shaft ends, and do not drop equipment off truck beds.

D. Store air handling equipment in a manner to prevent windmilling.

E. Rotate shafts periodically to prevent puddle corrosion of bearing races.

F. Close openings of air handling equipment to prevent entry of dirt and foreign matter.

G. On air handling equipment expected to be stored or to remain unused for extended periods, protect bearings from corrosion and contamination using method recommended by bearing manufacturer.

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 size, location, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate installation of restrained vibration isolation roof-curb rails, which are specified in Division 20 Section "Mechanical Vibration Controls."

1.08 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components listed below of indirect-fired H&V units that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Heat Exchangers: Manufacturer's standard, but not less than 10 years from date of Substantial Completion.

1.09 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set for each unit.
2. Fan Belts: One set for each unit.

PART 2 PRODUCTS

2.01 **COMMERCIAL INDIRECT-FIRED MAKEUP AIR UNITS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ventrol; Nortek Air Solutions.
2. Sterling HVAC Products; Mestek, Inc.
3. Reznor HVAC.
4. Modine Manufacturing Company; Commercial HVAC systems.
5. Greenheck Fan Corporation.
6. CaptiveAire

B. Description:

1. Factory-assembled, prewired, self-contained unit consisting of cabinet, supply fan, controls, filters, cooling package, and indirect-fired gas furnace to be installed outside the building.

C. Cabinet (Outdoor Units):

1. Cabinet: Double-wall galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. Cabinet shall be fully weatherized for outside installation.
2. Access Panels: Lift-out or piano hinged with cam-lock fasteners for furnace and fan motor assemblies on both sides of unit.

3. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II, applied on complete unit.
    a. Thickness: 1 inch.
    b. Insulation Adhesive: Comply with ASTM C 916, Type I.
    c. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.
4. Finish: Heat-resistant, baked enamel.

D. Supply-Air Fan:
1. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft.
2. Drive: Belt or Direct Drive, refer to drawings.
3. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

E. Outdoor-Air Intake:
1. Outdoor-Air Hood: Galvanized steel with bird screen, and finish to match cabinet; and sized to supply maximum 100 percent outdoor air.

F. Air Filters:
1. Comply with NFPA 90A.
2. Disposable Panel Filters: 1-inch-thick, factory-fabricated, pleated-panel type air filters with holding frames, with a minimum efficiency report value of 6 according to ASHRAE 52.2 and 90 percent average arrestance according to ASHRAE 52.1.
    a. Media: Interlaced glass fibers.
    b. Frame: Galvanized steel.

G. Dampers:
1. Outdoor-Air Damper: Galvanized-steel, opposed-blade dampers with vinyl blade seals and stainless-steel jamb seals, having a maximum leakage of 10 cfm/sq. ft. of damper area, at differential pressure of 2-inch wg.
2. Damper Operator: Direct coupled, electronic with spring return or fully modulating as required by the control sequence.

H. Condenser Coil Fans: Propeller type, directly driven by permanently lubricated motor.

I. Condenser Coils: Heavy duty aluminum fins mechanically bonded to seamless copper tubes, tested to 450 psig and leak tested to 300 psig with air under water. Provide subcooling circuit(s) integral with condenser coils to maximize efficiency and prevent premature flashing of liquid refrigerant, to a gaseous state, ahead of the expansion valve. Condenser coils shall not exceed 14 fins per inch density in order to permit routine cleaning, and prevent excessive air pressure drop across the condenser coil.

J. Direct Expansion Cooling Coils: Aluminum-plate fin and seamless copper tube in stainless-steel casing inter-circuited to assure complete coil face activity, with equalizing-type vertical distributor and thermal expansion valve; tested to 450 psig and leak tested to 300 psig with air under water.

K. Drain Pan: Under cooling coils. Formed of stainless-steel sheet and complying with requirements in ASHRAE 62.1. Fabricate pans with slopes in two planes to collect condensate from cooling coils (including coil piping connections and return bends) and when units are operating at maximum design face velocity across the coils.

1. Drain Connections: Both ends of pan.
2. Units with stacked coils shall have an intermediate stainless steel drain pan or drain trough to collect condensate from top coil.

L. Compressor(s): Hermetic scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater(s). Provide a combination of variable speed and fixed speed staged compressors. Capacity of variable speed compressor(s) shall be equal to or greater than the capacity of the largest fixed speed staged compressor.

M. Refrigeration System:

1. Compressor(s).
2. Condenser coils and fans.
3. Direct expansion cooling coil and supply-air fan.
4. Check valves.
5. Expansion valves with replaceable thermostatic elements.
6. Refrigerant dryers.
7. High-pressure switches.
8. Low-pressure switches.
9. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.
10. Independent refrigerant circuits.
11. Brass service valves installed in discharge and liquid lines.
12. Refrigerant: As scheduled.
13. Compressor Motor Overload Protection: Manual reset.
14. Anti-recycling Timing Device: Prevents compressor restart for five minutes after shutdown.
15. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.

N. Indirect-Fired Gas Furnace:

1. Description: Factory assembled, piped, and wired; and complying with ANSI Z83.8 and CSA 2.6, and NFPA 54, "National Fuel Gas Code."
    a. CSA Approval: Certified by and bearing label of CSA International.
    b. Burners:
        1) Gas Control Valve: Modulating, turndown ratio as scheduled on the Drawings.
        2) Fuel: Natural gas.
        3) Minimum Thermal Efficiency: 80 percent.
        4) Ignition: Electronically controlled electric spark with flame sensor.
2. Power Vent: Integral, motorized centrifugal fan interlocked with gas valve.
3. Heat Exchanger: Stainless steel construction including secondary tubes.

4. Heat-Exchanger Drain Pan: Stainless steel.
5. Safety Controls:
    a. Gas Train: Control devices and control sequence shall comply with ANSI standards and AXA XL GAPS (formerly IRI).
    b. Purge-Period Timer: Automatically delays burner ignition and bypasses low-limit control.
    c. Airflow Proving Switch: Differential pressure switch senses correct airflow before energizing pilot.
    d. Automatic-Reset, High-Limit Control Device: Stops burner and closes main gas valve if high-limit temperature is exceeded.
    e. Safety Lockout Switch: Locks out ignition sequence if burner fails to light after three tries. Controls are reset manually by turning the unit off and on.
    f. Control Transformer: 24-V ac.

O. Controls:
1. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote control panel.
2. Control Panel: Surface-mounted remote panel, with engraved plastic cover, and the following lights and switches:
    a. On-off-auto fan switch.
    b. Heat-vent-cool switch. Automatic changeover
    c. Supply-fan operation indicating light.
    d. Heating operation indicating light.
    e. Thermostat.
    f. Damper position potentiometer.
    g. Cooling operation indicating light.
    h. Dirty-filter indicating light operated by unit-mounted differential pressure switch.
    i. Safety-lockout indicating light.
3. Refer to Division 23 Section "Temperature Controls" for control equipment. Sequence of operation is indicated on the Drawings.
4. Fan Control: Interlock fan to start with exhaust fan(s). Refer to Division 23 Section “Power Ventilators” and Sequence of Operation on the Drawings for exhaust fan controls.
    a. Fan-Discharge Thermostat: Stops fan on burner failure when outdoor-air temperature is less than 40 deg F.
    b. Smoke detectors, located in supply air, shall stop fans when the presence of smoke is detected.
5. Outdoor-Air Damper Control, 100 Percent Outdoor-Air Units: Outdoor-air damper shall open when supply fan starts, and close when fan stops.
6. Temperature Control: Operates gas valve to maintain supply-air temperature.
    a. Operates gas valve to maintain discharge-air temperature with factory-mounted sensor in blower outlet.
    b. Furnace Control: 20 to 100 percent modulation of the firing rate. 10 to 100 percent with dual furnace units.

7. DDC: Stand-alone control module for link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 Section "Temperature Controls."
    a. Provide start and stop interface relay, and relay to notify DDC system alarm condition.
    b. Provide hardware interface or additional sensors as follows:
        1) Room temperature.
        2) Discharge-air temperature.
        3) Furnace operating.

2.02 **ROOF CURB**

A. Isolation Curb: Refer to Division 20 Section “Mechanical Vibration Controls.”

2.03 **MOTORS**

A. Comply with requirements in Division 20 Section "Motors."

2.04 **CAPACITIES AND CHARACTERISTICS**

A. Refer to Schedule on Drawings.

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 installation of indirect-fired H&V units.

B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where rooftop replacement-air units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install gas-fired units according to NFPA 54, "National Fuel Gas Code."

B. Hoist, transport, and rig units or their shipping sections into position following procedures recommended by manufacturer.

C. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI Guideline B.

D. Deliver roof curbs and equipment supports to site for installation under Division 07. Install rooftop H&V units on equipment curbs and supports specified. Secure units to curb support with anchor bolts.

E. Install controls and equipment shipped by manufacturer for field installation with indirect-fired H&V units.

3.03 CONNECTIONS

A. Piping Connections: Drawings indicate general arrangement of piping, fittings, and specialties. Install piping adjacent to machine to allow service and maintenance.

1. Gas Piping: Comply with requirements in Division 23 Section "Fuel Gas Piping." Connect gas piping with shutoff valve and union and with sufficient clearance for burner removal and service. Provide CSA-approved flexible connectors.

B. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply ducts to indirect-fired H&V units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Duct Accessories."

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for visible damage to furnace combustion chamber.
2. Inspect casing insulation for integrity, moisture content, and adhesion.
3. Verify that clearances have been provided for servicing.
4. Verify that controls are connected and operable.
5. Verify that filters are installed.
6. Purge gas line.
7. Inspect and adjust vibration isolators.
8. Verify bearing lubrication.
9. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
10. Adjust fan belts to proper alignment and tension.
11. Start unit according to manufacturer's written instructions.
12. Complete startup sheets and attach copy with Contractor's startup report.
13. Inspect and record performance of interlocks and protective devices; verify sequences.
14. Operate unit for run-in period recommended by manufacturer.
15. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency:
    a. Gas Burner:
        1) Measure gas pressure at manifold.
        2) Measure combustion-air temperature at inlet to combustion chamber.
        3) Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
16. Calibrate thermostats.
17. Adjust and inspect high-temperature limits.

18. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
19. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
20. Measure and record airflow. Plot fan volumes on fan curve.
21. Verify operation of remote panel, including pilot-operation and failure modes. Inspect the following:
    a. High-limit heat.
    b. Alarms.
22. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.

D. Prepare written report of the results of startup services.

3.05 **ADJUSTING**

A. Adjust initial temperature set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. 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 during other-than-normal occupancy hours for this purpose.

3.06 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain indirect-fired H&V units.

END OF SECTION

SECTION 23 8146 - WATER-TO-AIR HEAT PUMPS

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 "Mechanical Vibration Controls" for isolation pads, and spring isolators.
3. Division 23 Section "Temperature Controls" for control devices not packaged with units.

1.02 DEFINITIONS

A. EVA: Ethylene-vinyl acetate.

B. MS/TP: Master slave/token passing data link protocol.

C. PVC: Polyvinyl chloride.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each model.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which heat pumps will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

C. Product Certificates: For each type of water-source heat pump, signed by product manufacturer.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For water-source heat pumps to include in operation and maintenance manuals.

1.06 **QUALITY ASSURANCE**

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of water-source heat pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

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. ASHRAE Compliance:

1. ASHRAE 15.

D. Comply with minimum COP/efficiency levels according to ASHRAE/IESNA 90.1.

E. Comply with NFPA 70.

F. Comply with safety requirements in UL 484 for assembly of free-delivery water-source heat pumps.

G. Comply with safety requirements in UL 1995 for duct-system connections.

1.07 **COORDINATION**

A. Coordinate layout and installation of water-source heat pumps and suspension components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components, and partition assemblies.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

1.08 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. One set of filters for each unit.

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 **CONCEALED WATER-SOURCE HEAT PUMPS, 6 TONS AND SMALLER**

A. Manufacturers:

1. Carrier; a United Technologies Company.
2. ClimateMaster, Inc.
3. Daikin Applied; a member of Daikin Industries, Ltd.
4. FHP Manufacturing; Bosch Thermotechnology.
5. Nortek Global HVAC; Mammoth Inc.
6. Trane; a Trane Technologies Brand.
7. WaterFurnace International, Inc.

B. Description: Packaged water-source heat pump; factory assembled, tested, and rated according to ASHRAE/AHRI/ISO-13256-1.

C. Cabinet and Chassis: Galvanized-steel casing with the following features:

1. Access panel for access and maintenance of internal components.
2. Knockouts for electrical and piping connections.
3. Flanged duct connections.
4. Cabinet Insulation: Glass-fiber liner, minimum 1/2 inch thick, complying with UL 181.
5. Units field convertible for various discharge configurations.
6. Condensate Drainage: High-density polyethylene plastic or stainless-steel drain pan with condensate drain piping projecting through unit cabinet
    a. Condensate Overflow Protection Switch: Solid state electronic; mechanical float switch not permitted.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Sound Attenuation Package:
    a. Minimum 0.598-inch- thick compressor enclosure and front panel. Minimum 0.0937-inch- thick foam gasket around the compressor and perimeter of end panel.
    b. Sound attenuating blanket over compressor.
    c. Hot-gas muffler.

D. Fan: Direct driven, centrifugal, with multispeed motor resiliently mounted in fan inlet.

1. General requirements for motors are specified in Division 20 Section "Motors."
2. Motor: Multispeed, permanently lubricated, ECM motor.

E. Water Circuit:

1. Refrigerant-to-Water Heat Exchangers:

a. Coaxial heat exchangers with copper or cupronickel water tube with enhanced heat-transfer surfaces inside a steel shell; both shell and tube leak tested to 450 psig on refrigerant side and 400 psig on water side. Factory mount heat exchanger in unit on resilient rubber vibration isolators.

2. Motorized Water Valve: Stop water flow through the unit when compressor is off.

F. Refrigerant-to-Air Coils: Copper tubes with aluminum fins, leak tested to 450 psig.

G. Refrigerant Circuit Components:

1. Sealed Refrigerant Circuit: Charge with R-407C or R-410A refrigerant.

2. Filter-Dryer: Factory installed to clean and dehydrate the refrigerant circuit.

3. Charging Connections: Service fittings on suction and liquid for charging and testing.

4. Reversing Valve: Pilot-operated sliding-type valve designed to be fail-safe in heating position with replaceable magnetic coil.

5. Compressor: Hermetic scroll compressor installed on vibration isolators and housed in an acoustically treated enclosure with factory-installed safeties as follows:

a. Antirecycle timer.

b. High-pressure cutout.

c. Low-pressure cutout or loss of charge switch.

d. Internal thermal-overload protection.

e. Freezestat to stop compressor if water-loop temperature in refrigerant-to-water heat exchanger falls below 35 deg F.

f. Condensate overflow switch to stop compressor with high condensate level in condensate drain pan.

6. Refrigerant Piping Materials: ASTM B 743 copper tube with wrought-copper fittings and brazed joints.

7. Pipe Insulation: Refrigerant minimum 3/8-inch- thick, flexible elastomeric insulation on piping exposed to airflow through the unit. Maximum 25/50 flame-spread/smoke-development indexes according to ASTM E 84.

8. Refrigerant Metering Device: Thermal expansion valve to allow specified operation with entering-water temperatures from 25 to 125 deg F.

9. Hot-Gas Reheat Valve: Pilot-operated sliding-type valve with replaceable magnetic coil.

H. Hot-Gas Reheat: Reheat valve diverts refrigerant hot gas to reheat coil when remote humidistat calls for dehumidification.

I. Filters: Disposable, pleated type, 1 inch thick and with a minimum of 90 percent arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) of 7 according to ASHRAE 52.2.

J. Control equipment is specified in Division 23 Section "Temperature Controls."

K. Sequence of operation is indicated on the Drawings.

L. Electrical Connection: Single electrical connection with non-fused disconnect.

1. Power Factor Correction: Unit power factor of 0.90 or better at single point of connection.

M. Capacities and Characteristics: Refer to Schedule on Drawings.

2.03 **HOSE KIT ASSEMBLIES**

A. Supply hose having "Y" strainer with blowdown valve, and ball valve with pressure temperature port; return hose having automatic flow regulator with PT ports, and ball valve.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of water-source heat pumps.

B. Examine roughing-in for piping and electric installations for water-source heat pumps to verify actual locations of piping connections and electrical conduit before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Suspend water-source heat pumps from structure with threaded steel rods and vibration isolators.

1. Vibration isolators are specified in Division 20 Section "Mechanical Vibration Controls."]

B. Install wall-mounting thermostats, humidistats, and switch controls in electrical outlet boxes at heights to match lighting controls or as required in Division 23 Section "Temperature Controls."

3.03 **CONNECTIONS**

A. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Connect supply and return hydronic piping to heat pump with hose kits.

2. Connect heat-pump condensate drain pan to indirect waste connection with condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts. Specific connection requirements are as follows:

1. Connect supply and return ducts to water-source heat pumps with flexible duct connectors specified in Division 23 Section "Duct Accessories."

C. Install electrical devices furnished by manufacturer but not specified to be factory mounted.

D. Install piping adjacent to machine to allow service and maintenance.

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

3.04 **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. After installing water-source heat pumps and after electrical circuitry has been energized, test units for compliance with requirements.

2. Inspect for and remove shipping bolts, blocks, and tie-down straps.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Heat pumps will be considered defective if they do not pass tests and inspections.

D. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Adjust vibration isolators.
9. Inspect operation of barometric dampers.
10. Verify bearing lubrication on fan.
11. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
12. Start unit according to manufacturer's written instructions.
13. Complete startup sheets and attach copy with Contractor's startup report.
14. Inspect and record performance of interlocks and protective devices; verify sequences.
15. Operate unit for an initial period as recommended or required by manufacturer.
16. Verify thermostat and humidistat calibration.
17. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
18. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

3.06 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. 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 during other than normal occupancy hours for this purpose.

3.07 CLEANING

A. Replace filters used during construction prior to air balance or substantial completion.

B. After completing installation of exposed, factory-finished water-source heat pumps, inspect exposed finishes and repair damaged finishes.

3.08 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water-source heat pumps.

END OF SECTION

SECTION 23 8216 - HEATING AND COOLING COILS

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 23 Sections for coils that are integral to air-handling units.

1.02 SUMMARY

A. This Section includes duct-mounted heating and cooling coils, and heating and cooling coils that are an integral part of air-handling units.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each coil. Include rated capacity and pressure drop for each coil.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Diagram power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For air coils to include in 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. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.

PART 2 PRODUCTS

2.01 ELECTRIC COILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Brasch Manufacturing Co., Inc.
2. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
3. INDEECO Heating Solutions; ASPEQ Heating Group.
4. Markel Products Company; TPI Corporation.
5. Thermolec Ltd.
6. Trane; a Trane Technologies Brand.
7. Neptronic

B. Coil Assembly: Comply with UL 1995.

C. Heating Elements: Coiled resistance wire of 80 percent nickel and 20 percent chromium; surrounded by compacted magnesium-oxide powder in tubular-steel sheath; with spiral-wound, copper-plated, steel fins continuously brazed to sheath.

D. High-Temperature Coil Protection: Disk-type, automatically reset, thermal-cutout, safety device; serviceable through terminal box without removing heater from duct or casing.

1. Secondary Protection: Load-carrying, manually reset or manually replaceable, thermal cutouts; factory wired in series with each heater stage.

E. Frames: Heavy gage galvanized-steel channel frame, minimum for slip-in mounting.

F. Control Panel: Unit mounted with disconnecting means and overcurrent protection. Include the following controls:

1. Magnetic contactor.
2. Toggle switches; one per step.
3. SCR controller.
4. Time-delay relay.
5. Pilot lights; one per step.
6. Airflow proving switch.

G. Refer to Division 23 Section "Temperature Controls" for thermostat.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.

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. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION

SECTION 23 8241 - PROPELLER FAN UNIT HEATERS – STEAM, HOT WATER, ELECTRIC

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 SUMMARY

A. This Section includes propeller fan unit heaters with electric-resistance coils.

1.03 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

1.04 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Coordination Drawings: Plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Other items, including the following:
    a. Lighting fixtures.
    b. Sprinklers.
    c. Ductwork.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For propeller unit heaters 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 PRODUCTS

2.01 **GENERAL**

1. Electric Unit Heaters:
    a. Berko Electric Heating; a division of Marley Engineered Products.
    b. Brasch Manufacturing Company, Inc.
    c. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.
    d. Indeeco Heating Solutions; ASPEQ Heating Group.
    e. Markel Products; a division of TPI Corporation.
    f. Sterling Radiator; a Mestek Company.
    g. Trane Inc.; a Trane Technologies Brand.

2.02 **UNIT HEATERS**

A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

B. Comply with UL 2021.

2.03 **CASING**

A. Cabinet: Removable panels for maintenance access to controls.

B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

C. Discharge Louver: Four-way adjustable louvers for horizontal units and adjustable pattern diffuser for projection units.

2.04 **ELECTRIC-RESISTANCE HEATING ELEMENTS**

A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.05 **FAN**

A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.06 **FAN MOTORS**

A. Comply with requirements in Division 20 Section "Motors."

B. Motor Type: Permanently lubricated.

2.07 **CONTROLS**

A. Control Devices:

1. Wall-mounting thermostat.

2.08 **CAPACITIES AND CHARACTERISTICS**

A. Refer to Schedule on Drawings.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install propeller unit heaters level and plumb.

B. Install propeller unit heaters to comply with NFPA 90A.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers.

1. Hanger rods and attachments to structure are specified in Division 20 Section "Hangers and Supports."

2. Vibration hangers are specified in Division 20 Section "Mechanical Vibration Controls."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.

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. Testing: Perform the following field quality-control testing and report results in writing:

1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safeties.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller fan unit heaters. Refer to Division 20 Section "Mechanical General Requirements."

END OF SECTION

SECTION 23 8244 - CENTRIFUGAL FAN CABINET UNIT HEATERS (ELECTRIC)

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 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Location and arrangement of integral controls.
4. Wiring Diagrams: Power, signal, and control wiring.

B. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

1.04 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For cabinet unit heaters to include in operation and maintenance manuals.

1.05 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

1.06 **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. Cabinet Unit Heater Filters: Furnish spare filter for each filter installed.

PART 2 PRODUCTS

2.01 **MANUFACTURED UNITS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Berko Electric Heating; a division of Marley Engineered Products.

2. Brasch Manufacturing Company, Inc.

3. Chromalox Advanced Thermal Technologies; Spirax-Sarco Engineering plc.

4. Daikin Applied; a member of Daikin Industries, Ltd.

5. Indeeco Heating Solutions; ASPEQ Heating Group.

6. Markel Products; a division of TPI Corporation.

7. QMark Electric Heating; a division of Marley Engineered Products.

B. Description: A factory-assembled and -tested unit complying with AHRI 440.

1. Comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.

1. Thickness: Minimum 1/2 inch.

2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.

3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.

5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
2. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
3. Recessing Flanges for Units That Are Semirecessed or Fully Recessed: Steel, finished to match cabinet.
4. Control Access Door: Key operated.
5. Base for Surface, Vertical, Wall-Mounting Units: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.

E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber Treated with Adhesive: Throw-away type 80 percent arrestance and 5 MERV.

F. Electric-Resistance Heating Coil: Non-glowing type. Steel fins brazed to high temperature resistance wire enclosed in incoloy sheath; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

G. Fan and Motor Board: Removable.

1. Fan: Forward curved, double-width centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 20 Section "Motors."
3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Electrical Connection: Factory wire motors and controls for a single field connection.

I. Capacities and Characteristics: Refer to Schedule on Drawings.

2.02 **UNIT CONTROLS**

A. Control devices are specified in Division 23 Section "Temperature Controls," and operational sequences are indicated on the Drawings.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for electrical connections to verify actual locations before cabinet unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers.

1. Vibration isolators are specified in Division 20 Section "Mechanical Vibration Controls."

C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

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. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

2. Operate electric heating elements through each stage to verify proper operation and electrical connections.

3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.05 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.

END OF SECTION

SECTION 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

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 complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
2. The Contractor understands that the work herein described shall be complete in every detail.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.

1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.

C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner’s Representatives causes interference.

1.05 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.06 **DRAWINGS**

A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 **MATERIAL AND EQUIPMENT MANUFACTURERS**

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 **INSPECTION OF SITE**

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 **ITEMS REQUIRING PRIOR APPROVAL**

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated

design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.
2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 **SHOP DRAWINGS/SUBMITTALS**

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.

D. 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.

1.11 **COORDINATION DRAWINGS**

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 **OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:

1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.
4. Submittals.
5. Recommended spare parts list.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 **RECORD DRAWINGS**

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be clearly marked with a contrasting color so the marks are readily apparent.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request during the course of construction.

1.14 **INSTRUCTION OF OWNER PERSONNEL**

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 **WARRANTY**

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 **USE OF EQUIPMENT**

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 **COORDINATION**

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope

3.02 **INSTALLATION OF EQUIPMENT**

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:

1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.03 **WORK IN EXISTING BUILDINGS**

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

3.04 **TEMPORARY SERVICES**

A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.05 **DISPOSAL**

A. Fluorescent Lamps

1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.
3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.

B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.

3.06 **CHASES AND RECESSES**

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.07 **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.

3.08 **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.

3.09 **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.

3.10 **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.

3.11 **EXTRA WORK**

A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 1/2", 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, I.G. receptacle, data box, V4000 wiremold, fire alarm combination visual/audible notification appliance, fire alarm visual notification appliance, clock, or other devices which may be required for any proposed extra work.

3.12 **DRAWINGS AND MEASUREMENTS**

A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor’s responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.

END OF SECTION

SECTION 26 0513 - MEDIUM-VOLTAGE CABLES

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 cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

1.03 DEFINITIONS

A. Jacket: A continuous nonmetallic outer covering for conductors or cables.

B. NETA ATS: Acceptance Testing Specification.

C. Sheath: A continuous metallic covering for conductors or cables.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 PRODUCTS

2.01 MANUFACTURERS:

A. Subject to compliance with requirements, provide products by the following:

1. Cables:
    a. General Cable Technologies Corporation.
    b. Okonite Company (The).
    c. Prysmian Cables & Systems.

d. Southwire Company.

2. Cable Splicing and Terminating Products and Accessories:

a. RTE Components; Cooper Power Systems, Inc.

b. Thomas & Betts Corporation.

c. 3M; Electrical Markets Division.

d. Tyco Electronics; Raychem Products.

B. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.02 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2 and NFPA 70.

2.03 CABLES

A. Cable Type: UL Type MV 90.

B. Comply with UL 1072, AEIC CS8, and ICEA S-94-649.

C. Conductor: Copper.

D. Conductor Stranding: Compact round, concentric lay, Class B

E. Conductor Insulation: Ethylene-propylene rubber (EPR)

1. Voltage Rating: 15 kV.

2. Insulation Thickness: 133 percent insulation level.

F. Shielding with Concentric Neutral: Solid copper wires helically applied over semiconducting insulation shield sized for 1/3 neutral capacity. Provide insulating encapsulating cable jacket over the neutral wires.

G. Cable Jacket: Linear Low Density Polyethylene (LLDPE).

2.04 CONNECTORS

A. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.

B. Copper-Conductor Connectors: Copper barrel crimped connectors.

2.05 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations, Interior: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.

2. Class 1 Terminations, Exterior: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.

2.06 SEPARABLE INSULATED CONNECTORS

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.

C. Load-Break Cable Terminators: Elbow-type units with 200-A-load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

D. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.

1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

F. Tool Set: Shotgun hot stick with energized terminal indicator, fault-indicator test tool, and carrying case.

2.07 SPLICE KITS

A. Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.

B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, materials, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.

1. Combination tape and cold-shrink-rubber sleeve kit with rejacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
3. Pre-molded, cold-shrink-rubber, in-line splicing kit.
4. Pre-molded, EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.
5. Separable multiway splice system with all components for the required splice configuration.

2.08 MEDIUM-VOLTAGE TAPES

A. Ethylene/propylene rubber-based, 30-mil splicing tape, rated for 130 deg C operation. Minimum 3/4 inch wide.

B. Silicone rubber-based, 12-mil self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inches wide.

C. Insulating-putty, 125-mil elastic filler tape. Minimum 1-1/2 inches wide.

2.09 ARC-PROOFING MATERIALS

A. Tape for First Course on Metal Objects: 10-mil- thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, and compatible with cable jacket.

C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1 inch wide.

2.10 **SOURCE QUALITY CONTROL**

A. Test and inspect cables according to ICEA S-94-649 before shipping.

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Install cables according to IEEE 576.

B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.

2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.

2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.

3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.

4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.

E. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."

F. Install "buried-cable" warning tape 12 inches above cables.

G. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.

H. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.

I. Install cable splices at pull points and elsewhere as indicated; use standard kits. Use dead-front separable watertight connectors in manholes and other locations subject to water infiltration.

J. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.

K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.

2. Wrap metallic cable components with 10-mil pipe-wrapping tape.

3. Smooth surface contours with electrical insulation putty.

4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.

5. Band arc-proofing tape with two layers of 1-inch- wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.

L. Seal around cables passing through fire-rated elements according to Section 07 8413 "Penetration Firestopping."

M. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.

N. Identify cables according to Section 26 0553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.02 **FIELD QUALITY CONTROL**

A. Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.

2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.

3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.

4. Perform Partial Discharge test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

5. Perform Dissipation Factor test of each new conductor according to NETA ATS, Ch. 7.3.3 and to test equipment manufacturer's recommendations.

B. Medium-voltage cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 26 0519 - CONDUCTORS AND CABLES

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.

B. Related Sections include the following:

1. Division 26 Section "Medium-Voltage Cables" for single-conductor and multiconductor cables, cable splices, and terminations for electrical distribution systems with 2001 to 35,000 V.

1.03 ACTION SUBMITTALS

A. Submit letter of compliance (intent) for copper and aluminum building wire.

B. Provide product data for the following:

1. Metal-Clad Cable, Type MC
2. Armored Cable, Type AC
3. Mineral Insulated Cable, Type MI
4. 2- Hour Fire Rated Mc Power Cable
5. Power Cable for Variable Frequency Controlled Motors

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.

4. Type RHW-2: Comply with UL 44.

2.02 **ALUMINUM BUILDING WIRE**

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

1. Allowed only for conductors used in feeders 100A and larger.

B. Manufacturers:

1. General Cable

2. Southwire

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Aluminum, complying with ASTM B 800 and ASTM B 801.

E. Conductor Insulation:

1. Type XHHW-2: Comply with UL 44.

2.03 **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.

2.04 2-HOUR FIRE RATED MINERAL INSULATED CABLE, TYPE MI

A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V.

B. Manufacturers:

1. KME America
2. Pentair
3. Watlow Electric Manufacturing

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 2196 for fire resistance.
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.

E. Conductors: Copper, complying with ASTM B 3 for bare annealed copper.

F. Insulation: Compressed magnesium oxide.

G. Sheath: Copper.

2.05 **2-HOUR FIRE RATED RHW-2, 600 VOLT**

A. Description: RHW-2 cable listed by UL as a 2-hour fire rated when installed in accordance with installation procedures complying with the product listing.

B. Manufacturers:

1. Prysmian Group/Draka – Lifeline.

C. Standards:

1. Listed and labeled as defined in NFPA 70 Article 728.4, by UL, and marked for intended location and use.
2. UL 44 listed for NEC compliance.
3. UL 2196 listed for fire resistance.
4. Electrical Circuit Integrity Systems (FHIT) – System No. 25B or System No. 25C, of the UL Fire Resistance Directory.
5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide", and NFPA 70, Article 728.120.

D. Conductors: Annealed Copper, Class B strand complying with ASTM B-3 and B-8.

E. Insulation: Thermoset, low smoke zero halogen ceramifiable silicone rubber.

F. Jacket: Low smoke, zero halogen, cross-linked polyolefin.

2.06 **2-HOUR FIRE RATED MC POWER CABLE**

A. Description: MC Power cable listed by UL as a 2 hour Fire Rated when installed in accordance with installation procedures complying with the product listing.

B. Manufacturers:

1. OMNI Cable – Vita Link
2. Prysmian GroupDraka – Lifeline MC.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. UL 1569
3. UL 2196 for fire resistance.
4. Electrical Circuit Integrity Systems (FHIT) – System No. 120 or System No. 50, of the UL Fire Resistance Directory
5. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide," and NFPA 70, Article 728.120 and Article 310.120.

D. Conductors: Annealed Copper, Class B strand complying with ASTM B-3 and B-8.

E. Insulation: Thermoset, low smoke zero halogen silicone rubber.

F. Armor: Continuously welded and corrugated copper exceeding the NEC requirement for equipment grounding conductor.

2.07 POWER CABLE FOR VARIABLE FREQUENCY CONTROLLED MOTORS

A. Description: A factory assembly of three conductor cable with three symmetrical ground conductors, a continuous shield, an overall PVC jacket and a product specific connector and termination kit.

B. Manufacturers:

1. Service Wire Co.

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 1277
3. Comply with ICEA S-95-658/NEMA WC 70 for Type TC-ER Power Cable (for VFD application)
4. 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 feeder.

E. Phase Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

F. Ground Conductor: Bare copper.

G. Phase Conductor Insulation: Moisture resistant, flame retardant, cross linked polyethylene (2KV RHW-2) suitable for 90degC conductor temperature operation inf dry, damp and wet locations

H. Shield: Helically applied minimum 5 mils thick bare copper with minimum 50% overlap.

I. Armor: Aluminum, interlocked.

J. Jacket: Oil resistant PVC

K. Connector: Water-tight and UL listed for installation on supplied TC cable (tray cable) assembly.

1. Body material: nickel clad aluminum
2. Connector shall provide a 360-degree electrical bonding of the copper tape shield to the connector body.
3. Connection of the copper tape shield to the connector body shall be accomplished by an integral and self-retaining grounding collar that automatically provides a 360-degree connection as the connector is tightened.
4. The connector assembly shall be designed to ensure against loosening of threads due to vibration.
5. A UL listed chrome plated grounding and bonding locknut with a 360-degree knurled teeth connection shall be provided with each connector to secure and bond the connector to the inverter cabinet / motor termination box.
6. Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to the inverter enclosure / back-panel and to the motor frame shall be provided as part of the cable system.

L. Termination Kit: Tinned copper braids (minimum ¾ inches wide) with installation hardware to connect the copper tape shield to cable core, to the inverter enclosure/back-panel, and to the motor frame shall be provided as part of the cable system.

1. Braid width shall be determined by cable core diameter size and shall be placed at a separation of 180 degrees.

2.08 **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. If providing aluminum feeders, contractor is responsible for providing correct feeder, equipment ground and conduit size based on voltage drop and any de-rating required.

C. Feeders and Branch Circuits: Solid or stranded for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

D. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).

E. Use conductor not smaller than 14 AWG for 120V control circuits.

F. Where equipment is listed for use with copper conductors only, use copper conductors for the entire length of feeder.

3.02 **CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

A. Refer to application schedule on the drawings

B. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.

C. Connection between Variable Frequency Controllers and Motors: Use power cable for variable frequency- controlled motors. Install and terminate according to cable manufacturer’s recommendations.

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.

P. Install fire resistive cable assemblies (Type MI cable and/or fire rated MC cable) in accordance with the manufacturer’s instructions and the product UL listing.

1. Do not paint fire resistive cable assemblies.

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 splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

2. Use compression type terminations for aluminum 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

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 "Underground Ducts and Utility Structures" for ground test wells.
2. Division 26 Section “Electrical General Requirements”.
3. 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 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.

D. ASTM B 187: Specification for Copper, Bus Bar, Rod, and Shapes and General Purpose Rod, Bar, and Shapes.

E. IEEE 81: Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

F. IEEE 142: Grounding of Industrial and Commercial Power Systems.

G. IEEE C2: National Electrical Safety Code.

H. NETA MTS – 2001: Maintenance Testing Specifications.

I. NFPA 70: National Electrical Code.

J. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

K. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

L. UL 467: Grounding and Bonding Equipment.

M. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

N. UL 486B: Wire Connectors for Use with Aluminum 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. Grounding Rods:
    a. American Electric-Blackburn.
    b. Apache Grounding/Erico Inc.
    c. Chance/Hubbell.
3. Mechanical Connectors:
    a. American Electric-Blackburn.
    b. Burndy.
    c. Chance/Hubbell.
4. Exothermic Connections:
    a. Cadweld.
5. 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. Material: Aluminum, copper-clad aluminum, and copper.

C. Equipment Grounding Conductors: Insulated with green-colored insulation.

D. Grounding Electrode Conductors: Stranded cable.

E. Underground Conductors: Bare, stranded, copper unless otherwise indicated.

F. Bare Copper Conductors: Comply with the following:
    1. Solid Conductors: ASTM B 3.
    2. Assembly of Stranded Conductors: ASTM B 8.

G. 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.
    3. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; size per the NEC.

H. Electrical Grounding Busbar
    1. 24” (min) x 2” x ¼” tin plated, copper busbar with two rows of ¼” x 20 tapped holes 1” on center.

I. Telecommunications Main Grounding Busbar (TMGB)
    1. 48” (min) x 4” x ¼” tin plated, copper busbar with three rows of ¼ x 20 tapped holes 1” on center.

J. Telecommunications Grounding Busbar (TGB)
    1. 12” (min) x 2” x ¼” tin plated, copper busbar with two rows of ¼ x 20 tapped holes 3” on center.

K. Telecommunications Bonding Backbone (TBB)
    1. Minimum No. 2 AWG insulated stranded copper.

L. Telecommunications Bonding Conductors

1. Minimum No. 6 AWG insulated stranded copper.

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. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.

D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.04 **GROUNDING ELECTRODES**

A. Ground Rods: Copper-clad steel.

1. Size: 5/8 in diameter.

2. Length: 120 inches.

B. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Provide handholes as specified in Division 2 Section "Underground Ducts and Utility Structures."

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. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.

C. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

D. 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.

E. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

F. Busway Supply Circuits: Install insulated equipment grounding conductor from the grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

G. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

H. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

I. 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.

J. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.

K. 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. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. 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.

D. 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.

E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. 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 or UL 486B as applicable.

G. 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.

H. 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. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:

1. Metal Underground Water Service Pipe.
2. Metal In-Ground Support Structure.
3. Concrete Encased Electrode.

4. Ground Rods.

B. Metal Underground Water Service Pipes in direct contact with the earth for 10 feet or more: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to all metal water service entrances to building including fire protection water service entrance. Connect grounding conductors to metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

C. Metal in-ground support structure in direct contact with the earth vertically for 10 feet (3.0 m) or more, with or without concrete encasement: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to at least one metal in-ground support structure, or as otherwise indicated. Connect grounding conductors to metal in-ground support structure by exothermic welds. Bond metal grounding conductor conduit or sleeve to conductor at each end.

D. Concrete Encased Electrode: Fabricate according to NFPA 70, Paragraph 250-81(c):

1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

E. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Verify that final backfill and compaction has been complete before driving ground rods.

2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.

3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds or non-reversing compression-type connectors, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.

F. Concrete Encased Electrode: Fabricate according to NFPA 70, Paragraph 250-81(c):

1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.

3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

G. 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.

1. Aluminum and copper-clad aluminum conductors shall not be used in direct contact with masonry, within 18 inches of the earth, or where subject to corrosive conditions.

H. 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.

I. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

J. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

K. 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.

L. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers to grounding electrodes per NFPA 70.

M. Packaged Engine Generator: Solidly ground the packaged engine generator neutral to the normal power source neutral. Do not ground the generator neutral to a separate grounding electrode.

N. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

O. Grounding Bus:

1. Install grounding bus in the locations listed below and elsewhere as indicated:
    a. Electrical equipment rooms.
    b. Telephone equipment rooms.
    c. Rooms housing service equipment.
2. Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

P. 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.

Q. Bond together metal building elements not attached to grounded structure; bond to ground.

R. Provide a flexible braid bonding jumper at each set of columns at expansion joints.

3.04 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall, inside manhole, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

B. Connections to Manhole Components: Connect all exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformers/substations by connecting them to underground cable and grounding electrodes. Use not less than a No. 2 AWG conductor for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.05 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:

1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main

building electrical grounding electrode system via a No. 4/0 AWG copper ground conductor.

2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.

3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.

4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB's or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.

D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB's as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. TMGB and TGB installation: Use insulated spacer; space 2 inch from wall and support from wall 12 inches above finished floor, unless otherwise indicated.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB's to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.06 **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.

2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.

b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

c. Perform ground-impedance measurements utilizing either the intersecting curves method of the slope method. (Ref. Nos. 40 and 41 in IEEE Std. 81).

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

a. Equipment Rated 500 kVA and Less: 10 ohms.

b. Equipment Rated 500 to 1000 kVA: 5 ohms.

c. Equipment Rated More Than 1000 kVA: 3 ohms.

d. Substations and Pad-Mounted Switching Equipment: 5 ohms.

e. Manhole Grounds: 10 ohms.

f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Product Data: For the following:

1. Steel slotted support systems.

2. Roof mounted supports.

1.06 **QUALITY ASSURANCE**

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.07 **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. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) Hilti Inc.
        2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        1) B-Line by Eaton.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
        5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.

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.

2.04 **BACKBOARDS**

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

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. Indoor dry and damp Locations: Painted Steel
   2. Outdoors and interior 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 pipes, ducts, mechanical equipment, and conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.

3.03 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 **CONCRETE BASES**

A. Provide concrete bases for all floor mounted electrical equipment.

B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.

C. Base/Pad Construction:

1. Construct per manufacturer's recommendations for particular equipment, including suggested piers and dowel rods.

2. Interior concrete bases shall have a minimum depth of 4" unless other indicated or recommended by the manufacturer.

3. Exterior concrete bases shall have a minimum depth of 8" unless other indicated or recommended by the manufacturer.

4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.

D. Anchor equipment to base per both supports and equipment manufacturer's instructions.

E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.

3.06 **BACKBOARDS**

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8'-6" above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.

B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).

C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.07 **PAINTING**

A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533 - RACEWAYS AND BOXES

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 26 Section, “Underground Ducts and Raceways for Electrical Systems” for exterior duct banks, manholes and underground utility construction.
2. Division 07 Section, “Penetration Firestopping” for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
3. Division 26 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.
4. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. ENT: Electrical nonmetallic tubing.

C. FMC: Flexible metal conduit.

D. IMC: Intermediate metal conduit.

E. 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.

J. RTRC: Reinforced Thermosetting Resin Conduit

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 **FIRE ALARM EMT**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube Triangle Century.

B. EMT conduit with bright red topcoat; Fire Alarm EMT.

C. EMT and Fittings: ANSI C80.3.

2.03 **NONMETALLIC CONDUIT AND TUBING**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American International.

2. Anamet Electrical, Inc.; Anaconda Metal Hose.

3. 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.

F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

2.04 **METAL WIREWAYS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.05 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.

2.06 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.

2.07 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with ANSI/SCTE 77.

1. Color of Frame and Cover: Green.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC", “COMMUNICATIONS” or as indicated for each system service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell: Quazite
   b. Armorcast Products Company.
   c. Carson Industries LLC.
   d. CDR Systems Corporation.
   e. NewBasis.
   f. Christy Concrete Products.

2.08 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."

2.09 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.

2.10 **GROUT**

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

2.11 **SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 EXECUTION

3.01 **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, Enclosures, and Handholes:

1. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.

2. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

E. Minimum Raceway Size: 3/4-inch trade size.

F. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

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 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 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. Communications and Signal Cabling Systems Raceways: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

1. Electrical condulet (LB’s) are not permitted.
2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
3. Conduits shall contain no continuous sections longer than 150 ft. without a pull point/box.
4. Conduit for fiber cabling shall have a bend radius of at least 10 times the internal diameter.
5. Conduit for copper cabling less than 2” shall have a bend radius of at least 6 times the internal diameter. Conduit for copper cabling 2” and larger shall have a bend radius of at least 10 times the internal diameter.
6. All conduit ends shall have an insulated bushing.

W. 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.

X. 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.

Y. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Z. 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.

AA. 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.

BB. 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.

CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

DD. Locate boxes so that cover or plate will not span different building finishes.

EE. 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.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.

HH. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

II. Do not route feeders across roof unless approved in writing by Engineer.

JJ. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.

KK. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Division 2 Section "Earthwork."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, 42” below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

3.05 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. 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.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.06 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.

3.07 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."

3.08 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.

3.09 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 0543 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

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, including:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.02 SUMMARY

A. This section includes underground ducts and structures for electrical feeders and branch circuits 600V and below, electrical feeders over 600V, fiber optic cable systems, telecommunications and other similar facilities; including:

1. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
2. Rigid nonmetallic duct.
3. Flexible nonmetallic duct.
4. Reinforced Thermosetting Resin Conduit
5. Duct accessories.
6. Precast concrete handholes.
7. Polymer concrete handholes and boxes with polymer concrete cover.
8. Fiberglass handholes and boxes with polymer concrete cover.

9. Precast manholes.
10. Cast-in-place manholes.
11. Utility structure accessories.

1.03 **DEFINITION**

A. RNC: Rigid nonmetallic conduit.

1.04 **ACTION SUBMITTALS**

A. Product Data: For the following:
   1. Duct-bank materials, including separators and miscellaneous components.
   2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   3. Accessories for manholes, handholes, boxes, and other utility structures.
   4. Warning tape.
   5. Warning planks.

B. Shop Drawings for Precast or Factory-Fabricated Underground Utility Structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:
   1. Duct entry provisions, including locations and duct sizes.
   2. Reinforcement details.
   3. Frame and cover design and manhole frame support rings.
   4. Ladder details.
   5. Grounding details.
   6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
   7. Joint details.

1.05 **INFORMATIONAL SUBMITTALS**

A. Product Certificates: For concrete and steel used in precast concrete manholes, as required by ASTM C 858.

B. Source quality-control test reports.

C. Field quality-control test reports.

1.06 **QUALITY ASSURANCE**

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.08 **COORDINATION**

A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.

B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 PRODUCTS

2.01 METAL CONDUIT AND FITTINGS

A. GRC: Comply with ANSI C80.1 and UL 6.

B. Coated Steel Conduit: PVC-coated GRC.

1. Comply with NEMA RN 1.

2. Coating Thickness: 0.040 inch (1 mm), minimum.

C. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.02 RIGID NONMETALLIC DUCT

A. Underground Plastic Utilities Duct: Type EPC-80-PVC and Type EPC-40-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.

B. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

C. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 FLEXIBLE NONMETALLIC DUCTS

A. HDPE Duct: Type EPEC-80 HDPE, complying with NEMA TC 7 and UL 651A.

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.

2.04 DUCT ACCESSORIES

A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.

B. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

b. Printing on tape shall be permanent and shall not be damaged by burial operations.

c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

b. Inscriptions for Red-Colored Tapes: "ELECTRIC"

c. Inscriptions for Orange-Colored Tapes: "COMMUNICATION"

3. Description:

a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

b. Width: 3 inches.

c. Overall Thickness: 5 mils.

d. Foil Core Thickness: 0.35 mil.

e. Weight: 28 lb/1000 sq. ft.

f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.

C. Concrete dye for medium voltage duct bank: Red, dry shake color hardener as produced by Architectural Colored Concrete Supplier.

2.05 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Concrete Products.
2. Carder Concrete Products.
3. Christy Concrete Products.
4. Elmhurst-Chicago Stone Co.
5. Oldcastle Precast Group.
6. Riverton Concrete Products; a division of Cretex Companies, Inc.
7. Utility Concrete Products, LLC.
8. Utility Vault Co.
9. Wausau Tile, Inc.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering, "ELECTRIC."
4. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension shall provide increased depth of 12 inches.
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.

b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.06 PRECAST MANHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advance Concrete Products.
2. Carder Concrete Products.
3. Christy Concrete Products.
4. Elmhurst-Chicago Stone Co.
5. Oldcastle Precast Group.
6. Riverton Concrete Products; a division of Cretex Companies, Inc.
7. Utility Concrete Products, LLC.
8. Utility Vault Co.
9. Wausau Tile, Inc.

B. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.

a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.

b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.

c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.

C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.07 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bilco Company (The).
2. Campbell Foundry Company.

3. Carder Concrete Products.
4. Christy Concrete Products.
5. East Jordan Iron Works, Inc.
6. Elmhurst-Chicago Stone Co.
7. McKinley Iron Works, Inc.
8. Neenah Foundry Company.
9. NewBasis.
10. Oldcastle Precast Group.
11. Osburn Associates, Inc.
12. Pennsylvania Insert Corporation.
13. Riverton Concrete Products; a division of Cretex Companies, Inc..
14. Strongwell Corporation; Lenoir City Division.
15. Underground Devices, Inc.
16. Utility Concrete Products, LLC.
17. Utility Vault Co.
18. Wausau Tile, Inc.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inches.
    a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
2. Cover Legend: Cast in. Selected to suit system.
    a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
    b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
    c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
    a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- diameter eye, and 1-by-4-inch bolt.

1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.

E. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

F. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.

G. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.

H. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.

1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.

2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.

I. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

J. Fixed Manhole Ladders: Arranged for attachment to wall of manhole. Ladder and mounting brackets and braces shall be fabricated from nonconductive, structural-grade, fiberglass-reinforced resin.

2.08 **SOURCE QUALITY CONTROL**

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

PART 3 EXECUTION

3.01 **PREPARATION**

A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.

B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.

C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 31 00 00 "Earthwork”

D. Remove and stockpile topsoil for reapplication according to Section 31 00 00 "Earthwork"

3.02 **UNDERGROUND DUCT APPLICATION**

A. Duct for Optical Fiber or other Communications or Data Utility Service Cables: Type EPC-40-PVC RNC, reinforced concrete-encased ductbank unless otherwise indicated.

B. Duct for Electrical Cables More Than 600 V:

1. Type EPC-40-PVC RNC in reinforced concrete-encased duct bank unless otherwise indicated and where MV-90 and MV-105 cables are only intended to be applied at 90 deg C.
2. The top of the concrete encasement for cables 5KV and above shall be died red utilizing a dry-shake color hardener.
3. Conduit sizes and configurations shall be as indicated on the drawings or as required for the application if not specifically indicated.

C. Duct for Electrical Branch Circuits, including site lighting circuits: Type EPC-40-PVC RNC, direct-buried unless otherwise indicated.

D. Direct buried ducts shall be 1” minimum.

E. Bored Underground Duct: Type EPEC-80-HDPE unless otherwise indicated.

1. Perform directional bore in accordance with section 33 05 23 “Utility Horizontal Directional Drilling”.

F. Duct and conduit within five feet of building foundation wall shall be GRC.

G. Stub-ups: Concrete-encased PVC-coated GRC unless otherwise indicated.

3.03 UNDERGROUND ENCLOSURE APPLICATION

A. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.04 EARTHWORK

A. Excavation and Backfill: Comply with Division 2 Section "Earthwork," but do not use heavy-duty, hydraulic-operated, compaction equipment.

3.05 DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and

without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Raceways and Boxes."

F. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

G. Pulling Cord: Install 100-lbf- test nylon cord in ducts, including spares.

H. Concrete-Encased Ducts: Support ducts on duct separators.

1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.

2. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.

a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into concrete on both sides of joint near corners of envelope.

3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.

5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.

6. Stub-Ups: Use manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Extend concrete encasement throughout the length of the elbow.

7. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of the centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

I. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 4 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 2 Section "Earthwork" for pipes less than 6 inches in nominal diameter.
4. Install backfill as specified in Division 2 Section "Earthwork."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."
6. Set elevation of bottom of duct bank below the frost line.
7. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
    b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
8. Warning Planks: Bury warning planks approximately 12 inches above direct-buried ducts and duct banks, placing them 24 inches o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

3.06 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:
1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:
1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
3. Install handholes with bottom below the frost line, 42” below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.

2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Waterproofing: Apply waterproofing to exterior surfaces of manholes after concrete has cured at least three days. Waterproofing materials and installation are specified in Division 7 Section "Elastomeric Sheet Waterproofing." After ducts have been connected and grouted, and before backfilling, waterproof joints and connections and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.

F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.

G. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.

H. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

I. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.07 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding."

3.08 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

3. Test manhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.09 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. 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 ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. 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, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.03 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.

1. Not less than 6 inches wide by 4 mils thick.

2. Compounded for permanent direct-burial service.

3. Embedded continuous metallic strip or core.

4. Printed legend shall indicate type of underground line.

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.05 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.

2.06 **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.

2.07 **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.

2.08 **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 Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.

B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.

C. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Security System: Blue and yellow.
2. Telecommunication System: Green and yellow.
3. Control Wiring: Green and red.

D. 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.

E. 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.

F. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.

G. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.

H. 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.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

K. 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.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.

L. 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. Transformers.
   e. Emergency system boxes and enclosures.
   f. Disconnect switches.

g. Enclosed circuit breakers.

h. Motor starters.

i. Push-button stations.

j. Power transfer equipment.

k. Contactors.

l. Remote-controlled switches, dimmer modules, and control devices.

m. Voice and data cable terminal equipment.

n. Master clock and program equipment.

o. Intercommunication and call system master and staff stations.

p. Television/audio components, racks, and controls.

q. Fire-alarm control panel and annunciators.

r. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.

s. Monitoring and control equipment.

t. Uninterruptible power supply equipment.

u. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

v. Breakers or switches at distribution panels.

M. Wiring Device Identification Labels: On each faceplate install circuit designation label that is consistent with panelboard directories, and as-built plan drawings. Apply labels to receptacle faceplates centered below bottom outlet. Apply labels to toggle switch faceplates on backside.

3.02 **INSTALLATION**

A. Verify identity of each item before installing identification products.

B. Location:

1. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.

C. Apply identification devices to surfaces after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:

a. Phase A: Black.

b. Phase B: Red.

c. Phase C: Blue.

d. Grounded Conductor (Neutral): White.

3. Colors for 480/277-V Circuits:

a. Phase A: Brown.

b. Phase B: Orange.

c. Phase C: Yellow.

d. Ground Conductor (Neutral): Grey.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

I. 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.

J. 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

K. 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.

L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

M. Degrease and clean surface to receive nameplates.

N. Install nameplate and labels parallel to equipment lines.

O. Secure nameplate to equipment front using screws.

P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

Q. Identify conduit using field painting where required.

R. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION

SECTION 26 0573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC FLASH STUDY

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 SCOPE

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer. The contractor and electrical equipment manufacturer shall gather all the information required to perform the short-circuit and protective coordination study.

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-2004, 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.

1.03 SUMMARY

A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies, and Arc Flash calculations. Protective devices shall be set based on results of the protective device coordination study.

1.04 SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.

1. For Arc Flash calculations computer software program certifying compliance with IEEE 1584.

C. Qualification Data: For coordination-study and Arc Flash specialist.

D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be hardcopy and in digital form.

1. Coordination-study input data, including completed computer program input data sheets.
2. Study and Equipment Evaluation Reports.
3. Coordination-Study Report.
4. Arc Flash Hazard level report labels as defined in NFPA 70 and NFPA 70E.

1.05 **QUALITY ASSURANCE**

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.

B. Coordination-Study and Arc Flash Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study and all calculations. All elements of the study shall be performed under the direct supervision and control of engineer.

C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 1584 for Arc Flash calculations.

PART 2 PRODUCTS

2.01 **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.

2.02 **COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

A. Comply with IEEE 399, and IEEE 1584.

B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots. Program shall generate signage indicating Arc Flash data that shall be installed on the equipment.

1. Optional Features:
    a. Arcing faults.
    b. Simultaneous faults.

c. Explicit negative sequence.

d. Mutual coupling in zero sequence.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings. Refer to one-line diagram.

1. Proceed with coordination and Arc Flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.02 POWER SYSTEM DATA

A. Gather and tabulate the following input data to support coordination study:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination and Arc Flash studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Impedance of utility service entrance.

3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:

a. Circuit-breaker and fuse-current ratings and types.

b. Relays and associated power and current transformer ratings and ratios.

c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.

d. Generator kilovolt amperes, size, voltage, and source impedance.

e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.

f. Busway ampacity and impedance.

g. Motor horsepower and code letter designation according to NEMA MG 1.

4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:

a. Special load considerations, including starting inrush currents and frequent starting and stopping.

b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.

c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.

d. Generator thermal-damage curve.

e. Ratings, types, and settings of utility company's overcurrent protective devices.

f. Special overcurrent protective device settings or types stipulated by utility company.

g. Time-current-characteristic curves of devices indicated to be coordinated.

h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.

i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.

j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

3.03 FAULT-CURRENT STUDY

A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:

1. Medium Voltage Switchgear.
2. Switchboards.
3. Distribution panelboards.
4. Branch circuit panelboards.

B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.

C. Calculate momentary and interrupting duties on the basis of maximum available fault current.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 242.

1. Transformers:
   a. ANSI C57.12.10.
   b. ANSI C57.12.22.
   c. IEEE C57.12.00.
   d. IEEE C57.96.
2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
3. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

3.04 **COORDINATION STUDY**

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.

2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.

3. Calculate the maximum and minimum ground-fault currents.

B. Comply with IEEE 241 (Grey Book) and IEEE 242 (Buff Book) recommendations for fault currents and time intervals.

C. Transformer Primary Overcurrent Protective Devices:

1. Device shall not operate in response to the following:

a. Inrush current when first energized.

b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.

c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.

2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.

D. Motors served by voltages more than 600 V shall be protected according to IEEE 620.

E. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.

F. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:

1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

a. Device tag.

b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.

c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.

d. Fuse-current rating and type.

e. Ground-fault relay-pickup and time-delay settings.

2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:

a. Device tag.

b. Voltage and current ratio for curves.

c. Three-phase and single-phase damage points for each transformer.

d. No damage, melting, and clearing curves for fuses.

e. Cable damage curves.

f. Transformer inrush points.

g. Maximum fault-current cutoff point.

G. Completed data sheets for setting of overcurrent protective devices and complete the equipment settings as required. Coordinate work with the electrical contractor/testing agency.

3.05 **ARC FLASH CALCULATIONS**

A. Perform calculations using an approved computer software program. Prepare signage and install on all equipment as defined by NFPA 70E.

1. Calculate maximum energy available at each location.

2. Indicate required P.P.E. equipment level.

B. Comply with IEEE and NFPA 70E.

C. Provide tabular report indicating the following information at each piece of equipment.

a. Energy available in CAL/CM^2.

b. Required P.P.E. level.

c. Available fault current.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

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. Time controllers.
2. Outdoor and indoor photoelectric control.
3. Occupancy sensors.
4. Outdoor motion sensors.
5. Lighting contactors.
6. Wall digital time switches.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. 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 **OUTDOOR PHOTOELECTRIC CONTROL**

A. Manufacturers:

1. Intermatic, Inc.
2. Square D.
3. TORK.

B. General

1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
2. Provide hermetically-sealed, one-inch-diameter , cadmium sulphide photoelectric cell with manual, light level selector.
3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F .

C. Description: Solid state, with SPST dry contacts rated for 2000 W tungsten or 1800 VA ballasted load, to operate connected load, relay, contactor coils, or microprocessor input, and complying with UL 773A.

1. Light-Level Monitoring Range: Adjustable turn-on range of 1 to 5 footcandle and adjustable turn-off range of 3 to 15 footcandle, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: Adjustable delay up to two minutes to prevent false operation.
3. Contacts: Normally closed, fail on.
4. Electrical: Provide photocell with operating voltage rated to switch the load directly unless otherwise indicated.
5. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
6. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
7. Provide hermatically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle , light level selector.

2.03 INDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:

1. Wattstopper LS-101.
2. Sensorswitch CM-PC.

B. Photoelectric Sensor: Solid-state, light-level sensor unit utilizing an internal photoconductive cell to detect changes in lighting levels and capable of controlling any lighting source.

1. Housing: White, thermoplastic, tamper resistant, ceiling mount.
2. Sensor shall operate on 24V DC power through a control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
3. Light-Level Monitoring Range: 10 to 200 footcandle, with an adjustment for turn-on and turn-off levels within that range.
4. Deadband: Adjustable range of 10 to 300%.
5. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
6. Indicator: Two LEDs to indicate the beginning of on and off cycles.
7. Manual override function.
8. Provide indoor photoelectric switches and control units from single manufacturer.
9. Provide indoor photoelectric switches from same manufacturer as occupancy sensors.

C. Indoor Photoelectric Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
    a. Control units shall be provided as required to power indoor photoelectric sensor, control lighting loads and provide a minimum of one auxiliary contact.
    b. Sensor control units shall mount external to 4” sq junction box in the ceiling space. Wiring between control unit and photoelectric switch shall be plenum rated.
    c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
    d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
    e. It is acceptable to provide controls and auxiliary contacts as required integral to the sensor, provided all required contacts are provided.
    f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.04 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. Wall Switch Passive Infrared Occupancy Sensor
1. Manufacturers:
   a. Perfect Sense – PS-PWS
   b. Wattstopper PW-100.
   c. Hubbell Building Automation SOM 101.
   d. Greengate OSW-P-0451-W.
   e. Sensorswitch WSD.
   f. Philips LRS2210.
   g. Leviton ODS10-IDW.
2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
   a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
   b. Functions: Automatic ON/Automatic OFF, or Manual ON/Automatic OFF operation, field selectable. Integral manual override pushbutton switch.
   c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.
   d. Device Body: White, plastic with momentary on/off override pushbutton designed to mount in a standard switch box with “decora” style switch plate.

C. 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.

D. 110° Wall Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
    a. Perfect Sense DTC.
    b. Wattstopper DT-200
    c. Hubbell Building Automation “LO-DT” Series.
    d. Sensorswitch WV-PDT-R/WV-BR.
    e. Philips LRM2265.
    f. Leviton OSW12-M0W.
2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
    a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
    b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
    c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
    d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
    e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
    f. Manual override function.

E. 360° Ceiling Mounted Ultrasonic Occupancy Sensors

1. Manufacturers:
    a. Perfect Sense WDS.
    b. Wattstopper “WT” Series.
    c. Hubbell Building Automation “OMNI-US” Series.
    d. Greengate OPC-U-2000.
    e. Sensorswitch CM MPT-10.
    f. Philips LRM2255.
    g. Leviton OSC20-U0W.
2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
    a. Housing: White, thermoplastic, tamper resistant.
    b. Adjustments: Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
    c. 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.
    d. Manual override function.

F. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.

1. Manufacturers:
    a. Perfect Sense CPS.

b. Wattstopper CI-200.

c. Hubbell Building Automation OMNI-IR.

d. Greengate OMC-P-04500-R.

e. Sensorswitch CM-9.

f. Philips LRM2250.

g. Leviton OSC04-I0W.

2. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.

a. Housing: White, thermoplastic, tamper resistant ceiling mount.

b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.

c. 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.

d. Manual override function.

G. 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.

2.05 LIGHTING CONTACTORS

A. Manufacturers:

1. Cutler-Hammer; Eaton Corporation.

2. Square D Co.

3. General Electric.

4. Siemens.

5. Square D Co; class 8903.

B. Contactor

1. Electrically-operated electrically-held contactor, per NEMA ICS2, with 120 volt, 60 hertz coil and 600 volt, 60 hertz, contacts with size and number of poles indicated.

2. Provide contacts to be 100 percent, continuously rated for all types of ballast and tungsten lighting and resistance loads without the need for in-rush current derating.

3. Provide NEMA type 1 enclosure unless otherwise indicated.
4. Provide solderless pressure wire terminals.
5. Provide corrosion-resistant primer treatment with light gray baked acrylic enamel finish.
6. Provide the following control and indicating devices:
    a. Auxiliary contacts: One field convertible.
    b. Auxiliary relay to convert maintained-contact type control circuit to momentary-contact type control circuit necessary for contactor control.
    c. Hand-off-auto selector switch, of the heavy-duty “oil-tight”, maintained-contact type, mounted on the front cover with legend plate.
    d. Green pilot light to indicate “power on” condition. Mount on front cover with legend plate.

PART 3 EXECUTION

3.01 LIGHTING CONTACTOR INSTALLATION

A. Install lighting contactors as indicated on plan. Install at accessible locations. Switch controls where provided shall be no higher than 54” or lower than 48”.

B. Demonstrate proper operation of all lighting control functions to the Owner and Engineer.

3.02 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

A. Mount photocell on roof or parapet to ½” GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.

B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.

C. Adjust photocell sensitivity and delay to meet owner’s requirements. Multiple adjustments may be required, as needed.

3.03 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.

3.04 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.

3.05 **IDENTIFICATION**

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.06 **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.

3.07 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION

SECTION 26 0943 - LIGHTING CONTROL SYSTEMS

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. Provide open protocol interface for interoperability with building automation system including status of each occupancy/vacancy sensor, control station, dimming module, relay, time schedule, display graphics and status of lighting controls by zone.

D. Coordinate lighting controls with devices specified in Division 26 Section “Lighting Control Devices”.

1.09 **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. Management Interface

1. System shall provide a web-based management interface that provides remote system control, live status monitoring, and configuration capabilities of lighting control settings and schedules.

2. Management interface must be compatible with industry-standard web browser clients, including, but not limited to, Microsoft Internet Explorer®, Apple Safari®, Google Chrome®, Mozilla Firefox®.

3. All system software updates must be available for automatic download and installation via the internet.

B. 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. Integration with Building Management Systems (BMS) and Heating, Ventilation and Air Conditioning (HVAC) equipment.

3. Device shall automatically detect all networked devices connected to it, including those connected to wired and wireless communication bridges.

4. Device shall have a standard and astronomical internal time clock.
5. System Controller shall support BACnet/IP and BACnet/MSTP protocols to directly interface with BMS and HVAC equipment without the need for additional protocol translation gateways.
    a. BACnet/MSTP shall support a minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
    b. BACnet/MSTP shall support 9600 to 115200 baud.
    c. System Controller shall be BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
    d. System controller must support BACnet/IP Broadcast Management Device (BBMD) and Foreign Device Registration (FDR).

2.05 **WIRED NETWORKED DEVICES**

A. Wired Networked Wall Switches, Dimmers, Scene Controllers
1. Wall switches & dimmers shall support the following device options:
    a. Number of control zones: 1, 2 or 4. Gang multiple switches where more than 4 control zones are required in a single location under a single faceplate.
    b. Control Types Supported: On/Off or On/Off/Dimming
2. Scene controllers shall support the following device options:
    a. Number of scenes: 1, 2 or 4
    b. Control Types Supported:
        1) On/Off or On/Off/Dimming
        2) Preset Level Scene Type
        3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene
        4) Selecting a lighting profile to be run by the system’s upstream controller to implement a selected lighting profile across multiple zones
3. Match color specified in Division 26 Section "Wiring Devices."
4. Integral green LED pilot light to indicate when circuit is on.
5. Internal white LED locator light to illuminate when circuit is off.
6. Networked switch stations shall have backlit buttons.
7. Wall Plates:
    a. Single and multi-gang plates as specified in Division 26 Section "Wiring Devices."
    b. Where multiple switches and/or dimmers are adjacent to each other, install a single cover plate. Provide separate boxes or barriers as required for the application.
    c. Provide cover plates that are identical in material and dimension to standard single and double gang switch plates.
    d. Verify back box requirements for multiple control points with manufacturer.
8. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

B. Wired Networked Auxiliary Input / Output (I/O) Devices
1. Auxiliary Input/output Devices shall be specified as an input or output device with the following options:

a. Contact closure input: Programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.

b. 0-10V analog input: Programmable to function as a daylight sensor.

c. RS-232/RS-485 digital input: Supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.

d. 0-10V dimming control output, capable of sinking a minimum of 20mA of current programmable to support all standard sequence of operations supported by system.

C. Wired Networked Occupancy and Photosensors

1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.

2. Sensing technologies that are acoustically passive, meaning they do not transmit sounds waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology, if factory required.

3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.

4. Sensor mounting type shall match project design requirements as shown on plans.

a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.

5. The system shall support the following types of photocell-based control:

a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint and automatically turned on if the photocell reading is below the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching.

b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

D. Wired Networked 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

E. 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

F. 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.

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 Division26 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

SECTION 26 0999 - ELECTRICAL TESTING

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 “Medium Voltage Cables.”
4. Division 26 Section “Grounding and Bonding.”
5. Division 26 Section “Packaged Engine Generators.”
6. Division 26 Section “Medium-Voltage Transformers.”
7. Division 26 Section “Medium Voltage Switchgear.”
8. Division 26 Section “Enclosed Switches.”
9. Division 26 Section “Transfer Switch.”
10. Division 26 Section “Enclosed Controllers.”
11. Division 26 Section “Surge Protective Devices”
12. Division 26 Section “Switchgear.”
13. Division 26 Section “Switchboards.”
14. Division 26 Section “Panelboards.”
15. Division 26 Section “Dry Type Transformers (600V and Less).”
16. Division 26 Section “Enclosed Bus Assemblies.”
17. Division 26 Section “Fuses.”

1.02 SECTION INCLUDES

A. Engage the services of a recognized corporately independent N.E.T.A. certified testing firm to perform inspections and tests as specified herein.

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 terms test agency, test contractor, testing laboratory, test organization, or contractor test company, shall be construed to mean the testing firm.

F. 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 1200 - MEDIUM VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.01 PRE-PURCHASE

A. Specification includes product, installation, and field quality control testing requirements. Installation requirements included for reference only.

1.02 RELATED DOCUMENTS

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

1.03 SUMMARY

A. This Section includes the pre-purchase of the following types of transformers with medium-voltage primaries:

1. Pad-mounted, liquid-filled transformers.

1.04 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.05 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, utility or manufacturer’s anchorage and base recommendations, installed devices and features, location of each field connection, and performance for each type and size of transformer indicated.

B. Manufacturer Seismic Qualification Certification: Submit certification that transformer assembly and components will withstand seismic forces defined in Division 26 Section "Electrical Supports and Seismic Restraints." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control test reports.

D. Follow-up service reports.

E. Operation and Maintenance Data: For transformer and accessories to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of transformers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2.

D. Comply with ANSI C57.12.10, ANSI C57.12.28, IEEE C57.12.70, and IEEE C57.12.80.

E. Comply with NFPA 70.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store transformers protected from weather and so condensation will not form on or in units. Provide temporary heating according to manufacturer's written instructions.

1.08 PROJECT CONDITIONS

A. Service Conditions: IEEE C37.121, usual service conditions except for the following:

1. Altitudes above 3300 feet.
2. Exposure to explosive environments.
3. Exposure to seismic shock or to abnormal vibration, shock, or tilting.
4. Exposure to excessively high or low temperatures.

1.09 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

B. Coordinate installation of louvers, doors, spill retention areas, and sumps. Coordinate installation so no piping or conduits are installed in space allocated for medium-voltage transformers except those directly associated with transformers.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries; Cooper Power Systems Division.
2. Square D; Schneider Electric.

2.02 PAD-MOUNTED, LIQUID-FILLED TRANSFORMERS

A. Description: ANSI/IEEE C57.12.00, pad-mounted, 2-winding transformers. Stainless-steel tank base.

B. Insulating Liquid: Less flammable, edible-seed-oil based, and UL listed as complying with NFPA 70 requirements for fire point of not less than 300 deg C when tested according to ASTM D 92. Liquid shall be biodegradable and nontoxic.

C. Insulation Temperature Rise: 65 deg C when operated at rated kVA output in a 40 deg C ambient temperature. Transformer shall be rated to operate at rated kilovolt ampere in an average ambient temperature of 30 deg C over 24 hours with a maximum ambient temperature of 40 deg C without loss of service life expectancy.

D. KVA and Voltage Ratings: As indicated on drawings.

E. Basic Impulse Level: Comply with U.L. 1062.

F. Cooling System: Class KNAN, self cooled.

G. Full-Capacity Voltage Taps: Four 2.5 percent taps, 2 above and 2 below rated high voltage; with externally operable tap changer for de-energized use and with position indicator and padlock hasp.

H. High-Voltage Terminations and Equipment: Dead front with universal-type bushing wells for dead-front bushing-well inserts, complying with IEEE 386 and including the following:

1. Bushing-Well Inserts: One for each high-voltage bushing well.
2. Surge Arresters: Dead-front, elbow-type, metal-oxide-varistor units.

I. Transformer cabinet construction and paint finish shall conform to ANSI C57.12.28. and ANSI Standard Draft 6 dated October 18, 1989, color shall be outdoor green.

J. The transformer enclosure shall have no exposed screws, bolts, or other fastening devices which are externally removable. There shall be no openings through which foreign objects such as sticks, rods, or wires might contact live parts. There shall be means for padlocking the compartment doors with a single padlock having a maximum 1/2" diameter shackle (provide padlock and 2 sets of keys). In addition to each door handle, a recessed pentahead bolt shall be provided. The high voltage compartment door shall have a fastening device which is accessible only through the low voltage compartment. The enclosure shall comply with utility standards of withstanding pull test of 150 pounds, prying of 75 foot pounds and axial force of 50 pounds. The tank shall be welded/sealed type construction, tamper resistant.

K. Sound level may not exceed sound levels listed in NEMA TR 1.

L. Impedance: 5.75 percent.

M. Accessories:

1. Drain Valve: 1 inch, with sampling device.
2. Dial-type thermometer.
3. Liquid-level gage.

4. Pressure-vacuum gage.

5. Pressure Relief Device: Self-sealing with an indicator.

2.03 **IDENTIFICATION DEVICES**

A. Provide porcelain enamel "DANGER HIGH VOLTAGE" warning signs on the outside and inside of each door.

B. Provide porcelain enamel identification nameplates on the outside of each door, indicating the distribution transformer name.

C. Warning Signs/Nameplates: mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Electrical Identification."

2.04 **SOURCE QUALITY CONTROL**

A. Factory Tests: Perform design and routine tests according to standards specified for components. Conduct transformer tests according to IEEE C57.12.90.

B. Factory Tests: Perform the following factory-certified tests on each transformer:

1. Resistance measurements of all windings on rated-voltage connection and on tap extreme connections.

2. Ratios on rated-voltage connection and on tap extreme connections.

3. Polarity and phase relation on rated-voltage connection.

4. No-load loss at rated voltage on rated-voltage connection.

5. Excitation current at rated voltage on rated-voltage connection.

6. Impedance and load loss at rated current on rated-voltage connection and on tap extreme connections.

7. Applied potential.

8. Induced potential.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas and conditions for compliance with requirements for medium-voltage transformers.

B. Examine roughing-in of conduits and grounding systems to verify the following:

1. Wiring entries comply with layout requirements.

2. Entries are within conduit-entry tolerances specified by manufacturer and no feeders will have to cross section barriers to reach load or line lugs.

C. Examine walls, floors, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and that requirements in Division 26 Section "Grounding and Bonding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install transformers and anchor to concrete bases according to utility or manufacturer's written instructions, seismic codes at Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.03 **IDENTIFICATION**

A. Identify field-installed wiring and components.

3.04 **CONNECTIONS**

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **FIELD QUALITY CONTROL**

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

B. Visual and Mechanical Inspection

1. Compare equipment nameplate information with single line diagram.
2. Inspect for physical damage, cracked insulators, leaks, tightness of connections, and general mechanical and electrical conditions.
3. Verify proper auxiliary device operation.
4. Verify proper liquid level in all tanks and bushings.
5. Perform specific inspections and mechanical tests as recommended by manufacturer.
6. Verify proper equipment grounding.
7. Verify removal of any shipping bracing after final placement.

C. Electrical Tests

1. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output as shown in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistence values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.
2. Perform a turns ratio test between windings at all tap positions. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.
3. Insulating liquid shall be sampled in accordance with ASTM D-923. Sample shall be laboratory tested for:
    a. Dielectric breakdown voltage: ASTM D-877 or ASTM D-1816
    b. Acid neutralization number: ASTM D-974
    c. Interfacial tension: ASTM D-971 or ASTM D-2285
    d. Color: ASTM D-1500
    e. Visual Condition: ASTM D-1524
    f. Perform dissolved gas analysis (DGA) in accordance with ANSI/IEEE C57.104 or ASTM D-3612 for transformers 500 kVA and larger.
    g. PPM water: ASTM D-1533.
4. Perform insulation power factor tests or dissipation factor tests on all windings and bushings. Overall dielectric-loss and power factor (C_H, C_L, C_{HL}) shall be determined. Test voltages should be limited to the line to ground voltage rating of the transformer winding.

5. Perform tests and adjustments on tap-changer, fan and pump controls, and alarm function.
6. Verify proper core grounding if accessible.
7. Perform percent oxygen test on the nitrogen gas blanket for 3000 kVA or larger.

D. Test Values

1. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.
2. The polarization index should be used for future reference.
3. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.
4. Maximum power factor of liquid filled transformers corrected to 20^{o}C shall be in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.3.
5. Bushing power factors and capacitances that vary from nameplate values by more than ten percent (10%) should be investigated.
6. Dielectric fluid should comply with N.E.T.A. Acceptance Testing Specifications, Table 10.4.

E. Remove and replace malfunctioning units and retest as specified above.

F. Test Reports: Prepare written reports 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 actions taken to achieve compliance with requirements.

3.06 **FOLLOW-UP SERVICE**

A. Voltage Monitoring and Adjusting: Perform the following voltage monitoring after Substantial Completion but not more than six months after Final Acceptance:

1. During a period of normal load cycles as evaluated by Owner, perform seven days of three-phase voltage recording at secondary terminals of each transformer. Use voltmeters with calibration traceable to National Institute of Science and Technology standards and with a chart speed of not less than 1 inch per hour. Voltage unbalance greater than 1 percent between phases, or deviation of any phase voltage from nominal value by more than plus or minus 5 percent during test period, is unacceptable.
2. Corrective Actions: If test results are unacceptable, perform the following corrective actions, as appropriate:
    a. Adjust transformer taps.
    b. Prepare written request for voltage adjustment by electric utility.
3. Retests: After corrective actions have been performed, repeat monitoring until satisfactory results are obtained.
4. Report: Prepare written report covering monitoring and corrective actions performed.

END OF SECTION

SECTION 26 1329 - MEDIUM VOLTAGE SWITCHGEAR

PART 1 GENERAL

1.01 PRE-PURCHASE

A. Specification includes product, installation, and field quality control testing requirements. Installation requirements included for reference only.

1.02 INSTALLATION

A. Installing contractor to assume requirements of entire specification.

1.03 SUMMARY

A. This Section includes the pre-purchase of the following types of Medium Voltage Switchgear and Utility Metering.

B. Manufacturers.

C. General description.

D. Ratings

E. Construction - assembly.

F. Components.

G. Outdoor construction.

H. Utility metering.

I. Accessories.

J. Manufacturers - medium voltage fuses.

K. Medium voltage fuses.

1.04 **REFERENCES**

A. ANSI/IEEE 24 - Performance Characteristics and Dimensions for Outdoor Apparatus Bushings.

B. ANSI/IEEE 37.20 - Switchgear Assemblies, Including Metal-Enclosed Bus.

C. IEEE 48 - Test Procedures and Requirements for High-Voltage AC Cable Terminations.

1.05 **SUBMITTALS**

A. Submit shop drawings under the provisions of Section 26 0010.

B. Submit shop drawings indicating outline dimensions, enclosure construction, shipping splits, lifting and supporting points, electrical single line diagram, and equipment electrical ratings.

C. Submit product data for components and accessories.

D. Submit shop drawings to local utility for their approval prior to submitting to Engineer.

1.06 **OPERATION AND MAINTENANCE DATA**

A. Submit operation and maintenance data under provisions of Section 26 0010.

B. Include fuse replacement, adjustment, and lubrication instructions.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver products to site under provisions of Section 26 0010.

B. Store and protect products under provisions of Section 26 0010.

C. Accept interrupter switches on site and inspect for damage.

D. Protect interrupter switches from weather and moisture by covering with heavy plastic or canvas and by maintaining heat within enclosure in accordance with manufacturer's instructions.

1.08 **EXTRA MATERIALS**

A. Submit maintenance materials under provisions of Section 26 0010.

B. Submit two insulated-handle tools designed for pulling fuses.

C. Provide one set of spare fuses of each size.

D. Provide pad locks for each door, keyed alike.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Square D (base bid – bid price shall include Square D equipment).

B. Park Metal

C. S&C.

2.02 **GENERAL DESCRIPTION**

A. The air interrupter switches shall consist of outdoor self-supporting bay, containing interrupter switch and power fuses with the necessary accessory components, all completely factory-assembled and operationally checked.

B. To ensure a completely coordinated design, the manufacturer shall have sole responsibility for performance of basic switch and fuse components as well as complete integrated assembly as rated.

2.03 **RATINGS**

A. The ratings for the integrated switchgear assembly shall be as designated below:

Short-Circuit Rating -3ph sym. MVA @ Nom. Voltage	600
KV, Operating	13.2
KV, Nom	13.8
KV, Max	15
Basic Insulation Impulse Level – KV	95
Main Bus, Amps	600
Momentary and Fault-Closing Rating - Amps.Asy	40,000

B. The momentary ratings of switches and bus and interrupting ratings of fuses shall equal or exceed the short-circuit rating as assigned above.

C. Incoming or main interrupter switches shall be rated 600 amperes continuous and load interrupter. The feeder interrupter switches shall be rated 600 amperes continuous and load interrupting. Interrupter switches shall have two-time duty-cycle fault-closing ratings equal to or exceeding the short-circuit rating of the integrated switchgear assembly. These ratings define the ability to close the interrupter switch, either alone (unfused) or in combination with the appropriate power fuse, against a three-phase fault with asymmetrical current in at least one phase equal to the rated value, with the switch remaining operable and able to carry and interrupt rated current. Tests substantiating these ratings shall be performed at maximum design voltage applied for at least ten cycles and certified copies of tests submitted for record information.

2.04 **CONSTRUCTION - ASSEMBLY**

A. All interrupter switches, fuse mounting insulators and main-bus support insulators shall be of an electrical-grade porcelain with characteristics and restrictions as follows:

1. Operating experience of at least 5 years under similar conditions.
2. Ablative action or inorganic glaze to ensure nontracking properties.
3. Leakage distance established by test per IEC Publication 507, First Edition, 1975.
4. Conformance with applicable ANSI Standards.
5. Meets primary customer requirements of Detroit Edison Company.

B. Bus shall be copper. No flexible braid or cable acceptable.

C. A ground bus of short-circuit rating equal to that of the integrated assembly shall be provided, maintaining electrical continuity throughout the integrated assembly. The ground bus shall consist of tin plated aluminum. In each bay, the ground bus shall be fastened to a bare metal surface of each vertical section.

D. The enclosure material shall be 11-gauge steel. Each bay containing high-voltage components shall be a complete unit in itself, with full side sheets resulting in double-wall construction between bays. To guard against unauthorized or inadvertent entry, externally removable bolted side and rear panels shall not be allowed. An inspection window shall be provided to view interrupter switch position.

E. Doors shall be 11-gauge steel of bulkhead-type construction. Doors shall have 90-degree flanges as well as deep overlapping between doors and door openings. Fixed door handles shall have provisions for padlocking. For controlled access, tamper resistance, arcing faults, and safety, each door shall have a minimum of three concealed, high-strength latches with stainless-steel hinge pins and foot-operated door holder.

F. Vertical fiberglass-reinforced polyester (NEMA Grade GPO-3) insulating barriers shall be provided where necessary to maintain the basic insulation level of the assembly. Each section shall have a barrier as required by the authority having jurisdiction.

G. Doors providing access to interrupter switches with power fuses shall be mechanically or key interlocked to guard against opening the door if the interrupter switch is closed and closing switch if door is open.

H. Each bay or compartment thereof containing high-voltage components shall be provided with a second or inner protective barrier screen door, bolted closed, in addition to enclosure door. This barrier to guard against inadvertent contact with energized parts when the enclosure door is open. This barrier shall allow inspection of switch through viewing windows when door is closed.

I. Access to the enclosure shall be from the front only.

J. Provide removable lifting eyes. Sockets for lifting eyes shall be blind tapped.

K. Provide pentahead security bolts (per DTE recommendations).

2.05 **COMPONENTS**

A. All interrupter switches shall be group-operated three-pole devices.

B. All arcing shall be contained within an interrupting chamber so that it will eliminate ionized gases discharged into enclosure at time of interruption.

C. The switch shall have a single blade design or be mechanically interlocked so that switch cannot be opened unless interrupting unit opens. Spring-loaded auxiliary blades without positive interlocking are not acceptable.

D. Switches shall be operated by a permanently mounted front accessible handle.

E. All moving switch contacts shall be silver or silver-tungsten with stainless-steel backup springs.

F. The interrupter switches shall be on a single rigid steel mounting frame which intercepts and grounds the leakage path which parallels the open gap of the interrupter switch to positively isolate the load circuit when the switches are in the open position.

G. Each switch shall have a built-in quick-make, quick-break mechanism to assure high-speed opening and closing independent of manual or power operator.

H. Switchgear shall not require field adjustment or assembly, except for shipping breakdown.

2.06 **OUTDOOR CONSTRUCTION**

A. All hardware (including door fittings), operating-mechanism parts, and other parts subjected to mechanical motion shall be nonferrous, galvanized or zinc plated. Cadmium plated not acceptable. Provide pentahead security bolts per Detroit Edison recommendations.

B. Provide 300 watt, 240-volt rated ac strip heaters in each bay, with integral thermostat(s). Provide integral transformer, circuiting and overcurrent protection to provide power for strip heaters.

C. Provide all necessary bay-to-bay connection gasket materials.

D. Provide the underside of roof with insulating coating to prevent condensation and dripping.

E. Provide internal "U" shaped gasket to waterproof bus opening between bays to prevent water leaks from contact with bus.

F. Louvers shall provide adequate ventilation to help prevent condensation and be constructed (with screening) to protect against insertion of foreign objects and insects.

G. A high-corrosion resistant finish shall be provided. The finish color shall be outdoor green, unless otherwise noted on the drawings.

H. This finish shall meet the following performance tests:

1. 1500 hours of exposure to salt-spray testing per ASTM B 117 with:

   a. Underfilm corrosion not to extend more than 1/32" from the scribe; and

   b. Loss of adhesion from bare metal not to extend more than 1/8" from the scribe.

2. 1000 hours of humidity testing per ASTM D 2247 with no blistering as evaluated per ASTM D 714.

3. 500 hours of accelerated weathering testing per ASTM G 53 with no chalking as evaluated per ASTM D 659, and no more than a 15% reduction of paint gloss as evaluated per ASTM D 523.
4. Crosshatch adhesion testing per ASTM D 3359 Method B with no loss of paint.
5. 160-inch pound impact adhesion testing per ASTM D 2794 with no paint chipping or cracking.

2.07 **UTILITY METERING**

A. Current-Transformer Compartment: Comply with requirements of electrical power utility company. Coordinate CT installation with DTE.

2.08 **ACCESSORIES**

A. Surge Arrestors: Distribution class, rated 10 KV; mount in incoming line compartment.

B. Incoming Cable Terminations: as required by Detroit Edison.

C. Provide porcelain enamel "HIGH VOLTAGE" warning signs on the outside and inside of each door.

D. Provide porcelain enamel identification signs on the outside of each door, indicating which distribution transformer the switch feeds.

E. Provide three spare fuses (match size of installed fuse) for each feeder switch. Provide spare fuse holder on the inside of each door.

F. Provide pad lock for each section, all keyed the same.

2.09 **MANUFACTURERS - MEDIUM VOLTAGE FUSES**

A. S&C.

B. Bussman.

2.10 **MEDIUM VOLTAGE FUSES**

A. Fuse: Enclosed power fuses with hinged base, S&C model SM-20 or equal as approved by D.T.E., suitable for use outdoors in enclosure.

B. Fuse Rating: E rated fuse, size as indicated.

C. Voltage: 15 KV.

D. Interrupting Rating: 40,000 amperes rms symmetrical.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on shop drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means installer accepts existing surface conditions.

3.02 **INSTALLATION**

A. Install in accordance with manufacturer's instructions.

3.03 **FIELD QUALITY CONTROL**

A. Field inspection and testing will be performed under provisions of Section 26 0999.

B. Visually inspect for physical damage.

C. Perform mechanical operator tests in accordance with manufacturer's instructions. Check blade alignment and arc interrupter operations.

D. Perform insulation resistance test on each phase to ground and from each phase to each other phase. Record results.

E. Perform AC over potential test to ANSI/IEEE 37.20.

F. Perform contact resistance test across each switch blade; report any contact resistance in excess of 50 microhms.

END OF SECTION

SECTION 26 2200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

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 types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:

1. Distribution transformers.
2. Control and signal transformers.

B. Related Section includes the following:

1. Division 26 Section “Electrical General Requirements.”
2. Division 26 Section “Grounding and Bonding.”
3. Division 26 Section “Conductors and Cables.”
4. Division 26 Section “Raceways and Boxes.”
5. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 REFERENCES

A. ANSI/IEEE C57.12.9: Test Code for Dry-Type Distribution and Power Transformers

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)

C. NEMA ST 1: Specialty Transformers

D. NEMA ST 20: Dry Type Transformers for General Applications

E. NEMA TP 1: Guide for Determining Energy Efficiency for Distribution Transformers

F. NEMA TP 2: Standard Test Method for Measuring the Energy Consumption of Distribution Transformers

G. NETA ATS: Acceptable Testing Specifications for Electrical Power Distribution Equipment and Systems

H. NFPA 70: National Electrical Code

I. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors

J. UL 486B: Wire Connectors for Use with Aluminum Conductors

K. UL 506: Specialty Transformers

L. UL 1561: Dry-Type General Purpose and Power Transformers

1.04 **ACTION SUBMITTALS**

A. Product Data Include rated nameplate data, capacities, weights, dimensions, utility or manufacturer's anchorage and base recommendations, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

1. Transformer Inrush: Provide time-current coordination curves demonstrating transformer inrush and ANSI damage curves with primary overcurrent device selections to clear inrush yet still protecting damage curve.

B. Shop Drawings: Wiring and connection diagrams.

1.05 **INFORMATIONAL SUBMITTALS**

A. Source quality-control test reports. Include loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

B. Field quality control test reports

C. Output Settings Reports: Record of tap adjustments specified in Part 3.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with IEEE C 57.12.91.

C. Comply with NFPA 70.

D. Energy-Efficient Transformers Rated 15 kVA and Larger: Certified as meeting doe 2016 efficiency levels when tested according to NEMA TP2.

1.07 **DELIVERY, STORAGE, AND HANDLING**

A. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

B. Store, protect, and handle products to site under provisions of Division 26 section "Electrical General Requirements."

C. Deliver transformers individually wrapped for protection and mounted on shipping skids.

D. Accept transformers on site. Inspect for damage.

E. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

F. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.08 **COORDINATION**

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

B. Coordinate installation of wall-mounting and structure-hanging supports.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton
2. ABB
3. Siemens Industries, Inc.
4. Square D/Groupe Schneider NA.

2.02 **GENERAL TRANSFORMER REQUIREMENTS**

A. Description: Factory-assembled and tested, air-cooled units for 60 Hz service.

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.

C. Transformers Rated 15 kVA and Larger:

1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
2. Marked as compliant with DOE 2016 efficiency levels by qualified electrical testing laboratory recognized by authorities having jurisdiction.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside transformer enclosure.

2.03 **DISTRIBUTION TRANSFORMERS**

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.

1. One leg per phase.
2. Grounded to enclosure.

C. Coils: Continuous windings without splices, except for taps.

1. Coil Material: Aluminum.
2. Internal Coil Connections: Brazed or pressure type.

D. Encapsulation: Transformers smaller than 30 kVA must have core and coils completely resin encapsulated.

E. Enclosures: Ventilated

1. Core and coil must be encapsulated within resin compound to seal out moisture and air.
2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
3. Vibration Isolation: Isolate core and coil from enclosure using vibration-absorbing mounts.
4. Wiring Compartment: Sized for conduit entry and wiring installation.
5. Environmental Protection:

a. Indoor: UL 50E, Type 2.

b. Outdoor: UL 50E, Type 3R.

6. Finish Color: Gray weather-resistant enamel.

F. Taps for Transformers 3 kVA and Smaller: None.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with maximum of 115 deg C rise above 40 deg C ambient temperature.

J. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with maximum of 150 deg C rise above 40 deg C ambient temperature.

K. Basic Impulse Level: 10 kV.

L. Mounting: Suitable for mounting as indicated.

M. Wall Brackets: Manufacturer's standard brackets.

N. Grounding: Provide ground-bar kit or ground bar installed on inside of transformer enclosure.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.04 CONTROL AND SIGNAL TRANSFORMERS

A. Description: Factory-assembled and tested, self-cooled, two-winding dry type, rated for continuous duty, and 60 Hz operation, complying with NEMA ST 1, and listed and labeled as complying with UL 506.

B. Ratings: Continuous duty. If rating is not indicated, provide at least 50 percent spare capacity above connected peak load.

2.05 SOURCE QUALITY CONTROL

A. Factory Tests and Inspections: Provide the factory tests on the actual transformers provided or on similar units identical to those provided. Test and inspect assembled system, by, or under supervision of, qualified electrical testing laboratory recognized by authorities having jurisdiction, in accordance with IEEE C57.12.01 and IEEE C57.12.91 before delivering to site. Affix label with name and date of certification of system compliance on control units.

1. Resistance measurements of windings at rated voltage connections and at tap connections.

2. Ratio tests at rated voltage connections and at tap connections.

3. Phase relation and polarity tests at rated voltage connections.

4. No load losses, and excitation current and rated voltage at rated voltage connections.

5. Impedance and load losses at rated current and rated frequency at rated voltage connections.

6. Applied and induced tensile tests.

7. Regulation and efficiency at rated load and voltage.

8. Insulation-Resistance Tests:

a. Line-side to ground.

b. Load-side to ground.

c. Line-side to load-side.

9. Temperature tests.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls and floors for suitable mounting conditions where transformers will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install Products in accordance with manufacturer’s instructions.

B. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

C. Install floor mounted transformers on and anchor to concrete bases according to manufacturer’s recommendations.

1. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

D. Identification: Engraved metal or laminated-plastic nameplate mounted with corrosion resistant screws. Provide nameplate according to Division 26 Section “Electrical Identification” indicating the following:

1. Transformer designation (e.g. “T-1”).
2. Primary power characteristics (e.g. “480V, 3PH, 3W”).
3. Secondary power characteristics (e.g. “208Y/120V, 3PH, 4W”).
4. Power rating (e.g. “75 kVA”).
5. Power source (e.g. “Fed from DP-1).

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."

C. Provide conduit according to Division 26 Section “Raceways and Boxes” for connections to transformer case. Make conduit connections to side panel of enclosure.

D. 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.

E. Check for damage and tighten connections prior to energizing transformer.

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing” for transformers 75KVA and above:

1. Visual and Mechanical Inspection

a. Inspect for physical damage, cracked insulators, tightness of connections, defective wiring and general mechanical and electrical conditions.

b. Verify proper core grounding.

c. Verify proper equipment grounding.

d. Compare equipment nameplate with single line diagram and report discrepancies.

2. Electrical Tests

a. Perform insulation resistance tests, winding-to-winding and windings-to-ground, utilizing a meg-ohmmeter with test voltage output in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Test duration shall be for 10 minutes with resistance values tabulated at 30 seconds, 1 minute, and 10 minutes. Calculate Polarization index.

b. Perform a turns ratio test between windings at every tap position. The final tap setting is to be set at the secondary system rated voltage at full load or as directed by the Architect/Engineer.

c. Verify proper secondary voltage phase-to-phase and phase-to-neutral after energization and prior to loading.

3. Test Values

a. Perform insulation resistance tests in accordance with N.E.T.A. Acceptance Testing Specifications, Table 10.5. Results to be temperature corrected in accordance with Table 10.14.

b. The polarization index should be above 1.2 unless an extremely high value is obtained initially, such that when doubled will not yield a meaningful value.

c. Turns ratio test results shall not deviate more than one half percent (0.5%) from either the adjacent coils or the calculated ratio.

3.05 **ADJUSTING**

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 5 percent. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION

SECTION 26 2413 - SWITCHBOARDS

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 service and distribution switchboards rated 600 V and less.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. RFI: Radio-frequency interference.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include

dimensions, utility or manufacturer’s anchorage and base recommendations, 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 switchboard and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. 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 switchboards and overcurrent protective devices.

d. Descriptive documentation of optional barriers specified for electrical insulation and isolation if specified.

e. Utility company's metering provisions with indication of approval by utility company if called out.

f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

D. Manufacturer Seismic Qualification Certification: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. 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.

F. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Routine maintenance requirements for switchboards and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.05 **QUALITY ASSURANCE**

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain switchboards through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."

F. Comply with NFPA 70.

1.06 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.07 **PROJECT CONDITIONS**

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. 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.

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 Construction Manager no fewer than seven days in advance of proposed interruption of electric service.

2. Indicate method of providing temporary electric service.

3. Do not proceed with interruption of electric service without Construction Manager's written permission.

1.08 **COORDINATION**

A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

1.09 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: 2 of each size and type.
2. Control-Power Fuses: 2 of each size and type.
3. Fuses for Fused Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
4. Indicating Lights: 3 of each size and type.

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 **MANUFACTURED UNITS**

A. Manufacturers:

1. Square D (base bid – bid price shall include Square D equipment).

B. Front-Connected, Front-Accessible Switchboard:

1. Main devices over 1200A: Fixed, individually mounted.
2. Main devices below 1200A, panel mounted.
3. Branch Devices: panel-mounted.
4. Sections rear aligned.

C. Nominal System Voltage: As noted on Drawings.

D. Main-Bus Continuous: As noted on Drawings.

E. Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

F. Enclosure: Steel, NEMA 250, Type 1 not over 102 in height.

G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

H. Insulation and isolation for main and vertical buses of feeder sections.

I. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

J. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

K. Buses and Connections: Three phase, four wire, unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity with feeder circuit-breaker line connections.

2. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with copper- or tin-plated, aluminum circuit-breaker line connections.
    a. If bus is aluminum, use copper- or tin-plated aluminum for circuit-breaker line connections.
    b. If bus is copper, use copper for feeder circuit-breaker line connections.
3. Ground Bus: 1/4-by-2-inch minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
4. Contact Surfaces of Buses: Silver plated.
5. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.
7. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.

L. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.03 SURGE PROTECTIVE DEVICES

A. Direct bus connected type as specified in Division 26 Section "Surge Protective Devices."

B. Provide Surge Protective Device for switchboards that are part of the emergency distribution system.

C. Provide Surge Protective Device for switchboards elsewhere where indicated on the drawings.

2.04 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. Electronic trip-unit circuit breakers shall have RMS sensing, field-replaceable rating plug, and the following field-adjustable settings with restricted access cover:
    a. Instantaneous trip.
    b. Long- and short-time pickup levels.
    c. Long- and short-time time adjustments.
    d. Ground-fault pickup level, time delay, and I^2t response.
3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

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 material.

2. Application Listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment.

3. Shunt Trip: 120-V trip coil energized from separate circuit.

4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

C. Enclosed, Insulated-Case Circuit Breaker: Fully rated, encased-power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.

2. Two-step, stored-energy closing.

3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings with restricted access cover.

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments with I^2t response.

d. Ground-fault pickup level, time delay, and I^2t response.

D. Circuit breaker selection for transformer primary protection:

1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

E. Circuit breakers rated 1200A and above:

1. Circuit breakers rated 1200A and above, not specified elsewhere with zone selective interlocking, shall be provided with an energy reducing maintenance switch with local status indicator.

2. The switch and status indicators shall be remote from the circuit breaker, located at the entrance to the electrical room where the circuit breaker is installed.

2.05 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.

2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.

3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 1 percent.

b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.

c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.

d. Megawatts: Plus or minus 2 percent.

e. Megavars: Plus or minus 2 percent.

f. Power Factor: Plus or minus 2 percent.

g. Frequency: Plus or minus 0.5 percent.

h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.

i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.

2. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door. Mounting height shall be 5’-6” above bottom of switchboard.

2.06 **CONTROL POWER**

A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.07 **ACCESSORY COMPONENTS AND FEATURES**

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Provide permanent provisions for locking all overcurrent devices in switchboard. Provisions shall remain in place whether or not lock is installed.

C. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 **PROTECTION**

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.02 **EXAMINATION**

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.03 **INSTALLATION**

A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.

B. Install switchboards and anchor to concrete bases according to utility or manufacturer's recommendations, seismic codes at Project, and requirements in Division 26 Section "Hangers and Supports for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

F. Set field-adjustable switches and circuit-breaker trip range.

3.04 ADJUSTING

A. Adjust circuit breaker trip and time delay settings to values as instructed by the Engineer.

3.05 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.06 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchboard 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, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.

b. Instruments, Equipment, and Reports:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2) Prepare a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.07 **CLEANING**

A. On completion of installation, inspect interior and exterior of switchboards. 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.

3.08 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories

END OF SECTION

SECTION 26 2416 - PANELBOARDS

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. Distribution panelboards.
2. 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.

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.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

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. Eaton.

b. ABB.

c. Siemens Industries, Inc.

d. Square D by Schneider Electric

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: Steel and 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: Same finish as panels and trim.

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.

3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

4. Double Lugs: Mechanical type mounted at location of main incoming lugs.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

F. Surge Protective Devices: Where indicated, provide manufactured units with direct bus connected type as specified in Division 26 Section “Surge Protective Devices.”

1. Provide Surge Protective Device for all Distribution and Branch Circuit Panelboards that are part of the Emergency Distribution System.

2. Provide Surge Protective Devices elsewhere where indicated on the drawings.

2.03 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.04 DISTRIBUTION PANELBOARDS

A. Main bus bars, neutral and ground, shall be aluminum and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

C. Main Overcurrent Protective Devices: Circuit breaker or Fused switch as indicated on drawings.

D. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

3. Fused switches.

2.05 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.

2.06 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. Electronic trip-unit circuit breakers shall have RMS sensing; field-replaceable rating plug; and with the following field-adjustable settings with restricted access cover:

a. Instantaneous trip.

b. Long- and short-time pickup levels.

c. Long- and short-time time adjustments.

d. Ground-fault pickup level, time delay, and I^2t response.

3. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

4. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
5. 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. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
4. Shunt Trip: 120-V trip coil energized from separate circuit.
5. Do not use tandem circuit breakers.
6. Provide lock on devices for circuit breakers when called out on panel schedules with “LOD” designation.
7. 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
8. Provide GFCI circuit breaker when called out on panel schedules with “GFCI” designation.
9. Provide shunt trip breakers when called out on panel schedules with “STB” designation.
10. Provide permanent padlockable handle for circuit breakers when called out on panel schedules with “PL” designation.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

D. Fuses are specified in Division 26 Section "Fuses."

E. Circuit Breaker Selection for Transformer Primary Protection:

1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.07 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Provide permanent provisions for padlocking all overcurrent devices in Distribution Panelboards. Provisions shall remain in place whether or not lock is installed.

C. Provide permanent provisions for padlocking overcurrent devices in Branch Circuit Panelboards that serve equipment not provided with a local, lockable disconnecting means. Provisions shall remain in place whether or not lock is installed

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.

1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. 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

SECTION 26 2726 - WIRING DEVICES

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. Receptacles with integral USB charger.
3. Ground-fault circuit interrupter receptacles.
4. Single- and double-pole snap switches.
5. Device wall plates.
6. Pin and sleeve connectors and receptacles.
7. Floor service fittings
8. Poke-through assemblies.

1.03 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. AFCI: Arc-fault circuit interrupter.

D. PVC: Polyvinyl chloride.

E. RFI: Radio-frequency interference.

F. SPD: Surge protective devices.

G. UTP: Unshielded twisted pair.

H. USB: Universal serial bus.

1.04 **REFERENCES**

A. DSCC W-C-596G: Federal Specification Connector, Electrical, Power, General Specification.

B. DSCC W-C-896F: Federal Specification Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. IEC 309-1, Part 1: General Requirements: Plugs, Socket-Outlets and Couplers for Industrial Purposes

D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.

E. NEMA WD 1: General Requirements for Wiring Devices.

F. NEMA WD 6: Wiring Device – Dimensional Requirements.

G. UL 20: General-Use Snap Switches.

H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

I. UL 486B: Wire Connectors for Use with Aluminum Conductors.

J. UL 498: Electrical Attachment Plugs and Receptacles.

K. UL 943: Ground Fault Circuit Interrupters.

L. 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. Wiring Devices Connected to Optional Standby Power System: Red.
3. 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

B. Weather- and 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 Wire Device-Kellems: BR20WRTR
   b. Eaton/Arrow Hart Wiring Devices: TWRBR20
   c. Leviton: TWR20
   d. Legrand, Pass & Seymour: WR5352TR

2.03 USB RECEPTACLES

A. Tamper-Resistant Duplex NEMA 5-20R and USB Charging Receptacle:

1. Decorator style.
2. Comply with UL 1310.
3. USB Charging 3.0A (minimum), 5VDC dual ports.
   a. Comply with battery charging specification USB BC1.2
   b. Compatible with USB 1.1/2.0/3.0 devices, including Apple products.

4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Legrand, Pass & Seymour: PTTR20ACUSB Full Duplex USB A and C.
    b. Leviton: T5833 Full Duplex USB A and C.

2.04 **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.

D. Dead Front GFCI, 20A:
1. Manufacturers: Subject to compliance with requirements, provide one of the following:
    a. Hubbell Wiring Device-Kellems: GFBFST20
    b. Eaton/Arrow Hart Wiring Devices: SGF20
    c. Leviton: GFRBF
    d. Legrand, Pass & Seymour: 2087

2.05 **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

2.06 **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 **CORD REELS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Reelcraft L4500 Series
2. Legrand, Pass & Seymour
3. Hubbell Wiring Device-Kellems
4. Daniel Woodhead

B. Description: Portable cord reel with portable outlet box and receptacle; steel construction NEMA 1 enclosure; adjustable cord stop; spring retractable with latch; 115V, 20A. rated and capable of being ceiling, wall or bench mounted.

C. Cord: 30 feet of 3 no. 12 SJO cord with strain relief and in line GFCI protection located just before portable outlet box.

D. Wiring device: Portable outlet box with liquidtight cord connector and two NEMA 5-20R tamper resistant duplex receptacles, outlet box and flip-top cover attached to end of cable reel.

E. Electrical Connection: Provide 48 inch pigtail with NEMA L5-20P plug.

2.08 **WALL SWITCHES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Wiring Device-Kellems: 1220 Series
2. Eaton/Arrow Hart Wiring Devices: AH1220 Series
3. Leviton: 1220 Series
4. Legrand, Pass & Seymour: PS20AC Series

B. Device body: Plastic handle.

C. Single- and Double-Pole Switches: Comply with DSCC W-C-896F and UL 20.

D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide key type where indicated. Furnish four keys to Owner.

2.09 **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 Cast aluminum with hinged cover and listed and labeled as Extra Duty Weatherproof While-In-Use.
    a. Manufacturers:
        1) Hubbell: MX3200
        2) Red Dot Model: CKLSVU, Thomas & Betts
        3) Intermatic: WP3110MXD
        4) Leviton: IUM1V

2.10 **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.

6. Install switches with OFF position down.

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 While-In-Use cover plates on receptacles in damp and wet locations.

H. Install tamper-resistant type receptacles in all locations.

I. Use oversized plates for outlets installed in masonry walls.

J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

K. Remove wall plates and protect devices and assemblies during painting.

L. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

M. 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.

2. Wall Switches: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section “Electrical Identification” with black-filled lettering on back side 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

SECTION 26 2813 - FUSES

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. Cartridge fuses rated 600 V and less for use in switches, switchboards, and controllers.

1.03 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

2. Let-through current curves for fuses with current-limiting characteristics.

3. Time-current curves, coordination charts and tables, and related data.

4. Fuse size for elevator feeders and elevator disconnect switches.

B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Division 1 Section " Operation and Maintenance Data," include the following:

a. Let-through current curves for fuses with current-limiting characteristics.

b. Time-current curves, coordination charts and tables, and related data.

c. Ambient temperature adjustment information.

1.04 **QUALITY ASSURANCE**

A. Source Limitations: Obtain fuses 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:

1. NEMA FU 1 – Low Voltage Cartridge Fuses.
2. NFPA 70 – National Electrical Code.
3. UL 198C – High-Interrupting-Capacity Fuses, Current-Limiting Types.
4. UL 198E – Class R Fuses.
5. UL 512 – Fuseholders.

1.05 **PROJECT CONDITIONS**

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.06 **COORDINATION**

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

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. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than 3 of each type and size.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussman, Inc.
2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
3. Ferraz Shawmut, Inc.
4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.02 **CARTRIDGE FUSES**

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

1. Service Entrance: Class L, time delay.
2. Feeders: Class J, time delay.
3. Motor Branch Circuits: Class RK5, time delay.
4. Other Branch Circuits: Class J, time delay.

2.03 **FLUORESCENT AND H.I.D. LIGHTING BALLAST FUSES**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussman, Inc. – GLR fuses with HLR holder.
2. Tracor, Inc.; Littelfuse, Inc. Subsidiary – LGR fuses with LHR-000 holder.
3. Ferraz Shawmut, Inc. – SLR fuses.

B. Provide each fluorescent and HID lighting ballast with individual protection on the line side.

C. Provide fuse and holder mounted within or as part of the fixture.

D. Provide fuse size and type recommended by the fixture manufacturer.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Install spare-fuse cabinet(s).

3.03 **IDENTIFICATION**

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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 “Fuses”.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
3. Molded-case circuit breakers.
4. Enclosures.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.04 **REFERENCES**

A. NECA 1: Practices for Good Workmanship in Electrical Contracting.

B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA FU 1: Low Voltage Cartridge Fuses.

F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.

I. NFPA 70: National Electrical Code.

1.05 **ACTION SUBMITTALS**

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current rating.

4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram 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 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.08 **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.

B. Comply with NFPA 70.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.09 **PROJECT CONDITIONS**

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.

2. Altitude: Not exceeding 6600 feet.

1.10 **COORDINATION**

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.11 **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. Spares: For the following:

a. Fuses for Fusible Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.

2. Spare Indicating Lights: Six of each type installed.

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 **FUSIBLE AND NONFUSIBLE SWITCHES**

A. Manufacturers:

1. Eaton.

2. ABB.

3. Siemens Industries, Inc.

4. Square D by Schneider Electric.

B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.

2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.03 **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 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.04 **ENCLOSURES**

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Indoor Dry Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **CONCRETE BASES**

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.03 **INSTALLATION**

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Install switches with off position down.

D. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.

E. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.

F. Install fuses in fusible disconnect switches.

G. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" whip.

H. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.

I. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

J. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

K. Support enclosures independent of connecting conduit or raceway system.

L. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Electrical Identification."

C. Provide adhesive label as specified in Division 26 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.05 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. Verify rating of installed fuses.

B. 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. Certify compliance with test parameters.
    1)
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.06 ADJUSTING

A. Set field-adjustable switches trip and time delay settings to values as determined by the protective device coordination study.

3.07 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 2913 - ENCLOSED CONTROLLERS

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 ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.

B. Related Sections include the following:

1. Division 20 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.
2. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

1.04 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: For each enclosed controller.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

a. Each installed unit's type and details.

b. Nameplate legends.

c. Short-circuit current rating of integrated unit.

d. UL listing for series rating of overcurrent protective devices in combination controllers.

e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.

2. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.

2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

B. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.06 **REFERENCES**

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.

C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.

D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).

E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.

F. NECA 402-2000 – Recommended Practice for Installing and Maintaining Motor Control Centers.

G. NEMA AB 1 - Molded Case Circuit Breakers.

H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

I. NEMA KS 1 - Enclosed Switches.

J. ANSI/NFPA 70 - National Electrical Code.

1.07 **QUALITY ASSURANCE**

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.

B. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

1.08 **DELIVERY, STORAGE, AND HANDLING**

A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.

B. Deliver products to site under provisions of Section 26 0010. Store and protect products under provisions of Section 26 0010.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.09 **PROJECT RECORD DOCUMENTS**

A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 26 0010.

1.10 **COORDINATION**

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

C. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

1.11 **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. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.
3. Keys: Furnish 2 of each to Owner.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB.
2. Danfoss Inc.; Danfoss Electronic Drives Div.
3. Eaton .
4. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
5. Siemens
6. Square D by Schneider Electric

2.02 **ACROSS-THE-LINE ENCLOSED CONTROLLERS**

A. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: NEMA KS 1, heavy-duty, fusible switch with rejection-type fuse clips rated for fuses. Select and size fuses to provide Type 2 protection according to IEC 947-4-1, as certified by an NRTL.
2. Non-fusible Disconnecting Means: NEMA KS 1, heavy-duty, non-fusible switch.
3. Circuit-Breaker Disconnecting Means: NEMA AB 1, motor-circuit protector with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.

2.03 **VARIABLE FREQUENCY CONTROLLERS**

A. Refer to Division 20 section “Variable Frequency Controllers.”

B. Equipment furnished by mechanical trades and installed by electrical trades.

2.04 **ENCLOSURES**

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

2.05 **ACCESSORIES**

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.

B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.

C. Indicating Lights: Run (Red), off or ready (Green).

D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.

E. Selector Switch: NEMA ISC 2, mounted in front cover to read “hand/off/auto,” provide auxiliary contact for auto position monitoring.

F. Control Relays: Auxiliary and adjustable time-delay relays.

G. Phase-Failure and Undervoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connection. Provide adjustable undervoltage setting.

H. Manufacturer provided nameplate shall be provided on controller enclosure. Nameplate shall contain the following information:

1. Manufacturer’s name or identification.
2. Voltage rating.
3. Current and/or horsepower rating.
4. Short-circuit current rating,

2.06 **FACTORY FINISHES**

A. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1).

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **APPLICATIONS**

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.03 **INSTALLATION**

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Comply with mounting and anchoring requirements specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 26 Section "Fuses."

E. Install motor control equipment and contactors in accordance with manufacturer’s instructions.

F. Select and install heater elements in motor starters to match installed motor characteristics.

G. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.04 **CONCRETE BASES**

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 26 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.05 **IDENTIFICATION**

A. Identify enclosed controller, components, and control wiring according to Division 26 Section "Electrical Identification."

3.06 **CONTROL WIRING INSTALLATION**

A. Install wiring between enclosed controllers according to Division 26 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.

1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.07 **CONNECTIONS**

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

3.08 **FIELD QUALITY CONTROL**

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.

2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.

3. Report results in writing.

C. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.09 **ADJUSTING**

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION

SECTION 26 3213 – PACKAGED ENGINE GENERATORS

PART 1 GENERAL

1.01 INSTALLATION

A. Installing contractor to assume requirements of entire specification.

1.02 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.

1.03 SUMMARY

A. This Section includes packaged engine generator sets for emergency and standby power supply with the following features:

1. Natural Gas engine.
2. Unit-mounted cooling system.
3. Unit-mounted control and monitoring.
4. Outdoor enclosure.
5. Temporary Generator Docking Station

B. Related Sections include the following:

1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.
2. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.04 **DEFINITIONS**

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

C. LP: Liquid petroleum.

1.05 **SUBMITTALS**

A. Product Data: Submit product data under provisions of Section 260010. Include the following:

1. Data on features, components, accessories ratings, and performance.
2. Thermal damage curve for generator.
3. Time-current characteristic curves for generator protective device.
4. Manufacturer’s anchorage and base recommendations.

B. Shop Drawings: Submit shop drawings under provisions of Section 260100. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Submit shop drawings showing plan and elevation views with overall interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.
3. Internal Wiring Diagrams: For engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, and remote annunciator.

C. Qualification Data: For manufacturer.

D. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
3. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
4. Report of sound generation.
5. Certified report of exhaust emissions showing compliance with applicable EPA regulations.
6. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

2. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

G. Warranty: Special warranty specified in this Section.

1.06 **QUALITY ASSURANCE**

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.

2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 50 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. UL2200 Listed and labeled

J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

K. Comply with NECA/EGSA 404-2000 – Recommended Practice for Installing Generator Sets.

L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1. Provide engines used for standby applications that carry certification of compliance with current EPA emissions requirements or provide engines which comply with EPA emissions requirements and provide the necessary field testing to certify EPA emissions compliance.

2. Provide engines used for prime power applicants which carry certification of compliance with EPA emissions requirements. Engines which are compliant, but require field certification are not acceptable.

M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.07 **COORDINATION**

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 26 “Hangers and Supports for Electrical Systems.”

1.08 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

2. If the engine-generator is not functional for a period longer than 24 hours during the warranty period, provide a portable generator to serve all loads connected to the generator until the existing, on site, generator is repaired.

1.09 **MAINTENANCE SERVICE**

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Maintenance agreements shall include parts and supplies as used in manufacture and installation of original equipment.

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. Fuses: One for every 10 of each type and rating, but not less than one of each.

2. Indicator Lamps: Two for every six of each type used, but not less than two of each.

3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Onan Corp./Cummins Power Generation; Industrial Business Group.

2. Kohler Co.; Generator Division.

3. Engineer approved equal.

2.02 **ENGINE-GENERATOR SET**

A. Packaged engine-generator set shall be a coordinated assembly of compatible components.

B. Safety Standard: Comply with ASME B15.1 and UL 2200.

C. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.

D. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated

2. Output Connections: Three-phase, four wire.

3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

E. Generator-set performance for sensitive loads:

1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.

2. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.

3. Steady-State Voltage Operational Bandwidth: 2 percent of rated output voltage from no load to full load.

4. Steady-State Voltage Modulation Frequency: Less than 1 Hz.

5. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.

6. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.

7. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.

8. Transient Frequency Performance: Less than 2-Hz variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.

9. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.

10. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.

11. Excitation System: Permanent magnet generator driven brushless exciter. Performance shall be unaffected by voltage distortion caused by nonlinear load.

12. Start Time: Comply with NFPA 110, Type 10, system requirements.

F. Provide guards for all external rotating parts to prevent accidental injury. Guards shall be securely bolted to the generator but removable for maintenance. Guards shall be painted with a rust inhibiting primer and an epoxy based gloss topcoat. Guards shall comply with OSHA requirements.

G. Service Conditions:

1. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:

a. Ambient Temperature: Minus 15 to plus 40 deg C.

b. Altitude: Rated for altitude at project location.

2.03 **ENGINE**

A. Fuel: Natural Gas

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:

1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.

2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System:
1. Natural Gas
a. Carburetor.
b. Secondary Gas Regulator.
c. Fuel-Shutoff Solenoid Valve.
d. Flexible Fuel Connectors.

E. Coolant Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F, and suitable for operation on 120 volts AC.

F. Governor: Adjustable Isochronous with speed sensing.

G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
4. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and non-collapsible under vacuum.
b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.

I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

J. Starting System: 12-V electric, with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
3. Cranking Cycle: As required by NFPA 110 for system level specified.
4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
   b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
   c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
   d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
   e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
   f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.04 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation:
   1. When mode-selector switch on the control and monitoring panel is in the automatic position, remote control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set.
   2. When mode-selector switch is switched to the on position the generator set starts.
   3. When mode-selector switch is switched to the off position it initiates generator set shutdown.
   4. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
   5. Operation of a remote emergency-stop switch also shuts down generator set.

B. Manual Starting System Sequence of Operation:
   1. Switching on-off switch on the generator control panel to the on position starts generator set.
   2. The off position of same switch initiates generator-set shutdown.
   3. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.
   4. Operation of a remote emergency-stop switch also shuts down generator set.

C. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gages shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.

D. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system.

E. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

F. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 26 Section "Electrical Power Monitoring and Control."

G. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

H. Remote Alarm Annunciator:

1. Comply with NFPA 99.
2. Labeled LED shall identify each alarm event.
3. Common audible signal shall sound for alarm conditions.
4. Silencing switch in face of panel shall silence signal without altering visual indication.
5. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
6. Cabinet and faceplate shall be surface mounted with brushed stainless steel.

I. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

J. The integrity of the control wiring between the Generator(s) and each Emergency System Automatic Transfer Switch shall be continuously monitored per National Electrical Code Section 700.

2.05 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Protector: Microprocessor-based unit that continuously monitors current level in each phase of generator output, integrates generator heating effect over time, and predicts when thermal damage of the alternator will occur. When signaled by the protector or other generator-set protective devices, a shunt-trip device in the generator disconnect switch shall open the switch to disconnect the generator from the load circuits. Protector shall perform the following functions:

1. Initiates a generator overload alarm when the generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
2. Under single or three-phase fault conditions, regulates the generator to 300 percent of rated full-load current for up to 10 seconds.
3. As the overcurrent heating effect on the generator approaches the thermal damage point of the unit, the protector switches the excitation system off, opens the generator disconnect device, and shuts down the generator set.
4. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot.

2.06 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with ANSI/NEMA MG 1

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: ANSI/NEMA MG 1: Class H or Class F.

D. Temperature Rise: 130 degrees C standby.

E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: ANSI/NEMA MG 1, open drip proof.

H. Instrument Transformers: Mounted within generator enclosure.

I. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.

1. Manual adjustment on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

2.07 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

1. Provide sound attenuating enclosure to meet the sound criteria specified in Part 1, “Quality Assurance”

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.08 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.09 FINISHES

A. Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.10 TEMPORARY GENERATOR DOCKING STATION

A. Description: Docking station for temporary connection of portable generator for use when permanent generator is out of service for testing or repair with integral manual transfer switch.

1. Listed to UL 1008

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Trystar (Base Bid)
2. ASCO
3. ESL Power Systems

C. Enclosure

1. NEMA 3R
    a. Pad-lockable front door shall include a hinged access plate at the bottom for entry of temporary cabling that prevents unauthorized tampering while in use.
    b. Enclosure Integrity shall be maintained while temporary cabling is connected during use

c. Front and Side shall be accessible for maintenance

d. Top, Side, and Bottom shall be accessible for permanent cabling

e. Wall mounted

2. Powder coat painted after fabrication.

D. Phase, Neutral, and Ground Busbar

1. Material: Silver-plated Copper
2. Equipment Ground Bus: bonded to box.
3. Ground Bus: 50% of phase size.
4. Neutral Bus: Rated 100 percent of phase bus.

E. Temporary generator connectors:

1. Series 16 male Cam-Lok style panel mounted connectors.
2. Connected to bus bar in panel.
3. Color code according to system voltage requirements.
4. Protected against accidental contact while not in use

F. Permanent Connection for line and load connections shall be factory installed, broad range set-screw mechanical type, located behind a physical barrier.

G. Transfer Switch Configuration

1. Integrated Rotary Manual Transfer Switch (MTS).

a. MTS shall have three positions – Permanent Line – OFF – Temporary Line

b. MTS shall be located behind pad lockable door to prevent any tampering by unauthorized personnel.

c. Provie auxiliary contact for switch status to indicate when permanent generator has been taken off line.

H. Short Circuit & Withstand Rating

1. Minimum 65K unless otherwise indicated on drawings

I. Voltage & Amperage

1. As required for the application and as indicated on the drawings.

J. Factory Installed Phase Rotation Monitor Device:

1. Phase monitoring relay to be Siemens 3U4512-1AR20 or equal and factory installed
2. Provide fusing for phase rotation monitor

K. Accessories:

1. Auto-start connections to match generator system
2. Strip Heater & Thermostat

2.11 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.

1. Tests: Comply with NFPA 110, Level 1 energy converters and with IEEE 115.

B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
6. Single-step load pickup.
7. Safety shutdown.
8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.

C. Report factory test results within 10 days of completion of test.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning of installation means Installer accepts existing conditions.

3.02 **INSTALLATION**

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with vibration isolation devices on concrete base.

1. Size concrete base as recommended by generator manufacturer.
2. The top of the concrete pad shall be a minimum of 4” above finished grade.
3. Secure sets to anchor bolts installed in concrete bases.
4. Concrete base construction is specified in Division 26 Section "Hangers and Supports for Electrical Systems."

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.03 **CONNECTIONS**

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect engine exhaust pipe to engine with flexible connector.

D. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Natural-gas piping, valves, and specialties for gas distribution outside the building are specified in Division 2 Section "Natural Gas Distribution."

E. Ground equipment according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

G. 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 **IDENTIFICATION**

A. Identify system components according to Division 23 Section "Mechanical Identification" and Division 26 “Section Electrical Identification."

3.05 **FIELD QUALITY CONTROL**

A. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing”

B. Perform the following field tests and inspections and prepare test reports:

1. Provide full load test utilizing portable resistor test bank, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal. Coordinate with Division 26 Section "Transfer Switches”
2. During test, record the following at 20 minute intervals:
    a. Kilowatts.
    b. Amperes.
    c. Voltage.
    d. Coolant temperature.
    e. Room temperature.
    f. Frequency.
    g. Oil pressure.
3. Test alarm and shutdown circuits by simulating conditions.
4. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.
5. Perform tests recommended by manufacturer.
6. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:
    a. Single-step full-load pickup test.
7. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
    a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
    b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
    c. Verify acceptance of charge for each element of the battery after discharge.
    d. Verify that measurements are within manufacturer's specifications.
8. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

9. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
10. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
11. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
12. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

K. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.
2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.06 DEMONSTRATION

A. Provide systems demonstration for Owner, Construction Manager and Electrical Engineer.

B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.

C. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 Section "Demonstration and Training."

1. Provide a minimum of two 3-hour training sessions for the Owner's personnel. One session shall be conducted at time of start-up, the other within three months of start-up.
2. Training shall include: Review of maintenance procedures and schedule, trouble shooting procedures, demonstration of all alarm and safety functions with appropriate actions to be taken, and review of regular testing and exercising schedule including inspection and observation procedures.
3. Coordinate with demonstration and training required in Division 26 section "Transfer Switches".

3.07 **CLEANING**

A. Clean engine and generator surfaces. Replace oil and fuel filters.

END OF SECTION

SECTION 26 3600 – TRANSFER SWITCHES

PART 1 GENERAL

1.01 INSTALLATION

A. Installing contractor to assume requirements of entire specification.

1.02 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.

1.03 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Remote annunciation system.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.04 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Field quality-control test reports.

D. Operation and Maintenance Data: Submit under provision of Section “Electrical General Requirements”. For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.

2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
3. Include instructions for operating equipment under emergency conditions.
4. Document ratings of equipment and each major component.
5. Include routine preventive maintenance and lubrication schedule.
6. List special tools, maintenance materials, and replacement parts.

1.05 **QUALITY ASSURANCE**

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: Refer to specification section “Electrical Testing”.

C. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches, non-automatic transfer switches, remote annunciators, and remote annunciator and control panels through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

F. UL 1008 - Standard for Automatic Transfer Switches, unless requirements of those specifications are stricter.

G. NFPA 70 - National Electrical Code, including use in emergency and standby systems in accordance with Articles 700, 701 and 702

H. NFPA 110 - Standard for Emergency and Standby Power Systems

I. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems (Orange Book)

J. IEEE Standard 241 - IEEE Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)

K. NEMA Standard ICS2-447 - AC Automatic Transfer Switches

L. IEC - Standard for Automatic Transfer Switches

1.06 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the transfer switch and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Contactor Transfer Switches:

a. Emerson; ASCO Power Technologies, LP

2.02 **GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS**

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Provide fault-current and withstand ratings in accordance with UL 1008 standard's 1½ and 3 cycle long-time ratings. Transfer switches which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

2. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels have communication capability matched with remote device.

D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.

2. Switch Action: Double throw; mechanically held in both directions.

3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Oversize Neutral: Ampacity and switch rating of neutral path through units indicated for oversize neutral shall be double the nominal rating of circuit in which switch is installed.

J. Heater: Equip switches exposed to outdoor temperatures and humidity, and other units indicated, with an internal heater. Provide thermostat within enclosure to control heater.

K. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.

2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.

3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

L. Enclosures: General-purpose NEMA 250, Type 1 or 3R as indicated on drawings, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.03 **AUTOMATIC TRANSFER SWITCH**

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Manual Switch Operation: Unloaded. Control circuit automatically disconnects from electrical operator during manual operation.

D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

G. Automatic Transfer-Switch Features

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulates normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.

   a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

   b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

10. Engine Shutdown Contacts:

a. Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

11. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:

a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.

b. Push-button programming control with digital display of settings.

c. Integral battery operation of time switch when normal control power is not available.

2.04 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel annunciates conditions for indicated transfer switches. Annunciation includes the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.

2. Switch position.

3. Switch in test mode.

4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

1. Indicating Lights: Grouped for each transfer switch monitored.

2. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

3. Mounting: Flush, modular, steel cabinet, unless otherwise indicated.

4. Lamp Test: Push-to-test or lamp-test switch on front panel.

2.05 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 EXECUTION

3.01 INSTALLATION

A. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

B. Identify components according to Division 26 Section “Electrical Identification”.

3.02 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

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.”

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. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing.”

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.22.3. Certify compliance with test parameters.

3. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.

   a. Check for electrical continuity of circuits and for short circuits.

   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

   c. Verify that manual transfer warnings are properly placed.

   d. Perform manual transfer operation.

4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

   b. Simulate loss of phase-to-ground voltage for each phase of normal source.

   c. Verify time-delay settings.

   d. Verify pickup and dropout voltages by data readout or inspection of control settings.

   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

5. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.

   a. Verify grounding connections and locations and ratings of sensors.

   b. Observe reaction of circuit-interrupting devices when simulated fault current is applied at sensors.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.05 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 1 Section "Closeout Procedures."

1. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 26 4313 - SURGE PROTECTIVE DEVICES

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.”

1.02 SUMMARY

A. These specifications describe the requirements for a high energy surge protective devices system (abbreviated as SPD in this specification and on all drawings). The specified system shall provide effective high energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments, as tested by ANSI/IEEE C62.45. The system shall be connected in parallel with the protected system; no series connected elements shall be used, which could constitute a single point failure.

1.03 RELATED SPECIFICATION

A. Main Distribution Switchboard Section 26 2413.

B. Panelboards Section 26 2416.

1.04 REFERENCES

A. The Surge Protective System Devices shall be designed and manufactured to the following standards.

B. American National Standards Institute and Institute of Electrical and Electronic Engineers (ANSI/EEE, C62.1, C62.41 and C62.45).

C. Federal Information Processing Standards Publication 94 (FIPS PUB 94).

D. National Electrical Manufacturers Association (NEMA LS-1).

E. National Fire Protection Association (NFPA 70, 75, and 78).

F. Underwriters Laboratories (UL 1449, Third Edition, UL 1283).

G. National Electric Code (NEC 285).

1.05 **SYSTEM DESCRIPTION**

A. Environmental Requirements:

1. Storage temperature range shall be -55 to +85 degrees C (-67 to +185 degrees F).

2. Operating temperature range shall be -40 to +50 degrees C (-40 to +122 degrees F).

3. Operation shall be reliable in an environment with 0% to 95% non-condensing relative humidity.

4. The audible noise level of the specified system shall be less that 45 dBa at 5 feet.

B. Transient voltage surge suppression system with integral EMI/RFI filtering (abbreviated as SPD in this specification and on all drawings). The specified system shall provide effective high energy surge current diversion and be suitable for application in ANSI/IEE C62.41 Category A, B, and C environments, as tested by ANSI/IEEE C62.45. The system shall be connected in parallel with the protected system; no series connected elements shall be used, which could constitute a single point failure.

C. Provide documentation of specified system's UL 1449, Third Edition, listing and suppression ratings which shall be included as required product data submittal information.

D. The SPD system may be mounted integral to the Main Distribution Panelboards or integral to the Electronic Grade Panelboards as indicated on the drawings and specified as follows:

1.06 **MAIN DISTRIBUTION PANELBOARDS AND BRANCH CIRCUIT PANELBOARDS**

A. Electrical Characteristics

1. Nominal Line Voltage:

a. 277/480 volts, three phase, 4 wire plus ground, as indicated on drawings (MDP-4).

b. 120/208 volts, three phase, 4 wire plus ground, as indicated on drawings (SPD branch circuit panelboards).

2. Maximum Continuous Line Current:

a. As noted on drawings.

3. Maximum Continuous Operating Voltage:

a. >115% of nominal.

4. Operating Frequency:

a. 47-63 Hz.

5. Protection Modes:

a. Line to line.

b. Line to neutral.

c. Line to ground.

d. Neutral to ground.

6. Connection Means:

a. Direct bus connection, parallel connection.

7. Main Distribution Panelboard Maximum Surge Current:

a. Maximum surge current shall be based on a single pulse, IEEE C62.41 standard 8 x 20 microsecond wave form. Device shall not suffer more than 10% deviation in clamping voltage at specified surge current.

1) Per Phase Total: 240 kA.

2) Per Mode: 120 kA.

8. Branch Circuit Panelboards Maximum Surge Current:

a. Maximum surge current shall be based on a single pulse, IEEE C62.41 standard 8 x 20 microsecond wave form. Device shall not suffer more than 10% deviation in clamping voltage at specified surge current.

1) Per Phase Total: 80 kA.

2) Per Mode: 40 kA.

9. UL 1449 voltage suppression rating:

a. L-N, L-G, N-G: 700 volts for 208/120V systems.

b. L-L: 1500 volts for 208/120V systems.

c. L-N, L-G, N-G: 1200 volts for 480/277V systems.

d. L-L: 2000 volts for 480/277V systems.

10. AC tracking filter with EMI/RFI filtering.

a. EMI-RFI Noise Rejection Based on MIL-STD-E220A Methodology:

1) 100 KHZ: 50dB

11. Surge Life Cycle:

a. Capable of surviving 1000 sequential category C3 combination wave surges as defined by ANSI/IEEE C62.41 and ANSI/IEE C62.45, without failing the specified UL 1449 suppression ratings.

12. Internal Connections:

a. All internal wiring within the SPD device subject to surge currents shall be made of low impedance copper bus bar. Modular, parallel SPD design shall consist of 40mm metal oxide varistors individually fused at 200KAIC for each suppression mode.

1.07 **DOCUMENTATION**

A. The manufacturer shall furnish an installation manual with installation, start up, and operating instructions for the specified system.

B. Electrical and mechanical drawings shall be provided by the manufacturer which show unit dimensions, weights, component and connection locations, mounting provisions, connection details, and wiring diagram.

C. Documentation of specified system's UL 1449 listing and clamping voltage ratings shall be included as required product data submittal information.

D. A list of recommended spare parts shall be supplied at the customer's request.

1.08 **WARRANTY**

A. The manufacturer shall provide a full five-year warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national or local electrical codes.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Square D.

2.02 **ACCESSORIES**

A. Unit Status indicators

1. Red and green LED indicators shall be provided on the front cover to redundantly indicate unit module status. The absence of the green light and the presence of the red light shall reliably indicate that one or more surge current diversion modules has failed and that service is needed to restore full operation.

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Service entrance suppressors shall be installed in the switchboard.

B. Locate suppressor on load side of main disconnect device, as close as possible to the phase conductors and ground/neutral bar.

C. A breaker shall be provided in the main distribution panelboard to directly connect the SPD unit. This breaker shall be directly integrated to the suppressor and switchboard bus using bolted bus bar connections.

D. The suppressor and integral disconnect shall be installed to the switchboard using a direct bus bar connection. SPD to disconnect conductors shall be as short and straight as possible, less than 5 feet.

E. All monitoring diagnostics features (indicator lights) shall be mounted on the front of the switchboard, adjacent to SPD.

3.02 **FIELD QUALITY CONTROL**

A. Field inspection and testing will be performed the manufacturer.

B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 26 5010 - THEATRICAL FIXTURE PACKAGE

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 WORK INCLUDED

A. The Electrical Contractor, as part of the work of this section, shall provide, deliver, install, test and rough focus a complete Theatrical Lighting Fixture System as specified herein and shown on Drawing TE1.1 and TE1.2

B. The Electrical Contractor will include the following in the scope of work.

   a. The Electrical Contractor will purchase the Theatrical Lighting Fixture System from a reputable Theatrical Equipment Manufacturer through an approved Theatrical Lighting Fixture Dealer.

C. The Electrical Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to:

   1. General Conditions
   2. Any Electrical Contractors
   3. Theatrical Sound Contractor
   4. Theatrical Lighting Control System Dealer
   5. Theatrical Rigging and Drapery Contractor

1.03 SYSTEM DESCRIPTION

A. The system shall be designed to be a fully functional Theatrical Fixture Lighting System controlled by the Theatrical Control Systems.

B. The location of the projects is the New Smith Middle School, Troy, Mi..

1.04 GENERAL REQUIREMENTS

A. All bidders will be responsible to inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or material item the bidder could have been informed of prior to the bid date.

B. Prior to commencement of work the Electrical Contractor will fully coordinated with all parties the proposed length of time to complete the project and the availability of the jobsite. Start date will have to be sensitive to the usage of the facility by the School District.

C. It is the responsibility of the Electrical Contractor to verify all dimensions in the field. Dimensions listed in this document are approximate and should not be considered final.

D. The system shall conform to all applicable code and industry standards, requirements and / or standard operations and practice. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the user to arrange and operate a safe assembly and working environment for audience and user personnel.

E. Upon completion of the project a set of as built drawings and / or any pertinent equipment manufacturer's operations manuals will be made available to the Architect and / or the end user.

F. The Theatrical Lighting Dealer will be responsible for providing a reasonable level of training to End User's designated staff on the practical and safe operations of the new Theatrical Lighting Fixture System.

1.05 SUBMITTALS

A. The Electrical Contractor shall provide electronic copies of full submittals. Submittals shall include:

   1. Component and installation drawings showing a full description and understanding of the scope and detail of the project. These drawing will be subject to the approval of the Architect prior to the beginning of any aspect of the project. Such approval does not relieve the Electrical Contractor of the responsibility for providing equipment in accordance with the specification.
   2. Catalog cut sheets for standard equipment items. They must contain full dimensional and

standard application information. If any modifications of construction or use are intended, they must be clearly outlined.

3. The Electrical Contractor and/or Theatrical Fixture Dealer or manufacturer shall provide any additional information, including equipment demonstration, as required by the Theatre Consultant.

1.06 ACCEPTABLE MANUFACTURERS AND QUALITY ASSURANCE

A. The equipment in this section shall be installed by reputable and reliable Electrical Contractor with equipment supplied by a Theatrical Fixture Manufacturer. The Manufacturer must have been involved continuously in the supply and installation of Theatrical Lighting Fixtures for at least 10 years, or can demonstrate an equal level of qualification. They shall have a permanent warehouse and sales facility staffed with sales and service personal on a permanent basis. The following lists of Dealers and Manufacturers shall be considered pre-qualified.

B. Any other interested company is subject to the approval of the Theatrical Consultant.
   1. Specific manufacturer's descriptions are intended to establish recognizable parameters for equipment function and in no way preclude the substitution of other manufacturer's competitive and equal equipment.
   2. Other alternative Dealers or Manufacturers must submit a full pre-approval package ten days prior to bid date, showing at least 10 completed projects of similar scope completed in the past 5 years.
   3. Approval of alternate Dealers or Manufacturers shall be at the discretion of the Architect and the Theatrical Consultant.
   4. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the Theatrical Lighting Contractor to ensure that any price quotations received and submittals made are for systems that meet or exceed the specifications.

C. Pre-approved Dealers and Manufacturers
   1. Dealers:
      a. Tobins Lake Sales — Ypsilanti, MI
      b. John Hyatt and Assoc. — Grand Rapids, MI
      c. Advance Lighting and Sound — Troy, Mi
      d. Vincent Systems — Solon, OH
   2. Manufactures:
      a. Electronic Theatre Controls
      b. Strand
      c. Lex Products
      d. Canto USA

D. Specific manufactures descriptions are intended to establish recognizable parameters for equipment function and in no way preclude the substitution of other manufactures competitive and equal equipment.

PART 2 PRODUCT

2.01 COLOR MIXING OR WHITE-LIGHT LIGHT EMITTING DIODE PROFILE FIXTURE

A. General
   1. The fixture shall be a color-mixing high-intensity LED illuminator with DMX control of intensity and color. The fixture shall be a ColorSource Spot jr as manufactured by Electronic Theatre Controls, Inc. or approved equal.
   2. All LED fixtures shall be provided by a single manufacturer to ensure compatibility.
   3. The fixture shall be provided with the minimum warranty of 5 years full fixture coverage and 10 years LED array coverage.
   4. ColorSource Spot jr and ColorSource Spot jr Deep Blue
      a. The fixture shall have LM-80 testing for all LEDs with a L70 rating of no less than 54,000 hours.

B. Physical
   1. The unit shall be constructed of rugged Acrylonitrile butadiene styrene (ABS) plastic

2. The unit shall utilize a 7-segment display for settings and operation
3. The following shall be provided:
    a. 0.024” full hard 301 stainless steel shutters
    b. Rugged steel yoke with two mounting positions allowing 300°+ rotation of the fixture within the yoke.
4. Power supply, cooling and electronics shall be integral to each unit.
5. The unit shall ship with:
    a. Theatrical-style hanging yoke as standard
    b. 5’ cable with Neutrik powerCON™ to choice of connector as standard

C. Optical
1. The light beam should have a 2-to-1 center-to-edge drop-off ratio
2. The unit shall have a 55mm gate.
    a. Shall utilize an M-sized pattern holder

D. Environmental and Agency Compliance
1. The fixture shall be ETL and cETL LISTED and/or CE rated, and shall be so labeled when delivered to the job site.
2. The fixture shall be ETL LISTED to the UL1598.
3. The fixture shall be rated for IP-20 dry location use.

E. Thermal
1. Fixture shall be equipped with a cooling fan.
2. The fixture shall utilize advanced thermal management systems to maintain LED life to an average of 70% intensity after 54,000 hours of use.
3. The fixture shall operate in an ambient temperature range of 0°C (32°F). minimum, to 40° C (104°F) maximum ambient temperature.

F. Electrical
1. The fixture shall be equipped with a 100V to 240V 50/60Hz internal power supply.
2. The fixture shall support power in and thru operation.
    1) Power in shall be via Neutrik® powerCON™ input connector.
    2) Power thru shall be via Neutrik ® powerCON™ output connector.
    3) Fixture power wiring and accessory power cables shall be rated to support linking of multiple fixtures up to the capacity of a 15A breaker.
3. The fixture requires power from a non-dim source.

G. LED Emitters
1. The fixture shall contain a minimum of four different LED colors to provide color characteristics as described in the Color Section below.
2. All LEDs used in the fixture shall be high brightness and proven quality from established and reputable LED manufacturers.
3. Fixture shall utilize Luxeon® *C* LED emitters

H. Calibration
1. Fixture shall be calibrated at factory to achieve consistent color and intensity output between fixtures built at different times and/or from different LED lots or bins.
    a. Calibration data shall be stored on the control card as a permanent part of on-board operating system.
    b. All arrays, including replacement arrays shall be calibrated to the same standard to insure consistency.
    c. Fixtures not offering LED calibration shall not be acceptable.

I. Color
1. The fixture shall utilize a minimum of 52 LED emitters.
    a. These emitters shall be made up of Red, Green, Blue and Lime for ColorSource Spot jr.
    b. These emitters shall be made up of Red, Green, Indigo and Lime for ColorSource Spot jr Deep Blue.

J. Dimming

1. The LED system shall use 15-bit nonlinear scaling techniques for high-resolution dimming.
2. The fixture shall utilize an Incandescent dimming curve.
3. Dimming curve shall be optimized for smooth dimming over longer timed fades.
4. LED control shall be compatible with broadcast equipment.

K. Control and User interface
1. The fixture shall be USITT DMX512-A compatible via In and Thru 5-pin XLR connectors.
2. The fixture shall be compatible with the ANSI RDM E1.20 standard.
   a. All fixture functions shall accessible via RDM protocol for modification from suitably equipped control console.
   b. Temperature sensors within the luminaire shall be viewable in real time via RDM.
   c. Fixtures not offering RDM compatibility, feature set access or temperature monitoring via RDM shall not be compatible.
3. The fixture shall be equipped with a 7-segment display.
4. The fixture shall be equipped with a three-button user-interface.
5. The fixture shall offer stand-alone functionality eliminating the need for a console.

2.02 COLOR MIXING LIGHT EMITTING DIODE WASH FIXTURE

A. General
1. The fixture shall be a color-mixing high-intensity LED illuminator with DMX control of intensity and color. The fixture shall be a ColorSource PAR as manufactured by Electronic Theatre Controls, Inc. or approved equal.
2. All LED fixtures shall be provided by a single manufacturer to ensure compatibility.
3. The fixture shall be UL 1573 listed for stage and studio use.
4. The fixture shall comply with the USITT DMX-512 A standard.

B. Physical
1. The fixture shall be contained in a rugged all-metal die-cast housing, free of burrs and pits.
2. The housing shall have a rugged black powder coat finish.
3. Power supply, cooling and electronics shall be integral to each unit.
4. Fixture housing shall provide two easy-access slots for secondary lenses and other accessories.
   a. Slots shall be equipped with locking retaining clip.
5. The unit shall ship with:
   a. Theatrical-style hanging yoke as standard.
   b. 5’ power lead with Edison connector as standard.

C. Environmental and Agency Compliance
1. The fixture shall be UL and cUL LISTED and/or CE rated, and shall be so labeled when delivered to the job site.
2. The fixture shall be UL LISTED to the UL1573 standard for stage and studio use
3. The fixture shall be rated for IP-20 dry location use.

D. Thermal
1. The fixture shall be cooled with a variable speed fan.
2. The fixture shall utilize advanced thermal management systems to maintain LED life to an average of 70% intensity after 20,000 hours of use.

E. Electrical
1. The fixture shall be equipped with 100V to 240V 50/60 Hz internal power supply.
2. The fixture shall support power in and thru operation.
   a. Power in shall be via Neutrik® PowerCon™ input connector.
   b. Power thru shall be via Neutrik ® PowerCon ™ output connector.
3. The fixture requires power from non-dim source.

F. LED Emitters
1. The fixture shall contain 4 different LED colors to provide color characteristics as described in Section H below.

2. All LEDs used in the fixture shall be high brightness and proven quality from established and reputable LED manufacturers.
    a. Fixture shall utilize Luxeon® Z™ LED emitters.

G. Calibration
1. Fixture shall be calibrated at factory for achieve consistent color between fixtures built at different times and/or from different LED lots or bins.

H. Color
1. The fixture shall utilize a minimum of 40 LED emitters.
    a. These emitters shall be made up of Red, Green, Blue and Lime.
2. The Pearl fixture version will have one color white.

I. Dimming
1. The LED system shall use 15-bit nonlinear scaling techniques for high-resolution dimming.
2. The dimming curve shall be optimized for smooth dimming over longer timed fades.

J. Control and User Interface
1. The fixture shall be USITT DMX 512A-compatible via In and Thru 5-pin XLR connectors.
2. The fixture shall be compatible with the ANSI RDM E1.20 standard.
3. The fixture shall be equipped with a 7-segment display for easy-to-read status and control.
4. The fixture shall be equipped with a three-button user-interface.
5. The fixture shall offer stand-alone functionality eliminating the need for a console

2.03 COLOR MIXING LIGHT EMITTING DIODE CYCLORAMA FIXTURE

A. General
1. The fixture shall be a color-mixing high-intensity LED illuminator with DMX control of intensity and color. The fixture shall be a ColorSource® CYC as manufactured by Electronic Theatre Controls, Inc. or approved equal.
2. All LED fixtures shall be provided by a single manufacturer to ensure compatibility
3. The fixture shall be UL 1573 listed for stage and studio use.
4. The fixture shall comply with the USITT DMX512-A standard.

B. Physical
1. The fixture shall be contained in a rugged all-metal die-cast housing, free of burrs and pits.
2. Power supply and electronics shall be integral to each unit.
3. Fixture housing shall provide built in spill control.
4. Fixture shall operate directly on the ground or by hanging via yoke.
5. The unit shall ship with:
    a. Theatrical-style hanging yoke as standard
    b. 5’ power lead with Neutrik® PowerCON™ to Edison connector as standard
6. Light output shall be produce an asymmetrical beam.

C. Environmental and Agency Compliance
1. The fixture shall be UL and cUL LISTED and/or CE rated, and shall be so labeled when delivered to the job site.
2. The fixture shall be UL LISTED to the UL1573 standard for stage and studio use.

D. Thermal
1. The fixture shall be natural convection cooled and shall not use a fan.
2. The fixture shall utilize advanced thermal management systems to maintain LED life to an average of 70% intensity after 50,000 hours of use.

E. Electrical
1. The fixture shall be equipped with 100V to 240V 50/60 Hz internal power supply.
2. The fixture shall support power in and thru operation.
    a. Power in shall be via Neutrik® PowerCON™ input connector.
    b. Power thru shall be via Neutrik ® PowerCON ™ output connector.
    c. Fixture power wiring and accessory power cables shall be rated to support linking of

multiple fixtures up to the capacity of a 15A breaker.
3. The fixture requires power from non-dim source.

F. LED Emitters
1. The fixture shall contain 5 different LED colors.
2. All LEDs used in the fixture shall be high brightness and proven quality from established and reputable LED manufacturers.
a. Fixture shall utilize Luxeon® C™ LED emitters.

G. Warranty
1. The fixture shall be provided with the minimum warranty:
a. 5 years full fixture coverage
b. 10 years LED coverage

H. Calibration
1. Fixture shall be calibrated at factory for achieve consistent color between fixtures built at different times and/or from different LED lots or bins.
2. The fixture shall utilize a minimum of 42 LED emitters.
a. These emitters shall be made up of Red, Green, Blue, Indigo and Lime.

I. Dimming
1. The LED system shall use 15-bit nonlinear scaling techniques for high-resolution dimming.
2. The dimming curve shall be optimized for smooth dimming over longer timed fades.

J. Control and User Interface
1. The fixture shall be USITT DMX512-A compatible via In and Thru 5-pin XLR connectors or RJ45 connectors.
2. The fixture shall be compatible with the ANSI RDM E1.20 standard.
3. The fixture shall be equipped with a 7-segment display for easy-to-read status and control.
4. The fixture shall offer stand-alone functionality eliminating the need for a console.

2.04 FOLLOWSPOT

A. Canto Astro 600 Follow Spot
1. Follow Spot Fixture with:
a. Power Cable
b. Iris
c. Lamp
d. Tripod Stand
e. 6 Color Boomerang
f. Electronic Power Supply
g. Cable to supply to head
2. Unit Stats:
a, Double Condenser+ Zoom
b. LED 6000K Cool White
c. Quick Installation Lamp
d. Internal Ballast
e. 8 degree to 16 degree Zoom

PART 3 PROVIDE THE FOLLOWING

3.01 THEARICAL LIGHTING EQUIPMENT

A. Fixtures:
12 - ETC CSSPOTjr, A ColorSource Spot Junior 25-50 Zoom
10 - ETC CSPAR, B ColorSource Par
10- ETC SELRM-7.5 Medium Diffuser for CSPAR
10 - ETC SELRW-7.5 Wide Diffuser for CSPAR
4 - ETC CSCYC, A ColorSource Cyc Fixture
1 - Canto Astro 600 LED Followspot complete with stand
1 - 25’ Extension Cords (for Canto Spot)

B. Misc. Fixture Accessories:
   26 - ETC 400SC Safety Cables
   26 - ETC 400CC C Clamps
C. Cable:
   10 - 10' #14/3 SJO PowerCon Jumpers
   10 - 10' #14/3 SJO True1 Jumpers
   26 - 10' DMX Cable
   2 - 25' DMX Cable

PART 4 EXECUTION

4.01 INSTALLATION

A. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the Theatrical Lighting Fixture System.
B. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the Theatrical Lighting Fixture System, even though a very item may not be specifically mentioned.
C. The Electrical Contractor will be responsible for field measurements and coordinating physical size equipment with the architectural requirements of the spaces into which they are to be installed.
D. The Electrical Contractor shall install the Theatrical Lighting Fixture System in accordance with manufacturer's approved shop drawings and the best applicable industry standards and practices.
E. The Electrical Contractor shall deliver on a timely basis to other trades any equipment that must be installed by them during construction.
F. During the installation of equipment, the Electrical Contractor shall arrange for access as necessary for inspection of equipment by the Architect or Owners Representative.
G. If specifications, the Architects Instructions, laws, ordinances, or any public authority requires any work to be specially tested or approved, the Electrical Contractor shall give the Architect timely notice of its readiness for inspection, and the dates of inspections.
H. Upon completion of the Theatrical Fixture System installation, the Electrical Contractor will notify the Architect. The Architect will them schedule a date for inspection. The Theatrical Lighting Fixture Dealer will provide personnel on that date to fully operate the system and to facilitate any tests as may be required by the Architect or Owners Representative. It will be the responsibility of the Electrical Contractor to correct any equipment failures at their expense and in a timely manner and to re-schedule a follow up inspection with the Architect.

4.02 THEATRICAL LIGHTING FIXTURE DEALER SERVICES

A. Upon completion of the installation, the Theatrical Fixture Dealer shall demonstrate operation and maintenance of the systems to the owner's representatives. Training shall not exceed four working hours. Additional training shall be available upon request.

4.03 WARRANTY

A. Manufacturer:
   1. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of one (1) year from date of delivery.
   2. Warranty shall cover repair or replacement of such parts determined defective upon inspection.
   3. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.
   4. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer's prior written authorization.
B. Theatrical Lighting Fixture Dealer and/or the Electrical Contractor
   1. The Theatrical Lighting Fixture Dealer and the Electrical Contractor will provide a one (1) year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner's Representative.

2. They will also warranty any equipment or materials they provide in addition to those by the manufacturer.
3. The guarantee shall not cover damage due to normal wear and tear, acts of God, or improper use of equipment.
4. Any required maintenance or replacement shall be provided by the Theatrical Lighting Fixture Dealer and/ or the Electrical Contractor within thirty (30) days of notification by the owner except for safety related items, which shall be corrected or addressed within 48 hours of notification.

END OF SECTION

SECTION 26 5020 - THEATRICAL LIGHTING DISTRIBUTION AND CONTROL

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 WORK INCLUDED

A. The Electrical Contractor, as part of the work of this section, shall provide, deliver, install, test and rough focus a complete Theatrical Lighting Distribution and Control system as specified herein and shown on Drawing TE1.1 and TE1.2.

B. The Electrical contractor will purchase Theatrical Lighting Distribution and Control equipment from an authorized Theatrical Equipment Dealer and work with them to provide equipment and services a outlined below.

C. The Electrical Contractor shall provide all conduit, high voltage wire, low voltage wire, boxes, connectors, hardware, and other incidental items as needed for the complete installation of the Theatrical Lighting Distribution and Control system.

D. The Electrical Contractor shall coordinate all work described in this section with all other applicable plans and specifications, including but not limited to:
   1. General Conditions
   2. Any Electrical Contractors
   3. Theatrical Sound Contractor
   4. Theatrical Lighting Fixture Dealer
   5. Theatrical Rigging and Drapery Contractor

1.03 SYSTEM DESCRIPTION

A. The system shall be designed to be a fully functional Theatrical Lighting Distribution and Control system.

B. The location of the projects are at the New Smith Middle School, Troy, Mi..

1.04 GENERAL REQUIREMENTS

A. All bidders will be responsible to inform themselves of the conditions under which the work is to be performed. No additional compensation shall be allowed for any labor or material item the bidder could have been informed of prior to the bid date.

B. Prior to commencement of work the Electrical Contractor will fully coordinated with all parties the proposed length of time to complete the project and the availability of the jobsite. Start date will have to be sensitive to the usage of the facility by the School District.

C. It is the responsibility of the Electrical Contractor to verify all dimensions in the field. Dimensions listed in this document are approximate and should not be considered final.

D. The system shall conform to all applicable code and industry standards, requirements and / or standard operations and practice. All materials, arrangements, and procedures shall comply with applicable code requirements, allowing the user to arrange and operate a safe assembly and working environment for audience and user personnel.

E. Upon completion of the project a set of as built drawings and / or any pertinent equipment manufacturer's operations manuals will be made available to the Architect and / or the end user.

F. The Theatrical Equipment Dealer will be responsible for providing a reasonable level of training to End User's designated staff on the practical and safe operations of the new Theatrical Lighting Distribution and Control system.

1.05 SUBMITTALS

A. The Electrical Contractor shall provide electronic copies of full submittals. Submittals shall include:
   1. Component and installation drawings showing a full description and understanding of the scope and detail of the project. These drawing will be subject to the approval of the Architect prior to the beginning of any aspect of the project. Such approval does not

relieve the Electrical Contractor of the responsibility for providing equipment in accordance with the specification.

2. Catalog cut sheets for standard equipment items. They must contain full dimensional and standard application information. If any modifications of construction or use are intended, they must be clearly outlined.
3. The Electrical Contractor and/or Theatrical Equipment Dealer or manufacturer shall provide any additional information, including equipment demonstration, as required by the Theatre Consultant.

1.06 ACCEPTABLE MANUFACTURERS AND QUALITY ASSURANCE

A. The equipment in this section shall be provided by a reputable and reliable Theatrical Equipment Dealer with equipment supplied by a Theatrical Lighting Distribution and Control Manufacturer. The Manufacturer must have been involved continuously in the supply and installation of Theatrical Lighting Distribution and Control systems for at least 10 years, or can demonstrate an equal level of qualification. They shall have a permanent warehouse and sales facility staffed with sales and service personal on a permanent basis. The following lists of Dealers and Manufacturers shall be considered pre- qualified.

B. Any other interested company is subject to the approval of the Theatrical Consultant.
   1. Specific manufacturer's descriptions are intended to establish recognizable parameters for equipment function and in no way preclude the substitution of other manufacturer's competitive and equal equipment.
   2. Other alternative Dealers or Manufacturers must submit a full pre-approval package ten days prior to bid date, showing at least 10 completed projects of similar scope completed in the past 5 years.
   3. Approval of alternate Dealers or Manufacturers shall be at the discretion of the Architect and the Theatrical Consultant.
   4. Permission to bid does not imply acceptance of the manufacturer. It is the sole responsibility of the Theatrical Lighting Contractor to ensure that any price quotations received and submittals made are for systems that meet or exceed the specifications.

C. Pre-approved Dealers and Manufacturers
   1. Dealers:
      a. Tobins Lake Sales — Ypsilanti, MI
      b. John Hyatt and Assoc. — Grand Rapids, MI
      c. Advance Lighting and Sound — Troy, Mi
      d. Vincent Systems — Solon, OH
   2. Manufacturers:
      a. Electronic Theatre Controls
      b. Strand
      c. Doug Fleonor Design

D. Specific manufactures descriptions are intended to establish recognizable parameters for equipment function and in no way preclude the substitution of other manufactures competitive and equal equipment.

PART 2 PRODUCT

2.01 RELAY PANEL AND LOAD CENTER WALL MOUNT

A. General
   1. The wall mount relay panel shall be the Echo Relay Panel as manufactured by ETC, Inc. or equal.
   2. Relay Panels shall be UL508, UL67, and UL924 Listed, and shall be so labeled when delivered.
   3. Relay Panels shall consist of a main enclosure with 30 pole breaker subpanel, relay/dimmer sub panel, integral control electronics, and a low voltage subpanel for data terminations and provision for accessory cards

B. Mechanical
   1. The panel shall be constructed of 16-gauge steel. All panel components shall be properly

treated and finished in fine-textured, scratch resistant paint.

2. Relay panels shall be available in 120 and 277 Volt AC configurations
   a. 120V enclosures shall be 67.5” high by 14.36” wide and 4” deep with a weight not more than 80 pounds.
3. The panel shall be capable of being mounted on the surface of a wall or recessed mounted.
4. Choice of panel covers shall be available for surface or recess mount applications. This outer panel shall ship complete with a locking door to limit access to electronics and breakers.
5. The unit shall provide interior cover over breaker panel to allow access only to class 2 wiring and prevent direct access to class 1 line voltage components.
6. The Relay panel shall support up to twenty-four 20-amp single pole circuits made up of relays or 300W phase-adaptive dimmers
7. Relays shall include integral switches for manual control while power is unavailable to the panel such that critical lighting can be set to an on state, without the need for power to the panel.

C, User Interface
1. The user interface shall contain a graphical display with button pad to include 0-9 number entry, up, down back arrow navigation and enter.
2. Test shortcut button shall be available for local activation of preset, sequence and set level overrides.

D. Functional
1. Panel setup shall be user programmable.
2. Relay panels shall support discrete addressing of each relay. Panels that are restricted to use of start address with sequential addressing and cannot assign each 0-10V output control to any internal relay shall not be acceptable
3. The panel shall be capable of switching all relays on or off at once, or in a user-selectable delay per relay using a period of 0.1 to 60 seconds, in 0.1 second increments

E. Electrical
1. Relay Panels shall be available to support power input from:
   a. 120/208V three phase 4-wire plus ground

F. Relay
1. Each relay shall have a manual override switch with on/off status indication.

G. Thermal
1. The panel shall be convection cooled. Panels that require the use of cooling fans shall not be acceptable.

2.02 LIGHTING CONSOLE AND ACCESSORIES

A. General
1. The lighting control console shall be a microprocessor-based system specifically designed to provide complete control of stage, studio, and entertainment lighting systems. The console shall be the ColorSource 20 as manufactured by Electronic Theatre Controls, Inc., or equal.
2. The system shall provide control of 512 DMX512A addresses on a maximum of forty (40) control channels. Any or all of the DMX512A outputs may be controlled by a channel.
3. A maximum of 999 cues may be contained in non-volatile electronic memory.
4. Twenty (20) faders shall provide access to individual intensity channels, intensity for devices as well as playbacks.
5. Four (4) configurable faders shall provide functionality for output of bump buttons, cue list control or crossfade control.
6. The console shall have one (1) built-in 7” color multi-touch touchscreen. The touchscreen shall provide the primary interface for system configuration, programming show data and multi-parameter control.
7. Six (6) softkey buttons shall be provided, five of which may be configured by the user.

B. Controls and Playback
1. Patching
a. The console shall provide patching facilities for dimmers and multi-parameter devices via a built in library of fixture definitions. The fixture library shall be updated via software based updates. It shall be possible to create custom fixture definitions using an offline application.
b. The console shall support patching, address setting, and mode changes using Remote Device Management (RDM) on the local DMX/RDM port.
2. Channel or Playback Faders
a. Twenty (20) proportional, fully overlapping faders shall be provided with 45mm potentiometers and bump buttons.
b. The faders shall provide direct manual control of intensity for all channels. Channel levels can be changed at any time by using the individual channel faders or through the use of the touch screen interface.

C. Programming Tools
1. The console shall provide a 7” color multi-touch touchscreen with six (6) softkeys, as well as touch-based controls. The LCD shall provide system configuration, programming show data and multi-parameter control.

D. Interface Options
1. The console shall provide connectors for the following:
a. 12V AC or DC input for external power supply
b. DMX512-A/RDM output (one (1) 5-pin XLR connector)
c. USB connection (one (1) type A connector)

E. Physical
1. All operator controls and console electronics shall be housed in a single desktop console.

2.03 WALL MOUNT PUSH BUTTON CONTROL

A. Doug Fleonor Design Preset Ten Architectural
1. The Preset 10 Architectural is a lighting control station capable of storing up to ten presets. These presets are recorded by capturing the output of a DMX console.
2. Presets are recalled by pressing one button.
3. The Preset 10 Architectural system can work in conjunction with a lighting console, automatically switching between preset and console control. When the console generates a DMX signal the Preset 10 goes offline.
4. Upon loss of the DMX signal from the console, the Preset 10 returns to it’s previous Preset setting.

B. Physical
1. Ten Preset push buttons
2. One recessed record push button
3. One recessed fade time push button
4. Ten green preset indicator LED
5. One red Lockout / Record LED
6. One yellow fade time LED

C. Power input
1. 9 to 15 volts AC or DC . 200mA per station

D. Size and Appearance
1. 4.5”H x 0.2”D x 2.75”W / single Gang Box
2. Black Anodized w/ silver engraved nomenclature

2.04 POWER DISTRIBUTION WITH DMX OUT

A. General

1. Connectors shall be duplex 20A “U” ground (dual rated “T-slot)
2. Plugging Strips and Outlet Boxes shall be supplied with appropriate brackets and hardware for mounting as shown on the drawings.
    a. Standard mounting options shall include pipe or wall mounting
3. There will also be a 5 pin DMX out receptacle mounted on the same plate to one side

B. Physical
1. Outlet boxes shall be fabricated from 18 gauge galvanized steel and finished in black fine-texture powder coat paint
2. Pipe mount or Wall mount surface or flush

2.05 DMX DATA PLUG-IN STATIONS

A. General
1. The Plug-in Stations shall consist of the appropriate connectors required for the functional intent of the system. These stations shall be available with DMX input or output, Connector

B. Connector Options
1. The following standard components shall be available for Plug-in Stations:
    a. 5-Pin male XLR connectors for DMX input
    b. 5-Pin female XLR connectors for DMX output

C. Physical
1. Station faceplates shall be .80” aluminum, finished in fine texture, scratch-resistant black powder coat. Silk-screened graphics shall be white.
2. The station panel shall mount into an industry standard back box, depending on size and quantity of connectors. A terminal block shall be supplied for contractor terminations.

2.06 ETC RESPONSE OPTO SPLITTER

A. General
1. Multi-port DMX Splitter with DMX-in and DMX-thru.
2. Optically isolated DMX512 ports
3. Supports Remote Device Management (RDM) Protocol
4. Power and DMX presence status indicators
5. Supports update of connected ETC fixtures
6. Module shall be designed to mount on standard 35mm DIN rail.

B. Description
1. ETC RSN-OPTO-12T
2. Response Opto - 12 Port DIN Rail Mount / Terminal connection.

C. Electrical
1. 12 VAC 50/60 Hz power input.

PART 3 PROVIDE THE FOLLOWING

3.01 THEATRICAL LIGHTING DISTRIBUTION AND CONTROL EQUIPMENT

1 ETC Power Relay ERP 12 Relay Panel
1 ETC Surface Mount Door Kit
1 ETC 100 amp 3 phase Main Breaker
1 ETC Colorsource CS20 Control Console
1 10’ DMX Cable
1 50’ DMX Cable
2 Doug Fleonor Design Preset10A Architectural Wall Mount Push Button Station / Surface or Flush Mount
2 ETC ECPB DMX in Wall Plate / Surface or Flush Mount
1 ETC Opto 12 Channel Opto splitter Din Rail mount
1 ETC DIN Rail Box Large
1 ETC PS-DIN24 Power Supply
4 ETC Power out Wall Box with 1 “AO outlet w/ 1 - DMX out / Surface Mount or Flush Wall Mount
2 ETC Plug Strip 6’ x 5 “AO” duplex outlets w/ 1 - DMX out / Pipe Mount

(FOH Cages)

1 ETC Plug Strip 26' x 15 "AO" duplex outlets on 3 circuits w/ 1 - DMX out / Pipe Mount (1st Electric)

1 ETC Plug Strip 22' x 8 "AO" duplex outlets on 2 circuits w/ 1 - DMX out / Pipe Mount (2nd Electric)

PART 4 EXECUTION

4.01 INSTALLATION

A. It shall be the responsibility of the Electrical Contractor to receive and store the necessary materials and equipment for installation of the Theatrical Lighting Distribution and Control system.

B. It is the intent of these specifications and plans to include everything required for proper and complete installation and operation of the Theatrical Lighting Distribution and Control system, even though a very item may not be specifically mentioned.

C. The Electrical Contractor will be responsible for field measurements and coordinating physical size equipment with the architectural requirements of the spaces into which they are to be installed.

D. The Electrical Contractor and Theatrical Lighting Contractor shall install the Theatrical Lighting Distribution and Control system in accordance with manufacturer's approved shop drawings and the best applicable industry standards and practices.

E. The Theatrical Lighting Contractor shall deliver on a timely basis to other trades any equipment that must be installed by them during construction.

F. During the installation of equipment, the Electrical Contractor shall arrange for access as necessary for inspection of equipment by the Architect or Owners Representative.

G. If specifications, the Architects Instructions, laws, ordinances, or any public authority requires any work to be specially tested or approved, the Electrical Contractor shall give the Architect timely notice of its readiness for inspection, and the dates of inspections.

H. Upon completion of the Theatrical Lighting Distribution and Contol system installation, the Electrical Contractor will notify the Architect. The Architect will them schedule a date for inspection. The Theatrical Equipment Contractor will provide personnel on that date to fully operate the system and to facilitate any tests as may be required by the Architect or Owners Representative. It will be the responsibility of the Electrical Contracter and/or Theatrical Equipment Contractor to correct any equipment failures at their expense and in a timely manner and to re-schedule a follow up inspection with the Architect.

4.02 THEATRICAL EQUIPMENT DEALER SERVICES

A. Upon completion of the installation, the Theatrical Equipment Contractor shall demonstrate operation and maintenance of the systems to the owner's representatives. Training shall not exceed four working hours. Additional training shall be available upon request.

4.03 WARRANTY

A. Manufacturer:
   1. Manufacturer shall warrant products under normal use and service to be free from defects in materials and workmanship for a period of one (1) year from date of delivery.
   2. Warranty shall cover repair or replacement of such parts determined defective upon inspection.
   3. Warranty does not cover any product or part of a product subject to accident, negligence, alteration, abuse or misuse. Warranty does not cover any accessories or parts not supplied by the manufacturer.
   4. Warranty shall not cover any labor expended or materials used to repair any equipment without manufacturer's prior written authorization.

B. Theatrical Equipment Contractor
   1. The Electrical Contractor will provide a one (1) year written guarantee against defects in materials or workmanship starting from the date of acceptance of equipment by the Owner's Representative.
   2. They will also warranty any equipment or materials they provide in addition to those by

the manufacturer.

3. The guarantee shall not cover damage due to normal wear and tear, acts of God, or improper use of equipment.
4. Any required maintenance or replacement shall be provided by the Electrical Contractor within thirty (30) days of notification by the owner except for safety related items, which shall be corrected or addressed within 48 hours of notification.

END OF SECTION

SECTION 26 5119 - LED INTERIOR LIGHTING

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 life, output (lumens, CCT, and CRI), and energy efficiency data.

5. 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. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. 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. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.

2. Diffusers and Lenses: 1% 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 State Police, Fire Marshall Division Policy Number 11-06 “Plastic Materials as Interior Finishes” pertaining to the use of plastic lenses in lighting fixtures for health care facilities.
6. 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 in Luminaire schedule shown on the drawings, first listed manufacturer is basis of design.

B. Acceptable alternate manufacturers are indicated on luminaire schedules. 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.

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. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

C. Unless otherwise specified in Luminaire product data, provide products with a CCT of 4000 K.

D. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 70,000 hours.

E. 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.

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.

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 luminaries 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. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.

E. Install recessed luminaires to permit removal from below.

F. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

G. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

H. Install fixture with no gaps between adjacent fixtures or between fixtures and surrounding surfaces. Trims of fixtures shall be properly and uniformly aligned.

I. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

K. Wall-Mounted Luminaire Support:

1. Attached to a minimum 20 gauge backing plate attached to wall structural members.

2. Do not attach luminaires directly to gypsum board.

L. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.

2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.

3. Ceiling mount with hook mount.

M. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

3. Continuous Rows of Luminaires: Use tubing, stem, or aircraft cable for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

N. Comply with requirements in Section 26 0519 "Conductors and Cables" for wiring connections.

O. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned.

P. 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. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

B. Adjust exit sign directional arrows as indicated on Drawings.

C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner’s representative and Architect/Engineer.

3.09 **CLEANING**

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures and lenses.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 5600 - EXTERIOR LIGHTING

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. Exterior luminaires with lamps and ballasts.
2. Poles and accessories.

B. Related Sections include the following:

1. Division 26 Section "LED Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.03 DEFINITIONS

A. CRI: Color-rendering index.

B. HID: High-intensity discharge.

C. Luminaire: Complete lighting fixture, including ballast housing if provided.

D. Pole: Luminaire support structure, including tower used for large area illumination.

E. Standard: Same definition as "Pole" above.

1.04 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Ice Load: Load of 3 lbf/sq. ft. applied as stated in AASHTO LTS-4.

C. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.

1. Wind speed for calculating wind load for poles 50 feet or less in height is 70 mph.

1.05 **ACTION SUBMITTALS**

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.

2. Details of attaching luminaires and accessories.

3. Details of installation and construction.

4. Luminaire materials.

5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.

a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Lamps, including life, output, and energy-efficiency data.

7. Materials, dimensions, and finishes of poles.

8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.

9. Anchor bolts for poles.

10. Manufactured pole foundations.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.06 **INFORMATIONAL SUBMITTALS**

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

B. Field quality-control test reports.

1.07 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

B. Warranty: Special warranty specified in this Section.

1.08 **MAINTENANCE MATERIALS SUBMITTALS**

A. Spare parts

B. Extra stock material

1.09 **QUALITY ASSURANCE**

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.10 **DELIVERY, STORAGE, AND HANDLING**

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.11 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.

4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

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. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 **LUMINAIRES, GENERAL REQUIREMENTS**

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

M. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.
    a. Color: Dark bronze.

2.03 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.
2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.

C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

2.04 **ALUMINUM POLES**

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: Square, straight.

2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.

2. Finish: Same as pole.

F. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: Dark bronze.

2.05 **POLE ACCESSORIES**

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

B. Vibration Dampener: For all steel and aluminum lighting poles taller than 25’, provide factory installed vibration dampening device to eliminate second mode or higher resonance that can occur with low velocity steady state winds.

PART 3 EXECUTION

3.01 **LUMINAIRE INSTALLATION**

A. Install exterior lighting system per N.E.C.A./I.E.S.N.A. 501-2006.

B. Fasten luminaire to indicated structural supports.

3.02 **POLE INSTALLATION**

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 5 feet.

2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet.
3. Trees: 15 feet

C. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

D. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

E. Raise and set poles using web fabric slings (not chain or cable).

3.03 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

3.04 GROUNDING

A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding."

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION

SECTION 27 5123.60 – AREA OF RESCUE ASSISTANCE TWO-WAY INTERCOMMUNICATION SYSTEM

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 a complete, digital, audio-visual intercom system, including central annunciator and control panel, remote call stations, battery backup, power supplies, remote call station expansion switches, signage, and all other necessary auxiliary devices, boxes, raceway, and wiring to provide a complete and operational Area of Rescue Assistance Two-way Communications system.

1.03 ACTION SUBMITTALS

A. Product Data: For the following:

1. Central annunciator and control panel.
2. Remote call stations.
3. Power Supply with Battery Backup.
4. Auto-dialer.
5. Signage.
6. Fire resistive wire and cable.

B. Shop Drawings:

1. Equipment Details: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.
2. Station-Arrangement Details: Scaled drawings for built-in equipment.
3. Wiring Diagrams: Power, signal, and control wiring. Include the following:
    a. Identify terminals to facilitate installation, operation, and maintenance.
    b. Single-line diagram showing interconnection of components.
    c. Cabling diagram showing cable routing.
    d. Identify provisions to achieve NFPA 72 Survivability requirements.

1.04 **INFORMATIONAL SUBMITTALS**

A. Qualification Data: For Installer.

B. Field quality-control test reports.

1.05 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For two-way communication equipment to include in emergency, operation and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.

1.06 **QUALITY ASSURANCE**

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than 4 hours' normal travel time from Installer's place of business to Project site.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70

D. Comply with NFPA 72

E. Comply with UL 50.

F. Comply with UL 2196

G. The contractor shall be an established communications contractor that has had and currently maintains a locally run and operated business for at least five (5) years. The contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full manufacturer’s five (5) year warranty.

H. The contractor shall show satisfactory evidence, upon request, that the supplies and maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cornell Communications, Inc.

2. Tek-Tone Sound and Signal Manufacturing
3. Rath MicroTech
4. Housing Devices, Inc.
5. Gai-tronics, Inc. (a Hubbell Inc. company)

2.02 **FUNCTIONAL DESCRIPTION OF TWO-WAY INTERCOMMUNICATION SYSTEM**

A. Basic system consists of central annunciator and control panel with system power supply and built-in battery backup, remote call stations, and related signage. Other components include a remote control panel at security office or other constantly attended location and a telephone system auto-dialer for off-site notification at a secondary location, usually 9-1-1 emergency service.

B. When a call is placed to the central annunciator and control panel, from a remote call station, the following occurs:

1. Audible and visual notification at the call station to indicate that a call has been initiated.
2. Audible and visual notification at the central annunciator and control panel which indicates that a call from a remote call station has been initiated and also identifies the remote call station location.
3. After initiation, the control station operator must manually reset the visual notification of each call location at the control station to terminate the notification.
4. After initiation, the control station operator must acknowledge the audible notifications that the call was placed at the control station, to terminate the notification.
5. After initiation, the control station operator must manually reset the visual notification at the remote call station.

C. When a call from a remote call station is acknowledged at a central annunciator and control panel, the following occurs:

1. Visual notification at the central annunciator and control station that the call has been acknowledged.
2. Visual notification at the remote call station that the call has been received.
3. Two-way intercommunication is established between the remote call station and the central annunciator and control panel.

D. When a call is placed to the central annunciator and control panel, from a remote call station, and is not acknowledged at the central annunciator and control panel, the following occurs:

1. After a programmed time delay, 9-1-1 is dialed from an automatic telephone dialer and a pre-recorded message is played, and two-way voice communication is established between the remote call station and the dialed emergency responder number.

2.03 **EQUIPMENT AND MATERIALS**

A. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Equipment: Modular type using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

C. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations.

2.04 **CENTRAL ANNUNCIATOR AND CONTROL STATION**

A. Wall mounted central annunciator and control station with handset for two way communication to remote call stations. Provide flush mounting of wall mounted station as indicated on plans.

B. Provide visual annunciation of remote call station via individual red LED lamps for each remote station and integral scrolling message screen indicating status and location of individual remote call station at central annunciator and control station.

C. Provide audible annunciation of remote call station call at central annunciator and control station.

D. Provide password protected memory with local and remote programming ability. Program shall identify the specific location of the remote call station.

2.05 **EXPANSION SWITCH**

A. Switch shall be designed to expand the system capacity by 1-8 devices including remote call stations, other expansion switches, and remote control panels.

B. Provide a surface mounted enclosure to house expansion switch. Mount adjacent to central annunciator and control station.

2.06 **REMOTE CALL STATIONS**

A. Provide recessed, hands free, vandal resistant, speaker phone with stainless steel faceplate including a red call button (push once to talk), and a red LED to indicate status of the call.

B. Faceplate identification shall include versions of the following: “Help Phone”, the international phone symbol, and raised Braille lettering in conformance with ADA requirements.

2.07 **SYSTEM POWER SUPPLY WITH BATTERY BACKUP**

A. Provide 120V. 60 Hertz input, 24V output, nickel cadmium battery backup for system operation. Provide flush or surface mounted battery enclosure as indicated on drawings. Provide AC power failure and low battery indicators. Batteries shall maintain system operation for 4 hours in case of power failure. Provide 5 year average battery life. Quantities shall be as required for complete system support.

2.08 **CONDUCTORS AND CABLES**

A. Provide wiring as recommended by Area of Rescue Assistance Two-Way Intercommunication System Manufacturers.

B. Conductors: Jacketed, twisted pair and twisted multi-pair, untinned solid copper. Sizes as recommended by system manufacturer, but not smaller than No. 22 AWG.

C. Shielding: For speaker-microphone leads and elsewhere where recommended by manufacturer; No. 34 AWG tinned, soft-copper strands formed into a braid or equivalent foil.

1. Minimum Shielding Coverage on Conductors: 60 percent.

D. Plenum Cable: Listed and labeled for plenum use.

E. Pathway Survivability:

1. Provide wiring with pathway survivability minimum Level 2:

a. 2-hour fire rated circuit integrity (CI) cable

b. 2-hour fore-rated cable system (electrical circuit protective systems)

c. 2-hour fire rated enclosure or protected area (only where specifically identified on drawings)

2.09 **ILLUMINATED SIGNAGE**

A. Provide instructional, tactile, and illuminated signage indicating the location and use of emergency two-way communications system.

B. Instructional signage detailing the use of the two communications system shall be posted on or adjacent to the remote call stations.

C. Tactile and visual signage shall be located at the entrance to each elevator lobby indicating that the two-way emergency communication system is available in area (location of remote call station).

D. Illuminated signage indicating Emergency Communications location (location of remote call station) shall be located at entrance to each elevator lobby and in path of egress indicating that the two-way emergency communication system is available in the area (location of remote call station).

PART 3 EXECUTION

3.01 INSTALLATION

A. Wiring Method: Install wiring in raceways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces where cable wiring method may be used. Use plenum cable in environmental air spaces, including plenum ceilings. Conceal cables and raceways except in unfinished spaces.

B. Install circuit integrity cable and fire resistive cable systems in accordance with the manufacturer's installation guidelines and in accordance with UL listing requirements.

C. Install exposed cables parallel and perpendicular to surfaces or exposed structural members, and follow surface contours. Secure and support cables by J- hooks or similar fittings designed and installed to avoid damage to cables. Secure cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, or fittings.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess. Use lacing bars in cabinets.

E. Control-Circuit Wiring: Install number and size of conductors as recommended by system manufacturer for control functions indicated.

F. Separation of Wires: Separate two way communication system equipment conductors as recommended by equipment manufacturer.

G. Splices, Taps, and Terminations: Arrange on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

H. Match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.

I. Identification of Conductors and Cables: Color-code conductors and apply wire and cable marking tape to designate wires and cables so they identify media in coordination with system wiring diagrams.

J. Connect wiring according to Division 26 Section "Conductors and Cables."

K. Weatherproof Equipment: For units that are mounted outdoors, in damp locations, or where exposed to weather, install consistent with requirements of weatherproof rating.

L. Mounting Heights: Remote Call Station – 48 inches from floor to center of device; Central Annunciator and Control Station – 60 inches to center of station, unless desk mounted type; Instructional Signage – 48 inches to center; Tactile signage – 60 inches to center; Illuminated signage – between 60 and 80 inches.

3.02 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at central annunciator and control panel. Isolate from power system and equipment grounding.

C. Install grounding electrodes as specified in Division 26 Section "Grounding and Bonding."

3.03 **SYSTEM PROGRAMMING**

A. Programming: Fully train Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.04 **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. Schedule tests with at least seven days' advance notice of test performance.

2. After installing two-way emergency intercom system equipment and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: Test two way communications between originating remote call station and central annunciator and control station. Verify proper routing and volume levels and that system is free of noise and distortion.

4. Frequency Response Test: Determine frequency response by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.

5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings using a 1000-Hz signal. Measure between central annunciation and control panel and remote control stations. Minimum acceptable ratio is 45 dB.

6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each remote call station and central panel. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.

7. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB; in levels between adjacent zones, plus or minus 5 dB.

8. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.

9. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Division 26 Section "Grounding and Bonding."

C. Retesting: Correct deficiencies and retest. Prepare a written record of tests.

D. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.

E. Prepare written test reports.

1. Include a record of final signal ground-resistance measurement certified by Installer.

3.05 **STARTUP SERVICE**

A. Engage a factory-authorized service representative to perform startup service and initial system programming.

B. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

C. Complete installation and startup checks according to manufacturer's written instructions.

3.06 **ADJUSTING**

A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, and adjusting controls to meet occupancy conditions.

B. 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 site outside normal occupancy hours for this purpose, without additional cost.

3.07 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain two-way communication equipment. Refer to Division 1 Section "Demonstration and Training."

1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment.

END OF SECTION

SECTION 28 3100 - FIRE ALARM

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 a new 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. All new fire alarm control panel, devices, and wiring.
2. System smoke detection above all control panels and notification appliance power supply panels.
3. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
4. System smoke detection in areas identified on plans
5. System carbon monoxide detection in areas identified on plans.
6. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.
7. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
8. Audible and visual notification appliances in all public and common areas of the building.
9. Emergency Generator Monitoring
10. Elevator Recall
11. Firefighter communication system, if required.

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. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM’s. Provide smoke detection as required by applicable codes.

I. 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.

J. 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. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.

13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.

a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.

b. Show field wiring and equipment required for HVAC unit shutdown on alarm.

c. Locate detectors in accordance with manufacturer's written instructions.

d. Show air-sampling detector pipe routing.

14. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.

15. 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 FACP 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors and Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.
8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
9. Air-Sampling Fan: Quantity equal to one for every five detectors, but no fewer than one unit of each type.

1.10 **QUALITY ASSURANCE**

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Work of this Section be performed by a UL-listed company.

C. Installer Qualifications: Personnel certified by NICET as Fire Alarm Level II.

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.

1.11 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
2. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
4. Keys and Tools: One extra set for access to locked and tamperproofed components.
5. Audible and Visual Notification Appliances: One of each type installed.
6. Fuses: Two of each type installed in the system.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:

a. National Time & Signal.

2.02 FACP

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864, 9th edition, listed.
2. Addressable initiation devices that communicate device identity and status.

a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at the FACP.

b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.

3. Addressable control circuits for operation of mechanical equipment.
4. Mounting: Flush.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Signaling Line Circuits between control panels: NFPA 72, Class A, Style 7
2. Signaling Line Circuits from control panel to devices: NFPA 72, Class B, Style 4.

a. System Layout: Install no more than 50 addressable devices on each signaling line circuit.

3. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
4. Actuation of alarm notification appliances, emergency voice communications, annunciation, elevator recall, and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required, provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.

E. Elevator Controls: Heat detector operation shuts down elevator power by operating a shunt trip in a circuit breaker feeding the elevator.

1. A field-mounted relay actuated by the fire detector or the FACP closes the shunt trip circuit and operates building notification appliances and annunciator.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.

2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.

3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.

I. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.

J. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines or radio alarm transmitter.

K. Voice/Alarm Signaling Service: A central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of the FACP.

1. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

L. Service Modem: The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.

M. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.

2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

N. Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.

1. Battery and Charger Capacity: Comply with NFPA 72.

O. Surge Protection:

1. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.03 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.

2. Station Reset: Key- or wrench-operated switch.

3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.

2.04 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

3. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.

4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

5. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

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.

a. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.

2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:

a. Sensor: LED or infrared light source with matching silicon-cell receiver.

b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
    a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.
5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.
8. Each sensor shall have multiple levels of detection sensitivity.
9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.
10. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

2.05 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or rate-of-rise of temperature that exceeds 15 deg F per minute, unless otherwise indicated.
1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
1. Mounting: Plug-in base, interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.06 SYSTEM CARBON MONOXIDE DETECTORS

A. General Description:
1. UL 2075 listed, operating at 24-V dc, nominal.
2. Provide means for addressable connection to fire-alarm system.
3. Detector must communicate detector status (normal, alarm, or trouble) to the FACP.
4. Detector must send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
5. Detector must provide alarm contacts and trouble contacts.
6. Mounting: Adapter plate for outlet box mounting.
7. Testable by introducing test carbon monoxide into sensing cell.
8. Locate, mount, and wire in accordance with manufacturer's written instructions.

9. Test button simulates alarm condition.

2.07 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly.

2. Finishes:

a. Wall mounted appliances: Provide red finish with white lettering.

b. Ceiling Mounted Appliances: Provide white finish with red lettering.

B. Voice/Tone Speakers:

1. UL 1480 listed.

2. High-Range Units: Rated 2 to 15 W.

3. Low-Range Units: Rated 1 to 2 W.

4. Matching Transformers: Tap range matched to the acoustical environment of the speaker location.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.

1. Rated Light Output: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.

2. Strobe Leads: Factory connected to screw terminals.

2.08 REMOTE STATUS AND ALARM INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.09 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.

2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.

3. Rating: 24-V ac or dc.

B. Material and Finish: Match door hardware.

2.10 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet, NEMA 250, Class 1.

B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.11 **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.

2.12 **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.

2.13 **DIGITAL ALARM COMMUNICATOR TRANSMITTER**

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.

D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.14 **GUARDS FOR PHYSICAL PROTECTION**

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of the device.

2. Finish: Paint of color to match the protected device.

2.15 **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

4. NPLFA circuit cable installed exposed in ceiling spaces, shafts and elsewhere: Multi-conductor Armored Cable, NFPA 70 Type MC, copper conductors, copper drain wire, aluminum or steel armor with red identifier stripe, UL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. Smoke or Heat 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.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

E. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector and each sprinkler water-flow switch and valve-tamper switch that is above 10’-0” aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.

F. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

G. Visible Alarm Notification Appliances: Install wall mounted appliances at 96” AFF or 6 inches below the ceiling, whichever is less.

H. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

I. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. FACP: Surface mounted with tops of cabinets not more than 72 inches above the finished floor.

1. Install smoke detector above panel. Install on ceiling for ceilings under 10 ft. For ceilings above 10’, wall mount a smoke detector listed for releasing service 10’ AFF or 1’ below finished ceiling (whichever is lower).

L. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

M. 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, gymnasiums 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.

2. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

3. Testing: Follow procedure and record results complying with requirements in NFPA 72.

4. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 **PROGRAMMING**

A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.07 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

C. Annual Test and Inspection: One year after date of Substantial Completion, test the fire alarm system complying with the testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for monthly, quarterly, semiannual, and annual periods. Use forms developed for initial tests and inspections.

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 "Demonstration and Training."

END OF SECTION

APPENDIXES

APPENDIX 1

Geotechnical Investigation

Dated March 12, 2024

Report on
Geotechnical Investigation

Smith Middle School
5835 Donaldson Road
Troy, Michigan 48085

Latitude 42.603756˚ N
Longitude 83.147882˚ W

Prepared for:

Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

G2 Project No. 230618
March 12, 2024

g2consultinggroup.com

Headquarters	1866 Woodslee St	Troy, MI 48083	P 248.680.0400	F 248.680.9745
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March 12, 2024

Ms. Michelle Kerns
Lecole Planners, LLC
145 North Center Street B
Northville, Michigan 48167

Re: Report on Geotechnical Investigation
Smith Middle School
5835 Donaldson Road
Troy, Michigan 48085
G2 Project No. 230618

Dear Ms. Kerns:

We have completed the geotechnical investigation for the proposed new Smith Middle School development in Troy, Michigan. This report presents the results of our observations and analyses, our recommendations for subgrade preparation, foundation and pavement design, and construction considerations as they relate to the geotechnical conditions on site.

We appreciate the opportunity to be of service to Lecole Planners and Troy School District and look forward to discussing the recommendations presented. In the meantime, if you have any questions regarding the report or any other matter pertaining to the project, please call us.

Sincerely,

G2 Consulting Group, LLC

Amy L. Schneider, P.E.
Project Manager, Associate

Noel J. Hargrave-Thomas, P.E.
Principal

ALS/NJHT/ljv

Enclosures

EXECUTIVE SUMMARY

We understand a new middle school campus will be constructed on the existing Smith Middle School property in Troy, Michigan. The new 103,661 square-foot middle school building will be constructed at the southwest side of the property, southwest of the existing building, and will have a finished floor elevation of 725.5 feet. New pavement areas will be constructed around the building including standard-duty bituminous concrete parking lots north and east of the proposed building, heavy-duty bituminous concrete drop-off loops adjacent to or surrounding the parking lots, two heavy-duty bituminous concrete access drives extending from Livernois Road, and a heavy-duty bituminous concrete access drive extending from Cotswold Drive.

Approximately 3 to 18 inches of crushed stone fill are present from the ground surface at borings B-27 and B-35. Approximately 1 to 14 inches of topsoil are present at the remaining boring locations with the exception of boring B-30 where approximately 24 inches of topsoil are present. Soft to very stiff sandy clay fill and silty clay fill with organic matter underlie the topsoil and stone fill at borings B-6, B-8, B-13, B-14, B-28, B-31 through B-35, B-37, B-38, B-42, B-44, and B-45 and extend to approximate depths ranging from 2 to 8 feet (Elevation 724-1/2 to 712-1/2 feet). A layer of buried topsoil was noted below the fill at borings B-33, B-38, and B-42. Loose to medium compact silty sand fill underlies the topsoil at boring B-7 and is present from the ground surface at boring B-25 and extends to approximate depths of 3 and 4 feet, respectively. Native soft to stiff silty clay and sandy clay are present below the fill or topsoil at borings B-6, B-20, B-25, B-26, B-27, B-30 through B-32, B-36, and B-38 and extend to approximate depths ranging from 3 to 8 feet (Elevation 732 to 714-1/2 feet). Native very stiff to hard silty clay, and to a lesser extent sandy clay, underlie the topsoil, fill, and lower native consistency cohesive soils and extend to the explored depths. Groundwater was encountered during drilling operations at borings B-5, B-27, B-30, B-31, B-32 through B-35, B-38, B-40, and B-44 at approximate depths ranging from 2 to 8 feet (Elevations 722-1/2 to 713-1/2 feet), typically with the existing fill. At boring B-36, groundwater was encountered at an approximate depth of 18 feet (~Elevation 705 feet). No measurable groundwater was encountered during or upon completion of drilling operations at the remaining boring locations.

Based on the proposed finished floor elevation of 725.5 feet, up to approximately 5-1/2 feet (increasing from north to south) of engineered fill are required across the building footprint to achieve proposed finished grades. Additionally, the existing fill soils, buried topsoil, and native soft to stiff sandy clay extending to approximate elevations ranging from 722-1/2 to 712-1/2 feet are not suitable for support of building foundations and marginally suitable for support of engineered fill to achieve finished grades and floor slabs. We recommend two options be considered for support of the proposed building and foundations including: **OPTION 1)** complete removal of the existing fill, buried topsoil, and native soft to stiff sandy clay to the underlying native very stiff to hard silty clay and replacement with engineered fill for support of shallow foundations, or **OPTION 2)** raising the site to proposed finished grades with engineered fill and installation of a ground improvement system, consisting of rammed aggregate piers or vibro compacted stone columns, for support of shallow foundations. Foundations bearing on a combination of the native very stiff to hard silty clay and engineered fill overlying native soils as described in OPTION 1 can be designed for a net allowable bearing capacity of 3,000 pounds per square foot (psf). Foundations designed to bear on the ground improvement system are able to achieve a cost optimized bearing capacity, typically ranging between 3,000 and 5,000 psf. Foundations bearing directly on the native very stiff to hard silty clay can be designed based on a net allowable bearing capacity of 4,000 psf. Further analyses will be required to determine the design parameters for ground improvement systems, performed by the ground improvement designer. Settlement of the existing fill and native soft to stiff sandy clay due to the overburden pressure from the additional fill to achieve finished grades must be evaluated by the design engineer. G2 Consulting Group, LLC (G2) must be on site during construction to observe the excavations, measure the bearing depths, and verify the adequacy of the bearing soils.

This summary is not to be considered separate from the entire text of this report, with all the conclusions and qualifications mentioned herein. Details of our analysis and recommendations are discussed in the following sections and in the Appendix of this report.

PROJECT DESCRIPTION

We understand a new middle school campus will be constructed on the existing Smith Middle School property in Troy, Michigan. The new 103,661 square-foot middle school building will be constructed at the southwest side of the property, southwest of the existing building, and will have a finished floor elevation 725.5 feet. A gymnasium will be situated at the northwest quadrant and the orchestra room will be located at the northeast quadrant, both of which will have high ceilings. The remainder of the structure will be classroom, office, or learning space. These areas are indicated on the Soil Boring Location Plan, Plate No. 1 in the Appendix. The structural loading conditions for the proposed building were not available at the time of this investigation. We anticipate column loads may be on the order of 100 to 150 kips and wall loads may range from 2 to 4 kips per lineal foot, with the higher loads anticipated in the areas of the gymnasium, orchestra, and two-story portion.

New pavement areas will be constructed around the building including standard-duty bituminous concrete parking lots north and east of the proposed building, heavy-duty bituminous concrete drop-off loops adjacent to or surrounding the parking lots, two heavy-duty bituminous concrete access drives extending from Livernois Road, and a heavy-duty bituminous concrete access drive extending from Cotswold Drive.

Existing and proposed grades were interpolated from the Grading & SESC Plans (Sheets C-4.1 and C-4.2) prepared by PEA Group, dated October 17, 2023. The north parking lot has proposed grades sloping downward to the perimeter of the lot, ranging from approximately Elevation 728-1/4 feet to 726 feet. The drop-off loop south of this lot has proposed grades sloping downward to the south, ranging from approximately Elevation 726 to 724 feet. The east parking lot has proposed grades sloping downward to the southeast, ranging from approximately Elevation 724 feet to 721 feet. The perimeter drop-off loop around this lot has finished grades sloping downward to the east and northeast, ranging from approximately Elevation 724 feet adjacent to the building to Elevation 718 feet at Cotswold Road. The north access drive extending to Livernois Road has proposed finished grades sloping upward from the north parking lot to the west, ranging from approximately Elevation 729 to 741 feet. The south access drive extending to Livernois Road has proposed finished grades sloping upward from the building to the west, ranging from approximately Elevation 724-1/2 to 738 feet.

If the proposed finished floor elevation, site grades, or estimated loaded conditions vary, G2 must be notified to evaluate the potential effect on the provided design and construction recommendations.

PREVIOUS INVESTIGATION

G2 previously performed two geotechnical investigations for the property which had different campus layouts. Our initial geotechnical investigation report was dated September 6, 2023 and was focused on the preliminary building layout. At the time of the initial investigation, the building was to be situated in the general location of the existing athletic field/running track. Soil borings B-1 through B-16 were performed in conjunction with this investigation. Our second geotechnical investigation report was dated December 29, 2023 and was focused on the pavements which were to be in the location of the existing residential properties along Livernois Road. Soil borings B-17 through B-27 were performed in conjunction with this investigation.

We have included all of the borings in this investigation for use in providing recommendations for the revised campus layout. However, borings B-17 through B-19, B-21 through B-24, and B-41 are outside the limits of the revised plan and will not be discussed in this report.

SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under the direction and supervision of a licensed professional engineer. Our services were performed according to generally accepted standards and procedures in the practice of geotechnical engineering in this area.

Our scope of services for this project is as follows:

1. We drilled a total of forty-four soi borings in conjunction with the overall development. Soil borings B-10 through B-16 and B-27 through B-38 were drilled in or directly adjacent to the footprint of the proposed building extending to depths of 20 to 25 feet each below existing grade. Boring B-20 was drilled in the alignment of the north access drive and extended to a depth of 5 feet below existing grade. Borings B-25 and B-26 were drilled in the alignment of the south access drive and extended to a depth of 5 feet each below existing grade. Borings B-1 through B-9, B-39, and B-40 were drilled in the north parking lot and drop-off loop and extended to depths of 5 and 25 feet. Borings B-42 through B-45 were drilled in the east parking lot and drop-off loop and extended to a depth of 5 feet each.

2. We performed laboratory testing on representative samples obtained from the soil borings. Laboratory testing included visual engineering classification, natural moisture content, loss-on-ignition (L.O.I.), dry density, and unconfined compressive strength determination.

3. We prepared this engineering report. Our report includes recommendations regarding foundation types suitable for the encountered subsurface conditions, foundation and pavement design, and construction considerations related to site construction and associated development.

FIELD OPERATIONS

G2, in conjunction with Lecole Partners, selected the number, depth, and location of the soil borings based on the layout of the proposed building and site improvements. The soil boring locations were located in the field by measuring from existing site features using conventional taping methods in combination with using GPS assisted mobile technology and staked by a G2 staff engineer prior to drilling operations. The approximate soil boring locations relative to the existing site layout and proposed building are shown on the Soil Boring Location Plan, Plate No. 1. Ground surface elevations at the boring locations were interpolated from the topographic contour lines and spot elevations presented on the Grading & SESC Plans (Sheets C-4.1 and C-4.2) prepared by PEA Group, dated October 17, 2023.

The soil borings were drilled using both a truck-mounted drilling rig and an all-terrain vehicle (ATV) rotary drilling rig. Continuous flight, 2-1/4 inch inside diameter, hollow-stem augers were used to advance the boreholes to the explored depths. Within each soil boring, soil samples were obtained at intervals of 2-1/2 feet within the upper 10 feet and at intervals of 5 feet thereafter. These samples were obtained by the Standard Penetration Test method ASTM D 1586, which involves driving a 2-inch diameter split-spoon sampler into the soil with a 140-pound weight falling 30 inches. The sampler is generally driven three successive 6-inch increments with the number of blows for each increment recorded. The number of blows required to advance the sampler the last 12 inches is termed the Standard Penetration Resistance (N). The blow counts for each 6-inch increment and the resulting N-value are presented on the individual soil boring logs.

The soil samples were placed in sealed containers in the field and brought to the laboratory for testing and classification. During field operations, drilling representatives maintained boring logs of the subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final boring logs are based on the field logs and laboratory soil classification and testing results. After completion of the drilling operations, the boreholes were backfilled with auger cuttings and capped with cold patch, where applicable.

LABORATORY TESTING

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to pavement and foundation design and site preparation. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System. Laboratory testing included organic matter content (L.O.I), natural moisture content, dry density, and

unconfined compressive strength determinations. The organic matter content of representative samples was determined in accordance with ASTM Test Method D 2974, "Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils". The unconfined compressive strengths were determined by ASTM Test Method D2166 and a spring-loaded hand penetrometer. Per ASTM Test Method D2166, the unconfined compressive strength of cohesive soils is determined by axially loading a small cylindrical soil sample under a slow rate of strain. The unconfined compressive strength is defined as the maximum stress applied to the soil sample before shear failure. If shear failure does not occur prior to a total strain of fifteen percent, the unconfined compressive strength is defined as the stress at a strain of fifteen percent. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot (tsf) by measuring the resistance of the soil sample to the penetration of a calibrated spring-loaded cylinder.

The results of the moisture content, organic matter content, dry density, and unconfined compressive strength test are indicated on the soil boring logs at the depths the samples were collected. The results of the unconfined compressive strengths determined in accordance with ASTM Test Method D2166 are also presented graphically in the Appendix on Figure No. 45. We will hold the soil samples for 60 days from the date of this report, after which time they will be discarded. If you would like the samples, please let us know.

SOIL CONDITIONS

Building (Borings B-10 through B-16, B-27 through B-38)

Approximately 3 to 18 inches of crushed stone fill are present from the ground surface at borings B-27 and B-35. Approximately 5 to 14 inches of topsoil are present at the remaining boring locations with the exception of boring B-30 where approximately 24 inches of topsoil are present. Sandy clay fill and silty clay fill with organic matter underlie the topsoil and stone fill at borings B-13, B-14, B-28, B-31 through B-35, B-37, and B-38 and extend to approximate depths ranging from 2-1/2 to 8 feet (Elevations 724-1/2 to 712-1/2 feet). An approximately 12-inch layer of buried topsoil was noted below the fill at borings B-33 and B-38. Low consistency native sandy clay is present below the fill and topsoil at borings B-27, B-30, and B-31and extends to approximate depths ranging from 5-1/2 to 6 feet (Elevation 718 to 714-1/2 feet). Native silty clay and sandy clay underlie the topsoil, native low consistency sandy clay, and fill and extend to the explored depths.

The sandy clay fill and silty clay fill are generally stiff to very stiff in consistency with moisture contents ranging from 8 to 25 percent, unconfined compressive strengths ranging from 2,000 to 8,000 psf, and organic matter contents ranging from 1.0 to 4.0 percent. However, the sandy clay fill and silty clay fill below the topsoil at borings B-28 and B-33 and upper fill at boring B-34 are soft to medium in consistency with moisture contents ranging from 24 to 32 percent, unconfined compressive strengths ranging from 500 to 1,000 psf, and organic matter contents ranging from 2.3 to 5.7 percent. Layers of native stiff silty clay and sandy clay are present directly below the fill, topsoil, and soft to medium sandy clay at borings B-30, B-32, B-36, and B-38 with moisture contents ranging from 11 to 22 percent, a dry density of 127 pcf, and unconfined compressive strengths ranging from 2,000 to 3,000 psf. The remainder of the native silty clay and sandy clay is very stiff to hard in consistency with natural moisture contents ranging from 8 to 23 percent and unconfined compressive strengths ranging from 4,000 to 9,000 psf.

Pavements (Borings B-1 through B-9, B-20, B-25, B-26, B-39, B-40, and B-42 through B-45)

Approximately 1 to 14 inches of topsoil are present at the boring locations. Silty clay fill and sandy clay fill underlie the topsoil at borings B-6, B-8, B-42, B-44, and B-45 and extend to approximate depths ranging from 2 to 5 feet (~Elevation 722-1/2 to 714 feet). A layer of buried topsoil is present below the fill at boring B-42 and extends to the explored depth of 5 feet. Silty sand fill underlies the topsoil at boring B-7 and is present from the ground surface at boring B-25 and extends to approximate depths of

3 and 4 feet (Elevations 722-1/2 and 733 feet), respectively. Native silty clay and to a lesser extent sandy clay underlies the fill and topsoil at the remaining boring locations and extends to the explored depths 5 and 25 feet.

The silty clay fill and sandy clay fill are stiff to very stiff in consistency with moisture contents ranging from 13 to 19 percent, unconfined compressive strengths ranging from 3,000 to 8,000 psf, and organic matter contents ranging from 1.9 to 2.6 percent. The silty sand fill is loose to medium compact with N-values of 5 and 20 blows per foot and an organic matter content of 3.3 percent (boring B-25). Layers of medium to stiff native silty clay and sandy clay are present below the topsoil or fill at borings B-6, B-20, and B-26 with natural moisture contents ranging from 17 to 21 percent, a dry density of 120 pcf, and unconfined compressive strengths ranging from 1,000 to 3,000 psf. The remainder of the native silty clay and sandy clay is very stiff to hard in consistency with natural moisture contents ranging from 10 to 20 psf, a dry density of115 pcf, and unconfined compressive strengths ranging from 5,000 to 9,000 psf.

General

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur between borings. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transitions may be more gradual than what are shown. We have prepared the boring logs on the basis of laboratory classification and testing as well as field logs of the soils encountered.

The Soil Boring Location Plan, Plate No. 1, Site Preparation Plan, Plate No. 2, Soil Boring Logs, Figure Nos. 1 through 44, and Unconfined Compressive Strength Test, Figure No. 45, are presented in the Appendix. The soil profiles described above are generalized descriptions of the conditions encountered at the boring locations. General Notes Terminology defining the nomenclature used on the boring logs and elsewhere in this report are presented on Figure No. 46.

GROUNDWATER CONDITIONS

Groundwater was encountered during drilling operations at borings B-6, B-27, B-28, B-30, B-31, B-32 through B-35, B-38, B-40, and B-44 at approximate depths ranging from 2 to 8 feet (Elevations 722-1/2 to 713-1/2 feet). At boring B-36, groundwater was encountered at an approximate depth of 18 feet (Elevation 705 feet). Upon completion of drilling operations, groundwater was measured at approximate depths ranging from 2 to 21 feet below existing grade (Elevations 721-1/2 to 703-1/2 feet) at borings B-6, B-27, B-28, B-30, B-31, B-33, B-34, B-35, B-36, B-38, and B-44. No measurable groundwater was encountered during or upon completion of drilling operations at the remaining boring locations.

Fluctuations in perched and long-term groundwater levels should be anticipated due to seasonal variations and following periods of prolonged precipitation. It should also be noted that groundwater observations made during drilling operations in cohesive soils are not necessarily indicative of the static groundwater level. This is due to the low permeability of such soils and the tendency of drilling operations to seal off the natural paths of groundwater flow.

SITE CONDITIONS

Smith Middle School is located at 5835 Donaldson Road in Troy, Michigan. The existing school building is situated at the northeast side of the property. The area south of the existing school is currently occupied by baseball fields. An athletic field with a perimeter running track is present west of the existing school and baseball fields are present south of the school, both in the footprint of the proposed new building. The fields and area surrounding the fields are currently grass covered with sand fill at the infields. A drainage swale and tree line run parallel to the west side of the track. The swale bisects the two access drives to Livernois but is not in the footprint of any of the other proposed structures or pavements. Martell Elementary School is adjacent to the south side of the middle school property. Bituminous concrete pavements are present north and east of the existing middle school building.

Surrounding properties are primarily residential in nature with a church north of the school. The existing topography within the proposed building footprint ranges from approximately Elevation 724 feet to 720-1/2 feet, sloping downward to the southeast. The drainage swale has elevations extending from approximately Elevation 724-1/2 feet along the west side of the track to Elevation 720 feet at the low point of the swale. Elevations then slope back upward to the west and the residential properties beyond. The drainage swale continues along the south property line and reaches a low elevation of approximately 713 feet at the southeast property corner. The existing school to the east has a finished floor elevation of 724.3 feet and grades slope downward from the building to the north, south, and east.

An underground fiber line extends along the west side of the existing school in a north / south direction, through the proposed building footprint. Additionally, underground storm basins are present at the interior perimeter of the athletic track and extend under the track alignment. The structures have inverts ranging from approximately Elevation 721-1/2 to 723 feet.

Residential properties are present west of the existing Middle School property, fronting Livernois Road. Three houses and associated garages / barns are present on these properties. Scattered mature trees are present around the residences with the remainder of the properties being grass covered. A slope and drainage ditch extend in a north /south direction between the existing Smith Middle School property and the residential properties. The southernmost property (in the area of borings B-25 and B-26) and the slope / ditch between the properties are heavily wooded.

Existing grades across the residential properties slope downward to the south, east, and southeast, ranging from approximately Elevation 742 feet at the northwest corner of the site adjacent to Livernois Road to Elevation 735 feet at the northeast corner of the residential properties and approximately Elevation 737 feet at the southwest corner of the property adjacent to Livernois Road to Elevation 727 feet at the southeast corner of the residential properties. At the intersection of the residential properties and the existing school property, a downward hill is present with a drainage swale at the bottom, with the lowest elevations ranging from approximately Elevation 720 to 722 feet. Grades then slope back up toward the proposed new building to an average of approximately Elevation 724 feet.

SITE PREPARATION

Based on the existing soil conditions and provided grading plan, a significant amount of earthwork will be required to develop the site. Earthwork operations are expected to consist of removing any existing topsoil, vegetation, trees, pavements, and fencing, demolition of existing utilities and foundations, backfilling the resulting excavations with engineered fill, undercutting unsuitable fill soils or installation of a ground improvement system for support of foundations, floor slabs, and engineered fill, subgrade preparation for support engineered fill and floor slabs, and placing engineered fill to achieve proposed grade. We recommend all earthwork operations be performed in accordance with comprehensive specifications and be properly monitored in the field by qualified geotechnical engineers and technicians.

At the start of earthwork operations, any vegetation, trees, associated root structures, topsoil, sidewalk, bituminous pavement, foundations, and athletic fencing should be completely removed from within the limits of any areas of development. Within the existing drainage swale, we anticipate soft and/or organic surface soil deposits may be present and should be completely removed to the underlying native very stiff to hard cohesive soil. The existing bleachers, goal posts, and associated foundations must be completely removed within the footprint of the proposed building, and resulting excavations must be backfilled with engineered fill.

Existing utilities in the footprint of the proposed building must be completely removed and excavations backfilled with engineered fill for support of shallow foundations, engineered fill, and floor slabs. Any existing utility lines that will be abandoned and lie outside the proposed building footprint and zone of influence of proposed foundations should either be completely removed or backfilled with cement grout.

Based on the proposed finished floor elevation of 725.5 feet, up to 5-1/2 feet of engineered fill will be required to achieve finished grades. The existing fill soils, buried topsoil, and soft to stiff sandy clay and silty clay extending to depths of up to 12 feet below finished grade are not suitable for direct support of additional engineered fill or foundations. Two options for site development and support of foundations and floor slabs are thoroughly discussed in the FOUNDATION RECOMMENDATIONS and FLOOR SLAB RECOMMENDATIONS sections of this report, including complete removal and replacement of the existing fill and underlying soft to stiff sandy clay or installation of a ground improvement system (stone columns or rammed aggregate piers).

Following satisfactory removal of any trees, vegetation, topsoil, sidewalk, and pavements and prior to placement of any engineered fill, the exposed cohesive subgrade (existing fill or native silty clay and sandy clay) should be thoroughly proof rolled with a tri-axle fully loaded dump truck. The subgrade should be monitored by a qualified geotechnical engineer or technician. Any unstable or unsuitable areas noted should be improved by additional compaction or removed and replaced with specified engineered fill. Any soils that are disturbed during earthwork operations should be removed and replaced with engineered fill.

Deep topsoil deposits (14 to 30 inches) were noted at borings B-26, B-30, and B-38. A budget for undercuts on the order of 25 to 30 percent of the pavement area at the west access drives, east parking lot, and east drop-off loop should be assumed in the bid phase in consideration of the loose granular fill, soft to medium cohesive soils, existing fill with organic matter, and buried topsoil anticipated at subgrade elevation, such as present in the vicinity of borings B-20, B-25, and B-42. The north parking lot and drop-off loop is anticipated to consist of predominantly native stiff to hard silty clay and sandy clay and stiff to very stiff sandy clay fill. In general, we anticipate these soils will be stable for support of engineered fill and pavements. The contractor should be prepared to use tri-axial geogrid to limit the undercut depths. Undercuts should be backfilled with MDOT 21AA limestone dense graded aggregate and drain tiles should be installed to connect to the stormwater management system to promote drainage and prevent water accumulation within the undercut excavations. A G2 representative must be on site during earthwork operations to observe these operations and provide recommendations on subgrade preparation.

We recommend earthwork operations be performed in the warm, dry summer months to minimize exposing the cohesive soils to moisture and undercut requirements. When exposed to significant traffic loads and precipitation events, undercuts of the cohesive soils should be anticipated. Areas of instability may develop under the repeated loading from heavy construction equipment or moisture. The contractor should be prepared to undercut any areas of instability that develop within the cohesive soils and place crushed limestone in combination with tri-axial geogrid, if necessary, to stabilize the subgrade soils. Recommendations for this should be provided by a representative of G2 on site. Additionally, we recommend the aggregate base for pavements be placed immediately after subgrade preparation operations have been completed to limit the amount of disturbance to the prepared subgrade.

Engineered fill should be free of organic matter, frozen soil, clods, or other harmful material. The fill should be placed in uniform horizontal layers that are not more than 9 inches in loose thickness. The engineered fill should be compacted to achieve a density of at least 95 percent of the maximum dry density as determined by the Modified Proctor compaction test (ASTM D 1557). All engineered fill material should be placed and compacted at approximately the optimum moisture content. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade. Based on the presence of organic matter, we do not anticipate the existing fill will be suitable for reuse as engineered fill within the building footprint or proposed pavement areas. Any existing fill can be used within landscape areas.

We recommend using granular engineered fill within confined areas such as demolished utility trenches and foundation excavations. Granular engineered fill is generally more easily compacted than cohesive

soils within these confined areas. Additionally, the proper placement and compaction of backfill within these areas is imperative to provide adequate support for overlying foundations, floor slabs, and pavements.

FOUNDATION RECOMMENDATIONS

Based on the proposed finished floor elevation of 725.5 feet, up to approximately 2-1/2 feet of engineered fill are required across the north half of the building footprint and up to 5-1/2 feet of engineered are required across the south half of the building footprint. The existing fill soils and buried topsoil encountered within the building footing (which extend to approximate elevations ranging from 722-1/2 to 712-1/2 feet) are not suitable for support of building foundations. Additionally, we estimate the native soft to stiff sandy clay extending to elevations ranging from 718 to 714-1/2 feet at borings B-27, B-30, and B-31 will consolidate under the weight of the engineered fill to raise site grades; therefore, settlement plates to monitor consolidation associated with the overburden pressure would be required for an extended period of time prior to construction of foundations and floor slabs.

Based on the constructability issues associated with the existing fill, soft to medium sandy clay, and required engineered fill to raise site grades, we recommend two options be considered for support of the proposed building including 1) complete removal of the existing fill, buried topsoil, and native soft to medium sandy clay to the underlying native stiff to hard silty clay and replacement with granular engineered fill for support of shallow foundations, or 2) installation of a ground improvement system, consisting of rammed aggregate piers or vibro compacted stone columns, for support of shallow foundations.

OPTION 1 includes complete removal of the existing fill, buried topsoil, and soft to medium sandy clay within the building footprint and a minimum of 10 feet beyond. No existing fill soils are present at borings B-10 through B-12, B-15, B-16, B-29, and B-36. At these boring locations, the native very stiff to hard silty clay and sandy clay are suitable for direct support of engineered fill to raise site grades and building foundations. At the remaining boring locations, approximately 3 to 8-1/2 feet of existing fill, buried topsoil, and soft to stiff sandy clay must be removed to expose the underlying native very stiff to hard silty clay and sandy clay within the building footprint and a minimum of 10 feet beyond. The approximate thicknesses of the existing fill, topsoil, soft to medium sandy clay, and required engineered fill to achieve proposed finished grades are presented on Plate No. 2 in the Appendix, Site Preparation Plan.

Following removal of the existing fill, buried topsoil, and soft to stiff sandy clay, the resulting excavations should be backfilled with engineered fill. Once the undercut excavations have been backfilled, additional engineered fill can then be placed to raise the building footprint to the proposed finished grade. We recommend granular engineered fill (such as Class II or Class III sand or MDOT 21AA) to backfill excavations to a minimum elevation of 720 feet to minimize settlement associated with the proposed thick fill layer. To allow foundation excavations to be earth formed, cohesive engineered fill can be used above Elevation 720 feet, if desired. Foundations bearing on a combination of the native stiff to hard silty clay and engineered fill overlying native soils can be designed for a net allowable bearing capacity of 3,000 psf.

OPTION 2 includes the existing fill and soft to medium sandy clay remaining in place for support of additional engineered fill and subsequent installation of a ground improvement system, consisting of rammed aggregate piers or vibro-compacted stone columns, for support of shallow foundations. We anticipate a cost savings can be assumed by using the native very stiff to hard silty clay and sandy clay at the north end of the building for support of foundations (and floor slabs), as able by the design engineer provided differential settlement is not a concern. *G2 should work closely in the field with the contractor during topsoil removal to determine where native versus fill soils begin across the building footprint. This delineate the extent of suitable soils for support of engineered fill, floor slabs, and potentially foundations.*

For this option, engineered fill to achieve proposed finished grades can be cohesive or granular. Following placement of engineered fill to achieve proposed finished grades, a soil improvement system, such as rammed aggregate piers or vibro compacted stone columns, may be used to improve ground conditions and support the proposed building foundations and floor slabs without the extensive undercut requirements. Rammed aggregate soil improvement systems typically consist of drilling 30-inch diameter holes and ramming 1-foot lifts of aggregate into the excavations to improve the bearing capacity of the existing soils. Vibro compacted stone columns are constructed by vibrating a lance into the ground and placing aggregate through the lance to displace and compact the existing fill soils.

Conventional strip and spread footings are then designed to bear on the improved subgrade. The rammed aggregate pier and vibro stone column spacing and depth are evaluated along with the existing soil and groundwater conditions to achieve a cost optimized bearing capacity, typically ranging between 3,000 and 5,000 psf. Foundations bearing directly on the native very stiff to hard silty clay and sandy clay can be designed for a net allowable soil bearing capacity of 4,000 psf. Further analyses will be required by the ground improvement design engineer to determine the design parameters for the ground improvement systems. Settlement of the existing fill and native soft to stiff sandy clay due to the overburden pressure from the additional fill to achieve finished grades must be evaluated by the design engineer.

General

Exterior foundations should bear at a minimum depth of 3-1/2 feet below finished grade for protection against frost heave. Interior foundations can bear at shallower depths provided suitable bearing soils are present and foundations are protected from frost during construction operations. G2 must be onsite during construction to observe the excavations, measure the bearing depths, and verify the adequacy of the bearing soils.

Continuous wall or strip footings should be at least 12 inches in width and isolated spread footings should be at least 30 inches in their least dimension. If required to construct foundations at different levels, the adjacent foundations should be designed and constructed so the least lateral distance between the foundations is equivalent to or more than the difference in their bearing levels. To achieve a change in the level of a strip footing, the footing should be gradually stepped at a grade no steeper than two units horizontal to one unit vertical.

If the recommendations outlined in this report are adhered to, total and differential settlements for the completed structure should be within 1 inch and 1/2 inch, respectively. We expect settlements of these magnitudes are within tolerable limits for the type of addition proposed. We recommend all strip footings be suitably reinforced to minimize the effects of differential settlements associated with local variations in subsoil conditions.

FLOOR SLAB RECOMMENDATIONS

Assuming the existing fill will remain and a ground improvement system is installed, the floor slab should be designed to be supported by the ground improvement system. At the north side of the building footprint, the native very stiff to hard silty clay and sandy clay and engineered fill placed directly over the native cohesive soils are suitable for direct support of floor slabs. Therefore, we recommend the ground improvement system design engineer evaluate the potential for supporting floor slabs on a combination of native silty clay and the ground improvement system. *The extent of native soil on the north side of the building footprint must be evaluated delineated by a representative of G2 prior to placement of any engineered fill.*

We recommend at least 4 inches of pea gravel be placed between the subgrade and the bottom of the floor slab for use as a capillary break to reduce moisture transmission through the concrete floors and to reduce the potential for concrete curling. If moisture sensitive floor coverings are planned, or if

greater protection against vapor transmission is desired, a vapor barrier, consisting of at least 10-mil plastic sheeting, may be placed over the capillary break layer beneath floor slabs. We recommend all concrete floor slabs be suitably reinforced and separated from the foundation system to allow for independent movement.

PAVEMENT RECOMMENDATIONS

We understand the project includes construction of new bituminous parking lots and access drives. We anticipate subgrade soils after completion of site grading operations will be variable across the extent of the property. The subgrade at the access drives extending to Livernois Road is anticipated to consist of native medium to stiff silty clay and loose silty sand fill with organic matter. The subgrade at the north parking lot and drop-off loop is anticipated to consist of very stiff sandy clay fill with organic matter, medium compact silty sand fill, native very stiff to hard silty clay, and engineered fill to raise site grades. The subgrade at the east parking lot and drop-off loop is anticipated to consist of hard silty clay fill with organic matter, buried topsoil, native hard sandy clay, and engineered fill to raise site grades.

The subgrade should be properly prepared as outlined in the SITE PREPARATION section of this report. For purposes of this design, we have assumed a soil resilient modulus of 6,000 pounds per square inch (psi) for the predominantly very stiff to hard fill and native cohesive soils and engineered fill to raise site grades.

We have assumed a load of 175,000 equivalent single-axle loads (ESALS) over a 20-year design life for the heavy-duty bituminous pavement section and 50,000 ESALS for the standard-duty section. If actual traffic loading information becomes available, G2 must be notified so that we may review our design assumptions. For purposes of design, we recommend a serviceability loss of 2.0, a standard deviation of 0.45 for flexible pavements, and a reliability factor of 0.90. Based on the results of our analysis, we recommend the following pavement design cross-sections:

Standard-Duty Flexible Pavement Section		
Material	**Thickness**	**Structural Coefficient**
Bituminous Wearing Course (MDOT 5EML)	2 inches	0.42
Bituminous Leveling Course (MDOT 4EML)	2 inches	0.42
MDOT 21AA Dense Graded Limestone Aggregate Base	8 inches	0.14

Heavy-Duty Flexible Pavement Section		
Material	**Thickness**	**Structural Coefficient**
Bituminous Wearing Course (MDOT 5EML)	2 inches	0.42
Bituminous Leveling Course (MDOT 4EML)	3 inches	0.42
MDOT 21AA Dense Graded Limestone Aggregate Base	10 inches	0.14

All pavement materials are specified within the 2020 Standard Specifications for Construction from the Michigan Department of Transportation. The bituminous pavement materials are described in Section 501 and can be assigned a structural coefficient number of 0.42. Imported MDOT 21AA dense graded aggregate base material can be assigned a structural coefficient number of 0.14. We recommend that bituminous concrete utilize grade PG 68-22 binder, with no more than 17 percent of the overall binder content from reclaimed asphalt pavement (RAP) within the top wearing course layer.

CONSTRUCTION CONSIDERATIONS

We anticipate the contractor will be able to excavate foundations within open, neat excavations within the existing cohesive soils at the north side of the proposed building. However, where granular

engineered fill is utilized to backfill excavations or raise grades, caving and sloughing may occur during foundation excavation operations. Therefore, the contractor should be prepared to over excavate and form foundations, as necessary. The sides of the foundations should be constructed straight and vertical to reduce the risk of frozen soil adhering to the concrete and raising the foundation.

In general, we do not anticipate significant groundwater will be encountered within foundation excavations. However, perched groundwater should be anticipated within the fill soils. Seepage from the soft to stiff sandy clay should also be anticipated. In general, we believe any surface run-off or seepage can typically be controlled with properly constructed sumps and pumps. Groundwater should not be allowed to accumulate on the existing cohesive soils to avoid disturbing the subgrade stability or bearing soils.

Where excavations extend deeper than 5 feet and sufficient space is available, we recommend maximum slopes of 2 horizontal units to 1 vertical unit (2H:1V) for sloped excavations within the existing fill and native soft to stiff sandy clay, and 1H:1V within the native very stiff to hard silty clay. The tops of the slopes should be barricaded to prevent vehicles and storage loads within 10 feet of the tops of the slopes. If the temporary construction excavations are to be maintained during the rainy season, berms are suggested along the tops of the slopes to prevent runoff water from entering the excavation and eroding the slope faces.

All excavations should be safely sheeted, shored, sloped, or braced in accordance with MI-OSHA requirements. If material is stored or equipment is operated near an excavation, lower angle slopes or stronger shoring must be used to resist the extra pressure due to the superimposed loads. Care should be exercised when excavating near existing roadways or utilities to avoid undermining.

GENERAL COMMENTS

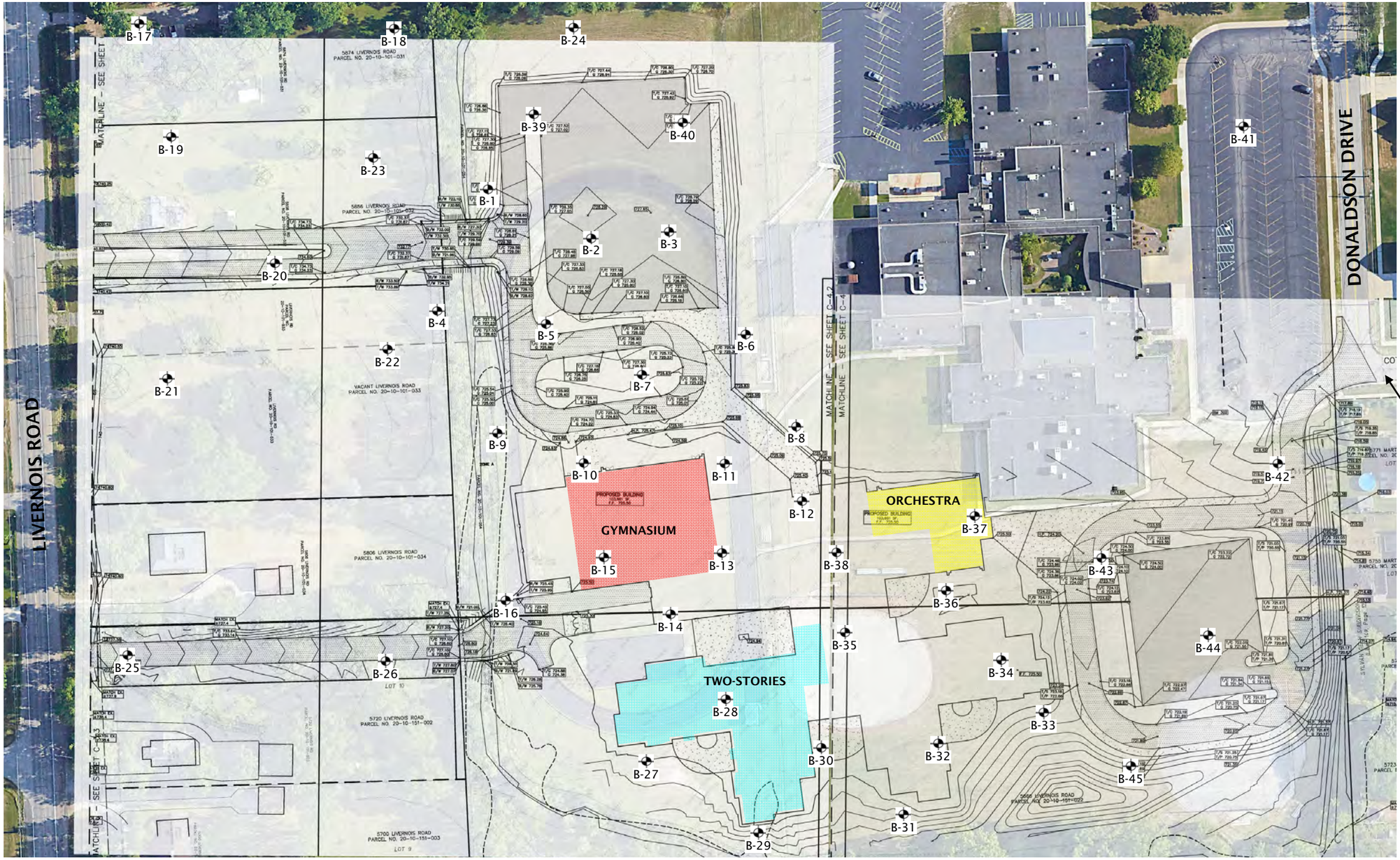
We have formulated the evaluations and recommendations presented in this report relative to site preparation and development on the basis of data provided to us relating to the project location, scope, and surface grade for the proposed site. Any significant change in this data should be brought to our attention for review and evaluation with respect to prevailing subsurface conditions. Furthermore, if changes occur in the design, location, or concept of the project, conclusions and recommendations contained in this report are not valid unless G2 Consulting Group, LLC reviews the changes. G2 Consulting Group, LLC will then confirm the recommendations presented herein or make changes in writing.

The scope of the present investigation was limited to evaluation of subsurface conditions for the proposed building and pavements and other related aspects of the development. No chemical, environmental, or hydrogeological testing or analyses were included in the scope of this investigation.

We base the analyses and recommendations submitted in this report upon the data from the soil borings performed at the approximate locations shown on the Soil Boring Location Plan, Plate No. 1. This report does not reflect variations that may occur between the actual boring locations and the proposed building location. The nature and extent of any such variations may not become clear until the time of construction. If significant variations then become evident, it may be necessary for us to re-evaluate our report recommendations.

We recommend G2 Consulting Group, LLC observe all geotechnical related work, including foundation construction, subgrade preparation, and engineered fill placement. G2 Consulting Group, LLC will perform the appropriate testing to confirm the geotechnical conditions given in the report are found during construction.

APPENDIX



Legend

Soil Borings B-1 through B-16 Drilled by 2G Drilling on August 3, 4, 21, and 22, 2023
Soil Borings B-17 through B-27 Drilled by Strata Drilling on November 30, 2023
Soil Borings B-27 through 45 Drilled by Strata Drilling on February 5 and 6, 2024

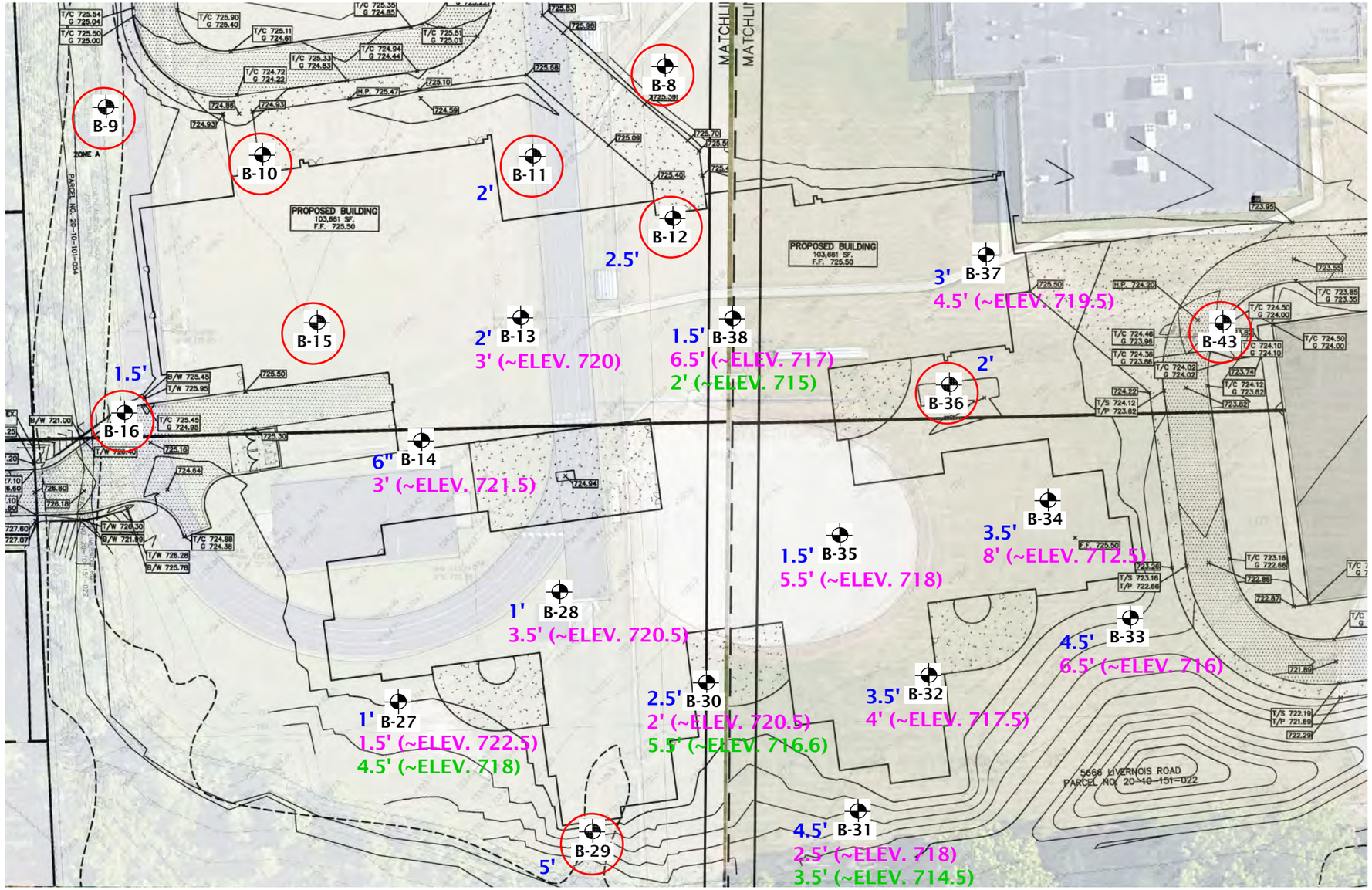
**B-4 not performed due to revised building alignment*

Soil Boring Location Plan

Smith Middle School - Revised Alignment
5835 Donaldson Road
Troy, Michigan 48085

2G CONSULTING GROUP

Project No. 230618	
Drawn by: ALS	
Date: 2/23/24	Plate No. 1
Scale: NTS	



Legend

○	NATIVE STIFF TO HARD SILTY CLAY AND SANDY CLAY @ SUBGRADE ELEVATION
1'	APPROXIMATE THICKNESS OF ENGINEERED FILL REQUIRED TO ACHIEVE SUBGRADE BELOW FINISHED FLOOR
1.5' (~ELEV. 722.5)	APPROXIMATE THICKNESS OF FILL AND BURIED TOPSOIL LAYER (ELEVATION @ BOTTOM)
4.5' (~ELEV. 718)	APPROXIMATE THICKNESS OF NATIVE SOFT TO STIFF SANDY CLAY LAYER (ELEVATION @ BOTTOM)

SITE PREPARATION PLAN

Smith Middle School - Revised Alignment
5835 Donaldson Road
Troy, Michigan 48085

2G CONSULTING GROUP

Project No. 230618	
Drawn by: ALS	
Date: 2/23/24	Plate No. 2
Scale: NTS	

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-1**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5							
		Very Stiff to Hard Brown Silty Clay with trace sand and gravel		S-1	5 4 3	7	11.9		9000*
719.0		4.0	5	S-2	4 3 4	7	12.7		6500*
				S-3	2 2 3	5	13.7		5000*
714.0			10	S-4	2 2 3	5	14.3		7000*
		Very Stiff to Hard Gray Silty Clay with trace sand and gravel							
709.0			15	S-5	3 3 5	8	15.2		9000*
704.0			20	S-6	3 3 5	8	13.9		8500*
699.0		25.0	25	S-7	3 7 9	16	14.6		8000*
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 3, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 1

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-2

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (8 inches) 0.7							
				S-1	6 8 8	16	11.0		9000*
720.5		Hard Brown Silty Clay with trace sand and gravel	5	S-2	6 12 18	30	11.4		9000*
				S-3	5 8 9	17	12.0		9000*
		9.0		S-4	4 5 6	11	11.6		9000*
715.5			10						
				S-5	4 6 6	12	13.7		8500*
710.5			15						
		Very Stiff to Hard Gray Silty Clay with trace sand and gravel		S-6	3 3 5	8	13.9		5000*
705.5			20						
				S-7	4 5 5	10	13.1		6000*
700.5		25.0	25						
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 3, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 2

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-3

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (4-1/2 inches) 0.4							
				S-1	3 4 5	9	14.5		9000*
719.5		Hard Mottled Brown and Gray Silty Clay with trace sand and gravel	5	S-2	4 9 13	22	14.8		9000*
		6.0		S-3	8 10 14	24	12.0		9000*
714.5		Hard Mottled Brown Silty Clay with trace sand and gravel	10	S-4	7 11 13	24	13.4		9000*
		13.0		S-5	3 4 7	11	13.2		6500*
709.5			15						
704.5		Very Stiff Gray Silty Clay with trace sand and gravel	20	S-6	4 5 8	13	13.4		6500*
699.5		25.0	25	S-7	5 6 8	14	12.4		6500*
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 21, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 3

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-5

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Brown Silty Clay (7 inches) 0.6							
				S-1	5 8 8	16	11.2		9000*
720.0		Hard Brown Silty Clay with trace sand	5	S-2	6 8 12	20	12.3		9000*
		7.0		S-3	6 7 7	14	10.2		9000*
715.0			10	S-4	5 5 6	11	12.0		9000*
710.0			15	S-5	4 5 7	12	13.5		7000*
705.0		Very Stiff to Hard Gray Silty Clay with trace sand and gravel	20	S-6	4 5 7	12	12.2		7000*
700.0		25.0	25	S-7	4 5 8	13	12.8		6500*
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 3, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 4

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-6

CONSULTING GROUP

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (7 inches) 0.6							
		Fill: Very Stiff Dark Brown Sandy Clay with trace silt, gravel, and organic matter (Organic Matter Content = 2.6%) 2.0		S-1	3 4 7	11	16.2		7000*
719.5		Stiff Brown Sandy Clay with trace silt and gravel	5	S-2	2 3 2	5	16.8	120	2500*
		6.0		S-3	6 8 10	18	12.5		9000*
714.5		Very Stiff to Hard Brown Sandy Clay with trace silt and gravel	10	S-4	10 11 12	23	11.4		6000*
		13.0							
709.5			15	S-5	4 6 10	16	13.6		5000*
704.5		Stiff to Very Stiff Gray Silty Clay with trace sand and gravel	20	S-6	3 4 6	10	13.8		3500*
699.5		25.0	25	S-7	5 7 9	16	13.6		5500*
		End of Boring @ 25 ft							

SUBSURFACE PROFILE

SOIL SAMPLE DATA

Total Depth: 25 ft
Drilling Date: August 22, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
6 feet during drilling; 21 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 5

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-7

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (5 inches) 0.4							
		Fill: Medium Compact Brown Silty Sand with trace clay and gravel		S-1	5 8 12	20			
		3.0							
720.5			5	S-2	4 6 10	16	17.2	113	8250
		Hard Brown Silty Clay with trace sand and gravel		S-3	5 6 9	15	13.7		9000*
715.5			10	S-4	6 8 11	19	12.8		9000*
		13.0							
710.5			15	S-5	3 4 6	10	12.7		8000*
		Very Stiff Gray Silty Clay with trace sand and gravel							
705.5			20	S-6	4 6 8	14	13.6		7500*
700.5		25.0	25	S-7	5 5	---	13.8		5500*
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 21, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 6

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-8**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (11 inches) 0.9							
		Fill: Stiff Black and Dark Brown Sandy Clay with trace silt, gravel, and organic matter (Organic Matter Content = 2.3%)		S-1	3 3 5	8	19.3		3000*
		4.0							
718.0			5	S-2	3 3 6	9	17.0	115	5240
				S-3	7 11 14	25	12.7		9000*
713.0		Very Stiff to Hard Mottled Brown Silty Clay with trace sand and gravel	10	S-4	7 13 15	28	12.4		9000*
		14.5		S-5	6 8 13	21	12.5		8500*
708.0			15						
703.0		Very Stiff to Hard Gray Silty Clay with trace sand and gravel	20	S-6	6 7 9	16	13.7		7500*
698.0		25.0	25	S-7	5 6 9	15	16.9		9000*
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 22, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 7

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-9**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (7 inches) 0.6							
				S-1	4 8 9	17	10.4		9000*
719.5		Hard Brown and Gray Silty Clay with trace sand and gravel	5	S-2	8 9 10	19	10.9		9000*
		6.0		S-3	6 6 8	14	11.9		9000*
714.5			10	S-4	5 6 8	14	12.6		9000*
709.5			15	S-5	6 8 10	18	12.1		8000*
704.5		Very Stiff to Hard Gray Silty Clay with trace sand and gravel	20	S-6	5 6 8	14	12.5		7000*
699.5		25.0	25	S-7	6 9 11	20	13.9		6000*
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 22, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 8

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-10**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (7 inches) 0.6		S-1	5 9 11	20	8.3		9000*
720.5		Hard Brown Silty Clay with trace with trace sand and gravel	5	S-2	4 6 11	17	12.6		9000*
				S-3	5 9 11	20	12.7		9000*
		9.0		S-4	5 8 10	18	12.7		9000*
715.5		Hard Brown and Gray Silty Clay with trace sand and gravel	10						
		12.0		S-5	12 15 20	35	12.8		9000*
710.5			15						
		Very Stiff to Hard Gray Silty Clay with trace sand and gravel		S-6	8 10 10	20	10.3		9000*
705.5			20						
				S-7	8 8 11	19	12.5		7000*
700.5		25.0	25						
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 4, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 9

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-11**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (6 inches) 0.5		S-1	4 5 4	9	15.4		8500*
719.0			5	S-2	4 3 4	7	12.0		7000*
		Very Stiff to Hard Brown Sandy Clay with trace silt and gravel		S-3	4 7 9	16	10.8		9000*
714.0			10	S-4	10 13 13	26	9.5		9000*
		12.0							
		Very Stiff Brown and Gray Silty Clay with trace sand and gravel		S-5	9 11 13	24	13.5		7500*
709.0			15						
		16.0							
				S-6	4 7 9	16	13.8		7000*
704.0			20						
		Very Stiff Gray Silty Clay with trace sand and gravel, occasional silt seams							
				S-7	4 6 8	14	12.7		6000*
699.0		25.0	25						
		End of Boring @ 25 ft							

Total Depth: 25 ft
Drilling Date: August 21, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 10

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-12

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (7 inches) 0.6							
		Hard Brown Sandy Clay with trace silt and gravel		S-1	8 12 7	19	10.0		9000*
		3.0							
718.0		Very Stiff Mottled Brown and Gray Silty Clay with trace sand and gravel	5	S-2	3 3 3	6	20.0	111	4940
		6.0							
				S-3	3 3 4	7	13.9		6000*
713.0		Very Stiff to Hard Brown Silty Clay with trace sand and gravel	10	S-4	6 9 12	21	12.2		9000*
		13.0							
708.0			15	S-5	7 10 12	22	12.2		9000*
703.0		Very Stiff to Hard Gray Silty Clay with trace sand and gravel 20.0	20	S-6	4 6 7	13	13.8		4500*
		End of Boring @ 20 ft							
698.0			25						

Total Depth: 20 ft
Drilling Date: August 22, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 11

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-13

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (5 inches) 0.4							
		Fill: Very Stiff Brown Sandy Clay with trace silt, gravel, and organic matter (Organic Matter Content = 1.1%)		S-1	4 3 4	7	14.3		5000*
		3.0							
718.0			5	S-2	3 3 4	7	17.7		8000*
				S-3	4 6 8	14	14.2		9000*
713.0		Very Stiff to Hard Mottled Brown Silty Clay with trace sand and gravel	10	S-4	8 12 17	29	13.6		9000*
708.0			15	S-5	3 4 7	11	16.9		7500*
		16.0							
		Hard Gray Silty Clay with trace sand and gravel							
703.0		20.0	20	S-6	3 4 7	11	13.1		8000*
		End of Boring @ 20 ft							
698.0			25						

Total Depth: 20 ft
Drilling Date: August 21, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 12

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-14**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (6 inches) 0.5							
		Fill: Very Stiff Dark Brown and Brown Sandy Clay with trace silt, gravel, and organic matter (Organic Matter Content = 1.6%)		S-1	3 3 4	7	15.0		6500*
		3.0							
719.5			5	S-2	1 2 3	5	17.0	116	8550
				S-3	9 12 13	25	13.1		9000*
		Very Stiff to Hard Brown Silty Clay with trace sand and gravel							
714.5			10	S-4	8 12 17	29	12.2		9000*
		13.0							
709.5			15	S-5	3 4 7	11	15.5		7000*
		Very Stiff Gray Silty Clay with trace sand and gravel							
704.5		20.0	20	S-6	2 4 8	12	12.7		8000*
		End of Boring @ 20 ft							
699.5			25						

Total Depth: 20 ft
Drilling Date: August 21, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 13

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-15

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Sandy Clay (6 inches) 0.5							
		Hard Brown Sandy Clay with trace silt and fine roots		S-1	4 7 9	16	14.6		9000*
		3.0							
720.0		Hard Brown and Gray Silty Clay with trace sand and gravel	5	S-2	6 11 10	21	18.9		9000*
		6.0		S-3	10 14 17	31	10.6		9000*
715.0		Hard Brown Silty Clay with trace sand and gravel	10	S-4	8 14 19	33	12.5		9000*
		12.0							
710.0			15	S-5	4 7 9	16	12.5		9000*
		Hard Gray Silty Clay with trace sand and gravel							
705.0		20.0	20	S-6	4 6 9	15	12.3		9000*
		End of Boring @ 20 ft							
700.0			25						

Total Depth: 20 ft
Drilling Date: August 4, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 14

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-16

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (6 inches) 0.5		S-1	3 4 5	9	12.9		9000*
718.5			5	S-2	3 9 13	22	12.1		9000*
		Hard Brown Silty Clay with trace sand and gravel		S-3	3 7 11	18	12.7		9000*
713.5			10	S-4	3 7 10	17	12.9		9000*
		12.0		S-5	4 4 7	11	13.1		7000*
708.5		Very Stiff Gray Silty Clay with trace sand and gravel	15						
		20.0		S-6	4 5 8	13	13.1		7500*
703.5		End of Boring @ 20 ft	20						
698.5			25						

Total Depth: 20 ft
Drilling Date: August 21, 2023
Inspector:
Contractor: 2G Drilling
Driller: H. Pace

Drilling Method:
2-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 15

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-17**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 742.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (16 inches) 1.3							
				S-1	2 2 5	7	17.4		5000*
		Very Stiff to Hard Brown Sandy Clay with trace silt and gravel							
737.0		5.0	5	S-2	8 14 16	30	10.1		9000*
		End of Boring @ 5 ft							
732.0			10						
727.0			15						
722.0			20						
717.0			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 16

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-18**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 736.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (8 inches) 0.7							
		Very Stiff Brown Silty Clay with little sand and trace gravel 2.5		S-1	3 7 7	14	15.1		8000*
731.0		Very Stiff Hard Brown Sandy Clay with trace silt and gravel 5.0	5	S-2	5 6 8	14	11.0		8000*
		End of Boring @ 5 ft							
726.0			10						
721.0			15						
716.0			20						
711.0			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 17

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-19

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 738.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (9 inches) 0.8							
		Medium Brown Sandy Clay with trace silt and gravel 2.5		S-1	0 2 2	4	16.8		1000*
733.5		Very Stiff Brown and Gray Silty Clay with trace sand and gravel 5.0	5	S-2	2 4 7	11	15.5		6000*
		End of Boring @ 5 ft							
728.5			10						
723.5			15						
718.5			20						
713.5			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
2-1/2 feet during drilling; 3-1/2 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 18

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-20

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 735.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Clayey Sand (12 inches) 1.0							
		Medium to Stiff Brown and Gray Silty Clay with trace sand and grave		S-1	0 1 3	4	18.4		2000*
730.5		5.0	5	S-2	2 2 2	4	20.5		1000*
		End of Boring @ 5 ft							
725.5			10						
720.5			15						
715.5			20						
710.5			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Standing water at ground surface during drilling; 3 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 19

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-21

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 739.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Clayey Sand (10 inches) 0.8							
		Fill: Soft Dark Brown Silty Clay with trace sand, gravel, and organic matter, occasional wet sand seams (Organic Matter Content = 2.3%) 3.0		S-1	0 1 1	2	17.4		500*
734.5		Hard Brown and Gray Silty Clay with trace sand and gravel 5.0	5	S-2	3 6 9	15	11.8		8000*
		End of Boring @ 5 ft							
729.5			10						
724.5			15						
719.5			20						
714.5			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
3 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 20

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-22

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 734.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (11 inches) 0.9							
		Fill: Very Loose Brown Clayey Sand with trace silt, gravel, and organic matter (Organic Matter Content = 1.5%)		S-1	0 2 2	4			
		3.5							
729.0		Hard Brown and Gray Silty Clay with trace sand and gravel 5.0	5	S-2	2 4 6	10	13.8		8000*
		End of Boring @ 5 ft							
724.0			10						
719.0			15						
714.0			20						
709.0			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
2-1/2 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 21

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-23

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 736.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (8 inches) 0.7							
		Fill: Medium Sandy Clay with trace silt and gravel, occasional sand seams 2.0		S-1	2 2 3	5	19.7		4000*
731.5		Very Stiff to Hard Brown Silty Clay with trace sand and gravel 5.0	5	S-2	5 6 8	14	12.3		9000*
		End of Boring @ 5 ft							
726.5			10						
721.5			15						
716.5			20						
711.5			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 22

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-24

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (8 inches) 0.7							
		Fill: Hard Dark Brown Silty Clay with trace sand and gravel		S-1	5 7 7	14	11.4		8000*
		3.0							
720.0		Hard Brown Silty Clay with trace sand and gravel 5.0	5	S-2	6 7 8	15	13.0		9000*
		End of Boring @ 5 ft							
715.0			10						
710.0			15						
705.0			20						
700.0			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 23

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-25

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 737.0 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Fill: Loose Reddish Brown Silty Sand with trace clay, gravel, and organic matter (Organic Matter Content = 3.3%)		S-1	2 2 3	5	30.2		
		4.0							
732.0		Stiff Brown and Gray Silty Clay with trace sand and gravel 5.0	5	S-2	2 2 3	5	20.2		2500*
		End of Boring @ 5 ft							
727.0			10						
722.0			15						
717.0			20						
712.0			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 24

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-26

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 729.5 ft ±	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Sand (14 inches) 1.2							
		Stiff Brown Silty Clay with trace sand and gravel 3.0		S-1	2 3 4	7	17.2		3000*
724.5		Hard Brown and Gray Silty Clay with trace sand and gravel 5.0	5	S-2	3 4 8	12	13.0		6000*
		End of Boring @ 5 ft							
719.5			10						
714.5			15						
709.5			20						
704.5			25						

Total Depth: 5 ft
Drilling Date: November 30, 2023
Inspector:
Contractor: Strata Dilling, Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 25

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-27

G2 CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Fill: Crushed Stone							
		1.5		S-1	5 4 6	10	14.6		3000*
720.5		Medium to Stiff Brown Sandy Clay with trace silt and gravel, occasional wet sand seams	5	S-2	2 3 4	7	17.6		1500*
		6.0		S-3	6 10 14	24	14.9		9000*
		Hard Brown and Gray Silty Clay with trace sand and gravel							
715.5		8.0	10	S-4	6 13 16	29	11.3		9000*
		Hard Brown Silty Clay with trace sand and gravel							
		12.0		S-5	4 6 9	15	13.7		6000*
710.5		Very Stiff Gray Silty Clay with trace sand and gravel	15						
705.5		20.0	20	S-6	4 7 9	16	13.2		6000*
		End of Boring @ 20 ft							
700.5			25						

Total Depth: 20 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
3-1/2 feet during drilling operations; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 26

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-28

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Sandy Clay (5 inches) 0.4							
		Fill: Soft Brown Sandy Clay with trace silt, gravel, roots, organic matter, occasional wet sand seams (Organic Matter Content = 2.3%)		S-1	0 0 2	2	26.3		500*
		3.5							
719.0		Very Stiff Brown and Gray Silty Clay with trace sand and gravel	5	S-2	3 6 9	15	15.5		4500*
		6.0		S-3	7 10 13	23	14.3		9000*
714.0		Very Stiff to Hard Brown Silty Clay with trace sand and gravel	10	S-4	6 12 18	30	12.9		9000*
		14.0		S-5	4 7 10	17	18.4		5000*
709.0		Very Stiff Gray Silty Clay with trace gravel and sand	15						
704.0		20.0	20	S-6	5 7 9	16	13.6		7000*
		End of Boring @ 20 ft							
699.0			25						

Total Depth: 20 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
3 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 27

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-29

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 720.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (7 inches) 0.6							
				S-1	3 3 4	7	16.1		4500*
715.0			5	S-2	4 8 12	20	11.1		6000*
		Very Stiff to Hard Brown Silty Clay with trace sand and gravel		S-3	6 10 12	22	11.2		7000*
710.0			10	S-4	7 14 18	32	12.0		9000*
		11.0							
705.0			15	S-5	3 6 8	14	13.6		6000*
		Very Stiff Gray Silty Clay with trace sand and gravel							
700.0		20.0	20	S-6	4 6 9	15	13.8		5000*
		End of Boring @ 20 ft							
695.0			25						

Total Depth: 20 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 28

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-30**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 722.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (Organic Matter Content = 1.3%)							
		2.0		S-1	2 2 4	6	14.3		1500*
717.5		Medium Brown Sandy Clay with trace silt and gravel	5	S-2	0 1 4	5	13.6		
		5.5		S-3	6 7 9	16	11.4		3000*
		8.0							
712.5		Hard Brown Silty Clay with trace sand and gravel	10	S-4	7 13 18	31	13.0		9000*
		12.0		S-5	3 6 8	14	14.0		4000*
707.5		Very Stiff Gray Silty Clay with trace sand and gravel	15						
702.5		20.0	20	S-6	4 7 9	16	12.6		5000*
		End of Boring @ 20 ft							
697.5			25						

Total Depth: 20 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
3 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 29

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-31

CONSULTING GROUP

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 720.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (10 inches) 0.8							
		Fill: Medium to Stiff Dark Brown Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 2.7%) 2.5		S-1	2 3 4	7	25.0		2000*
715.5		Medium to Stiff Brown Sandy Clay with trace silt and gravel, occasional wet silt seams	5	S-2	2 3 4	7	11.9		2000*
		6.0		S-3	7 11 14	25	10.1		7000*
		Very Stiff Brown Sandy Clay with trace sand and gravel 8.0							
710.5		Hard Brown Silty Clay with trace sand and gravel	10	S-4	6 12 19	31	10.8		9000*
		12.0							
705.5			15	S-5	6 7 10	17	13.5		3000*
		Stiff to Very Stiff Gray Silty Clay with trace sand and gravel							
700.5		20.0	20	S-6	4 6 9	15	14.0		7000*
		End of Boring @ 20 ft							
695.5			25						

Total Depth: 20 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
3 feet during drilling operations; 17 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 30

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-32

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 721.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (10 inches) 0.8							
		Fill: Stiff Dark Brown Silty Clay with trace sand, gravel, and organic matter, occasional wet silt seams (Organic Matter Content = 2.7%)		S-1	2 3 3	6	18.6		3000*
		4.0							
716.5		Stiff Brown Silty Clay with trace sand and gravel	5	S-2	0 2 4	6	21.5		2000*
		6.0		S-3	4 8 11	19	12.6		9000*
711.5		Hard Brown Silty Clay with trace sand and gravel	10	S-4	6 11 14	25	13.9		9000*
		12.0							
706.5			15	S-5	4 6 9	15	12.4		9000*
		Hard Gray Silty Clay with trace sand and gravel							
701.5		20.0	20	S-6	3 6 8	14	12.3		9000*
		End of Boring @ 20 ft							
696.5			25						

Total Depth: 20 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
3-1/2 feet during drilling operations; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 31

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-33

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 720.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (7 inches) 0.6							
		Fill: Soft Dark Gray Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 2.7%) 2.5		S-1	0 0 1	1	24.3		500*
715.5		Fill: Hard Brown Silty Clay with trace sand and gravel	5	S-2	3 4 5	9	14.5		9000*
		5.5							
		Buried Topsoil: Medium Dark Gray Silty Clay with sand, gravel, and organic matter 6.5		S-3	1 3 4	7	22.7		2000*
710.5		Very Stiff Brown and Gray Silty Clay with trace sand and gravel	10	S-4	3 4 6	10	18.5		7000*
		12.0							
705.5		Hard Brown Silty Clay with trace sand and gravel	15	S-5	9 16 22	38	13.1		9000*
		18.0							
700.5		Hard Gray Silty Clay with trace sand and gravel 20.0	20	S-6	6 10 13	23	13.7		9000*
		End of Boring @ 20 ft							
695.5			25						

Total Depth: 20 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
6 feet during drilling operations; 12 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 32

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-34

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 721.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (13 inches) 1.1							
		Fill: Stiff to Very Stiff Brown Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = <1%)		S-1	3 4 4	8	7.8		8000*
716.5			5	S-2	3 3 4	7	14.1		3000*
		5.5							
		Fill: Medium Dark Gray Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 5.7%)		S-3	1 2 3	5	31.9		1000*
		8.0							
711.5			10	S-4	2 4 6	10	20.5		8000*
		Very Stiff to Hard Brown and Gray Silty Clay with trace sand and gravel							
706.5			15	S-5	7 13 19	32	14.4		9000*
701.5		20.0	20	S-6	4 7 9	16	13.7		5500*
		End of Boring @ 20 ft							
696.5			25						

Total Depth: 20 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
8 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 33

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-35

G2 CONSULTING GROUP

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Fill: Crushed Stone (3 inches) 0.3							
		Fill: Very Stiff Brown Silty Clay with trace sand and gravel 2.5		S-1	5 7 7	14	11.2		8000*
718.5		Fill: Very Stiff Dark Brown Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 3.5%) 5.5	5	S-2	3 3 3	6	25.1		5500*
				S-3	4 5 7	12	15.4		7000*
713.5			10	S-4	4 7 8	15	13.7		9000*
		Very Stiff to Hard Mottled Brown and Gray Silty Clay with trace sand and gravel, occasional wet sand seams							
708.5			15	S-5	7 12 16	28	12.0		9000*
		18.0							
703.5		Very Stiff Gray Silty Clay with trace sand and gravel 20.0	20	S-6	6 9 11	20	13.4		5500*
		End of Boring @ 20 ft							
698.5			25						

Total Depth: 20 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
8 feet during drilling operations; 2 feet after 3 hours

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 34

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-36

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (8 inches) 0.7							
		Stiff to Very Stiff Brown Silty Clay with trace sand and gravel		S-1	3 3 3	6	14.2	127	2920
718.0		5.0	5	S-2	4 5 5	10	15.3		5000*
				S-3	6 10 12	22	12.6		9000*
713.0			10	S-4	7 13 16	29	13.1		9000*
		Very Stiff to Hard Brown Silty Clay with trace sand and gravel							
708.0			15	S-5	6 12 16	28	13.4		9000*
		18.0							
		Very Stiff Light Gray Silty Clay with trace sand and gravel, occasional wet sand seams							
703.0		20.0	20	S-6	4 7 10	17	14.5		5000*
		End of Boring @ 20 ft							
698.0			25						

Total Depth: 20 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
18 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 35

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-37

CONSULTING GROUP

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (9 inches) 0.8							
		Fill: Very Stiff Brown Sandy Clay with trace silt and gravel, dark brown topsoil layers (Organic Matter Content = 4.0%)		S-1	5 10 12	22	22.0		7000*
719.0		4.5	5	S-2	10 6 7	13	18.0		8000*
		Very Stiff to Hard Brown Silty Clay with little sand and trace gravel		S-3	5 11 13	24	13.0		9000*
714.0			10	S-4	6 13 16	29	13.1		9000*
		12.0							
709.0		Hard Brown Silty Clay with trace sand and gravel	15	S-5	8 15 19	34	12.7		9000*
		18.0							
704.0		Hard Gray Silty Clay with trace sand and gravel 20.0	20	S-6	37 13 17	30	12.5		9000*
		End of Boring @ 20 ft							
699.0			25						

Total Depth: 20 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 36

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-38

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 723.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Sandy Clay (14 inches) 1.2							
		Fill: Very Stiff Brown Sandy Clay with trace gravel, silt and organic matter		S-1	4 6 6	12	11.2		8000*
718.5			5	S-2	3 5 5	10	12.7		6000*
		5.5							
		Buried Topsoil: Dark Brown Silty Clay with organic matter 6.5		S-3	0 2 4	6	21.6		3000*
		Stiff Brown and Gray Silty Clay with trace sand and gravel 8.5							
713.5			10	S-4	4 6 11	17	14.1		9000*
		Hard Brown Silty Clay with trace sand and gravel		S-5	9 16 20	36	15.0		9000*
708.5			15						
		18.0							
		Very Stiff Gray Silty Clay with trace sand and gravel 20.0		S-6	5 9 12	21	12.4		5000*
703.5			20						
		End of Boring @ 20 ft							
698.5			25						

Total Depth: 20 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
5-1/2 feet during drilling operations; 17 feet upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 37

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-39

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 725.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (8 inches) 0.7							
		Hard Brown Silty Clay with little sand and trace gravel		S-1	4 7 7	14	11.9		9000*
720.0		5.0	5	S-2	4 8 12	20	11.2		9000*
		End of Boring @ 5 ft							
715.0			10						
710.0			15						
705.0			20						
700.0			25						

Total Depth: 5 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 38

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-40**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 724.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (6 inches) 0.5							
		Hard Brown Silty Clay with little sand and trace gravel, occasional wet silt seams		S-1	5 8 10	18	12.4		9000*
719.5		5.0	5	S-2	7 12 16	28	12.5		9000*
		End of Boring @ 5 ft							
714.5			10						
709.5			15						
704.5			20						
699.5			25						

Total Depth: 5 ft
Drilling Date: February 5, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
2 feet during drilling operations; dry upon completion

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 39

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-41**

CONSULTING GROUP

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 721.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Bituminous Concrete (3 inches) 0.3							
		Milled Asphalt			10				
		2.0			9				
		Fill: Gravelly Sand with trace silt and clay		S-1	6	15	18.1		3000*
		3.5							
		Buried Topsoil: Dark Brown Silty Clay with trace sand 4.0			3				
716.0		Very Stiff Brown Silty Clay with trace sand and gravel 5.0	5	S-2	5	11			
					6				
		End of Boring @ 5 ft							
711.0			10						
706.0			15						
701.0			20						
696.0			25						

Total Depth: 5 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings and cold patch

Figure No. 40

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. B-42

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 721.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (3 inches) 0.3							
		Fill: Very Stiff Brown Silty Clay with trace sand, gravel, and organic matter (Organic Matter Content = 1.9%)		S-1	3 6 7	13	14.6		8000*
716.0		Buried Topsoil: Dark Brown Silty Clay with trace sand 4.5 5.0	5	S-2	1 2 3	5	17.8		2000*
		End of Boring @ 5 ft							
711.0			10						
706.0			15						
701.0			20						
696.0			25						

Total Depth: 5 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 41

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-43**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 722.0 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (8 inches) 0.7							
		Hard Brown Sandy Clay with trace silt and gravel		S-1	3 6 8	14	10.5		9000*
		4.0							
717.0		Very Stiff Brown Silty Clay with trace sand and gravel 5.0	5	S-2	3 5 8	13	18.1		5000*
		End of Boring @ 5 ft							
712.0			10						
707.0			15						
702.0			20						
697.0			25						

Total Depth: 5 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 42

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-44**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 720.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (1 inch) 0.1							
		Fill: Very Stiff Brown Silty Clay with trace sand and gravel, occasional wet sand seams below 4 feet		S-1	7 9 6	15	13.0		7000*
715.5		5.0	5	S-2	5 6 5	11	17.5		1000*
		End of Boring @ 5 ft							
710.5			10						
705.5			15						
700.5			20						
695.5			25						

Total Depth: 5 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

Water Level Observation:
4 feet during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 43

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No. 230618

Latitude: N/A Longitude: N/A

Soil Boring No. **B-45**

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
ELEV. (ft)	PRO-FILE	GROUND SURFACE ELEVATION: 718.5 ft	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Silty Clay (8 inches) 0.7							
		Fill: Stiff Brown Silty Clay with trace sand and gravel		S-1	4 4 5	9	12.7		3000*
713.5		4.8	5	S-2	3 3 2	5	17.7		1000*
		Topsoil: Dark Brown Silty Clay with trace sand 5.0							
		End of Boring @ 5 ft							
708.5			10						
703.5			15						
698.5			20						
693.5			25						

Total Depth: 5 ft
Drilling Date: February 6, 2024
Inspector:
Contractor: Strata Drilling Inc.
Driller: B. Sienkiewicz

Drilling Method:
3-1/4 inch inside diameter hollow stem auger

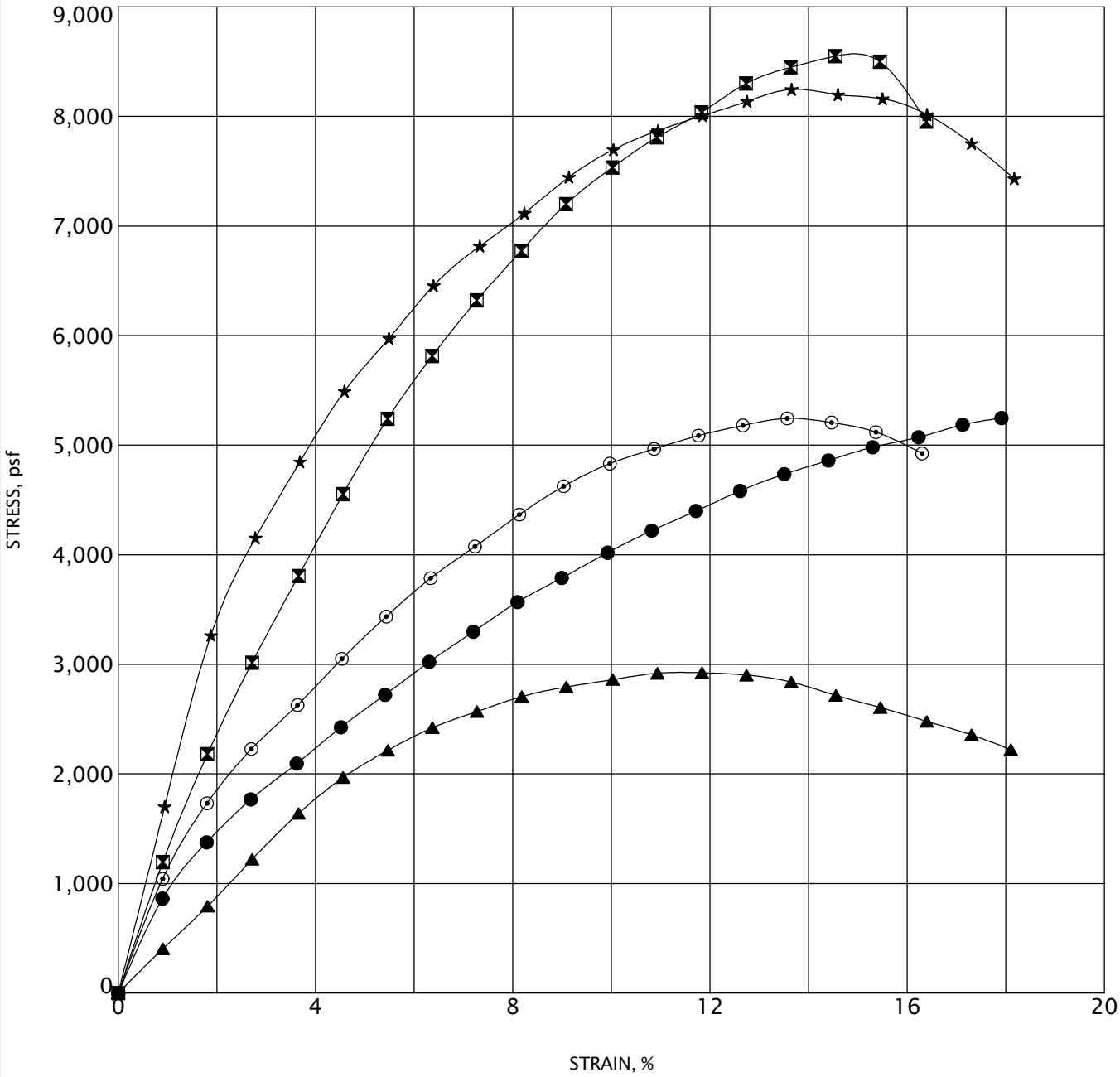
Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Auger cuttings

Figure No. 44

SOIL / PAVEMENT BORING 230618.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24



Specimen			Classification	MC%	γ_d	UC
●	B-12	S-2	Brown and Gray Silty Clay	20	111	4940
⊠	B-14	S-2	Brown Silty Clay	17	116	8550
▲	B-36	S-1	Brown Silty Clay	14	127	2920
★	B-7	S-2	Brown Silty Clay	17	113	8250
⊙	B-8	S-2	Brown Silty Clay	17	115	5240

G2 CONSULTING GROUP

UNCONFINED COMPRESSIVE STRENGTH TEST

Project Name: Smith Middle School

Project Location: 5835 Donaldson Road
Troy, Michigan 48085

G2 Project No.: 230618

Figure No. 45

US_UNCONFINED 230618.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 3/13/24

GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM 653.

PARTICLE SIZE

Boulders		- greater than 12 inches
Cobbles		- 3 inches to 12 inches
Gravel	- Coarse-	3/4 inches to 3 inches
	- Fine	- No. 4 to 3/4 inches
Sand	- Coarse-	No. 10 to No. 4
	- Medium	- No. 40 to No. 10
	- Fine	- No. 200 to No. 40
Silt		- 0.005mm to 0.074mm
Clay		- Less than 0.005mm

CLASSIFICATION

The major soil constituent is the principal noun, i.e. clay, silt, sand, gravel. The second major soil constituent and other minor constituents are reported as follows:

Second Major Constituent (percent by weight)	Minor Constituent (percent by weight)
Trace - 1 to 12%	Trace - 1 to 12%
Adjective - 12 to 35%	Little - 12 to 23%
And - over 35%	Some - 23 to 33%

COHESIVE SOILS

If clay content is sufficient so that clay dominates soil properties, clay becomes the principal noun with the other major soil constituent as modifier, i.e. sandy clay. Other minor soil constituents may be included in accordance with the classification breakdown for cohesionless soils, i.e. silty clay, trace sand, little gravel.

Consistency	Unconfined Compressive Strength (psf)	Approximate Range of (N)
Very Soft	Below 500	0 - 2
Soft	500 - 1,000	3 - 4
Medium	1,000 - 2,000	5 - 8
Stiff	2,000 - 4,000	9 - 15
Very Stiff	4,000 - 8,000	16 - 30
Hard	8,000 - 16,000	31 - 50
Very Hard	Over 16,000	Over 50

Consistency of cohesive soils is based upon an evaluation of the observed resistance to deformation under load and not upon the Standard Penetration Resistance (N).

COHESIONLESS SOILS

Density Classification	Relative Density %	Approximate Range of (N)
Very Loose	0 - 15	0 - 4
Loose	16 - 35	5 - 10
Medium Compact	36 - 65	11 - 30
Compact	66 - 85	31 - 50
Very Compact	86 - 100	Over 50

Relative Density of cohesionless soils is based upon the evaluation of the Standard Penetration Resistance (N), modified as required for depth effects, sampling effects, etc.

SAMPLE DESIGNATIONS

AS - Auger Sample – Cuttings directly from auger flight
BS - Bottle or Bag Samples
S - Split Spoon Sample - ASTM D 1586
LS - Liner Sample with liner insert 3 inches in length
ST - Shelby Tube sample - 3 inch diameter unless otherwise noted
PS - Piston Sample - 3 inch diameter unless otherwise noted
RC - Rock Core - NX core unless otherwise noted

STANDARD PENETRATION TEST (ASTM D 1586) - A 2.0 inch outside-diameter, 1-3/8 inch inside-diameter split barrel sampler is driven into undisturbed soil by means of a 140-pound weight falling freely through a vertical distance of 30 inches. The sampler is normally driven three successive 6-inch increments. The total number of blows required for the final 12 inches of penetration is the Standard Penetration Resistance (N).