PROJECT MANUAL

PROJECT:

WYLIE ELEMENTARY SCHOOL – CLASSROOM ADDITION
3060 Kensington Road
Dexter MI 48130

OWNER:

DEXTER COMMUNITY SCHOOL DISTRICT
2704 Baker Road
Dexter, MI 48130

TMP PROJECT NO.: 25023D

DATE: February 6, 2026

ISSUED FOR: CONSTRUCTION DOCUMENTS

ARCHITECT

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

PH (248) 338-4561
Email info@tmp-architecture.com

CONSTRUCTION MANAGER

GRANGER CONSTRUCTION COMPANY
1441 Brooklyne Street Suite 400
Detroit, MI 48226

PH (248) 724 2950

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CIVIL CONSULTANT

BECKETT & RAEDER, INC.
535 William Srette, Suite 101
Ann Arbor, MI 48103

PH (734) 663 2622
Email bria2.com

STRUCTURALCONSULTANT

WILLLIAM A. KIBBE & ASSOCXIATES
1475 S Washington Avenue
Saginaw, MI 48601

PH (989) 752 5000
Email kibbe.com

MECHANICAL CONSULTANT

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

PH (248) 879 5666
Email peterbassoassociates.com

ELECTRICAL CONSULTANT

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

PH (248) 879 5666
Email peterbassoassociates.com

TECHNOLOGY CONSULTANT

COMMTECH DESIGN, INC.
6585 Belding Road, northeast Suite B
Rockford, MI 49341

PH (616) 863 8132
Email commtechdesign.com

HARDWARE CONSULTANT

JENOSKY CONSULTING INC
43422 w. Oaks Drive,
Novi, MI 48377

PH: (248) 496 7900
Email: jenoskiconsulting.com

Wylie Elementary School Classroom Addition

TMP 25023D

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.	***William A. Kibbe Associates***	***Peter Basso Associates, Inc***
Architect	*Structural Engineer*	*Mechanical Engineer*

Seal	*Seal*
Peter Basso Associates, Inc	***Beckett & Raeder INC***
Electrical Engineer	*Civil Engineer*

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APPENDIX 1

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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 Wylie Elementary School - Addition and Renovations, dated February 6, 2026 and any subsequent Addenda and Contract modifications which may occur.

END OF SECTION 00 0115

SECTION 00 3100 - AVAILABLE PROJECT INFORMATION

PART 1 GENERAL

1.01 SUMMARY

A. Project Manual uses Appendixes to organize information that does not conform to 3-part specification formatting as defined by the Construction Specifications Institute (CSI).

1. Appendix information does not have a six-digit number or title as defined by CSI's MasterFormat.

1.02 EXISTING CONDITIONS

A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders as Information Available to Bidders, but will not be part of Contract Documents, as follows:

1. Geotechnical Report: Entitled Report on Geotechnical Investigation 2025 Dexter Schools Bond Program, dated October 13, 2025.
   a. Copy is attached to Project Manual in Appendix 1.

1.03 MISCELLANEOUS INFORMATION

A. Miscellaneous information relating to the project is available in the Appendixes as follows:

1. Includes information issued as an Appendix by Addendum or other subsequent Contract modification.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION -- NOT USED

END OF SECTION 00 3100

SECTION 00 8200.01 - TMP ELECTRONIC FILE RELEASE FORM

.

RE: AUTHORIZATION FORM FOR CAD FILE TRANSFERS
PROJECT NAME: _____
TMP PROJECT NO. : _____ BID PACK NO._____

DEAR SIR/MADAM:

A. 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.
B. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
C. 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.
D. 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 2018 dwg files].
E. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
F. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
G. Compensation for providing this material will be as follows:
    1. Base Fee of [$250] for 1 to 3 Drawings.
    2. Base Fee of [$500] for 4 to 10 Drawings.
H. For each additional Drawing after 10 the fee is [$40] per Drawing.
I. Example: [11 drawings = $540].
J. Payment must be provided along with a signed copy of this form 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.

FEE: $_____
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 00 8200.01

SECTION 00 8200 - AVAILABILITY OF ELECTRONIC FILES

AVAILABILITY OF ELECTRONIC FILES

1.01 POLICY

A. As a service to Contractor, subcontractors, vendors, material suppliers and others needing electronic copies of Drawings, the Architect will provide CAD files electronically in accordance with the following policy:

1. By acceptance it is understood and agreed that the data and medium being supplied is to be used only for the project referenced.
2. It is further understood and agreed that the undersigned will hold TMP Architecture, Inc. and its Consultants harmless and indemnify TMP Architecture, Inc. and its Consultants from all claims, liabilities, losses, and so forth, including attorney's fees arising out of the use or misuse of the transferred files.
3. It is understood and agreed that the files transmitted are prepared from CAD files current at the time of preparation. All files are AutoCAD version 2018 dwg files.
4. This information does not waive the need to verify and review current field conditions and the status of Addenda and/or Bulletin documentation.
5. As a record of information to be transmitted, TMP Architecture, Inc. will prepare a duplicate electronic back-up for its record.
6. Compensation Fee for providing this material will be as follows:
   a. Base Fee of $250 for 1 to 3 Drawings.
   b. Base Fee of $500 for 4 to 10 Drawings.
   c. For each additional Drawing after 10, the fee is $40 per Drawing.
      1) Example: 11 Drawings = $540.
7. A signed copy of the Release Form and Fee must be provided before files will be released.

1.02 REQUEST PROCEDURE

A. To receive Drawing CAD files the Release Form must be completed in full and submitted to the Construction Manager to be forwarded to the Project Manager at TMP Architecture, Inc.

1. A signed copy of the Release Form must be submitted.
   a. Faxed or emailed copies will be accepted.
2. Upon remittance of the signed Release Form and Fee, allow five working days for processing.
3. Transmission of Drawings will be provided electronically after the receipt of Fee.

1.03 RELEASE FORM

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

END OF SECTION 00 8200

SECTION 01 0005 - RELATED REQUIREMENTS

PART 1 GENERAL

1.01 DIVISION 00 AND DIVISION 01

A. Unless otherwise noted, all provisions of sections and documents in Division 00 and Division 01, including, but not limited to, General Conditions and Supplementary Conditions, relate and apply to all sections and documents within Project Manual; including, but not limited to, sections and documents in Division 00 through Division 48.

1.02 DRAWINGS

A. Unless otherwise noted, Drawings relate and apply to all specification sections and documents within Project Manual; including, but not limited to, sections and documents in Division 00 through Division 48.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION -- NOT USED

END OF SECTION 01 0005

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 - Window Treatment

1. Base Bid: To provide no window treatment - Roller Shades to windows.
2. Alternate: Provide and install window treatment - Roller Shades to interior windows as per Specification Section 12 2400 and as indicated on A10 Series Drawings and identifed by Keynote 6.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 2300

SECTION 01 2500.01 - TMP SUBSTITUTION REQUEST FORM

SUBSTITUTION REQUEST NUMBER: _____ DATE SUBMITTED: _____
TMP PROJECT NUMBER: 25023D PROJECT NAME: WYLIE ELEMENTARY SCHOOL - CLASSROOM ADDITION

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 01 2500.01

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 01 2500

SUBMITTAL AND SAMPLE TRANSMITTAL FORM

01 3000.01

CONST. MANAGER / CONTRACTOR	PROJECT	TMP PROJECT NO.	DATE SUBMITTED	SUBMITTAL NO.
Name and Address:	Title:	25023D		
	Wylie Elementary School Classroom Addition	* ACTION CODES		Initial Submittal ☐ Resubmittal ☐
Email:	Location:	R Reviewed – No Exceptions Taken RN Reviewed with Corrections Noted RR Revise and Resubmit X Not Approved – Resubmit NA No Action Taken – Not Reviewed		REVIEWED BY
Phone:	3060 Kensington Road Dexter, MI 48130			TMP ☐ Consultant ☐ 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 01 3000

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; 2025a.
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 01 4000

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. ASHRAE Std 90.1 I-P-2019 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2019, with Errata and Addenda (2021).
   2. Barrier Free Code: Comply with the following:
      a. Michigan Building Code; 2021.
      b. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
   3. School Fire Safety Rules: Michigan School Fire Safety Rules; 2016.
      a. Includes NFPA 101-2012 - Life Safety Code; 2012, plus amendments.
   4. Building Code: Michigan Building Code; 2021.
   5. Plumbing Code: Michigan Plumbing Code; 2021.
   6. Mechanical Code: Michigan Mechanical Code; 2021.
   7. Electrical Code: NFPA 70 - National Electric Code; 2023.
      a. Includes 2023 Michigan Construction Code - Part 8 Electrical Code Rules.
   8. Elevator Code: Comply with the following:
      a. ASME A17.1 - Safety Code for Elevators and Escalators; 2016.
      b. ASME A18.1- Safety Standard for Platform Lifts and Stairway Chairlifts; 2017.
      c. 2023 Michigan Elevator Safety Board General Rules.
   9. 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.
   10. Energy Code: Michigan Commercial Energy Code; 2021.
      a. Includes ASHRAE Std 90.1 I-P-2019 - Energy Standard for Buildings Except Low-Rise Residential Buildings; 2019.
   11. Existing Building Code: Michigan Rehabilitation Code; 2021.

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 01 4100

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 01 4216

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 , 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 01 4219

SECTION 01 5639 - TEMPORARY TREE AND PLANT PROTECTION

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.

1.02 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Sections:
1. Section 31 1000 "Site Clearing" for selective removal of existing plants.

1.03 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape at 6 inchesabove the ground for trees up to, and including, 4-inchsize; and 12 inchesabove the ground for trees larger than 4-inchsize.

B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Verification: For each type of the following:
1. Organic Mulch: 1-quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified arborist and tree service firm.

B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.

C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

D. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
   1. Use sufficiently detailed photographs or videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.06 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA.

B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

C. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
      a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
      b. Enforcing requirements for protection zones.
      c. Arborist's responsibilities.
      d. Arborist supervision.
      e. Field quality control.

1.07 PROJECT CONDITIONS

A. The following practices are prohibited within protection zones:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
   1. Type: Shredded hardwood.
   2. Size Range: 3 inchesmaximum, 1/2 inchminimum.
   3. Color: Natural.

B. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft.; remaining flexible from minus 60 to plus 200 deg F; inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi; secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.
   1. Height: 48 inches.
   2. Color: High-visibility orange, nonfading.

C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly fabricated with non-fading lettering and as follows:
   1. Text: “TREE PROTECTION ZONE – NO ACCESS”.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

C. All work within or immediately adjacent to the root zone of any tree shall be observed by a certified arborist. No work shall take place without the arborist present.

3.02 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation protection zones.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

3.03 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 50-feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Relocate protection-zone fencing as needed to facilitate construction operations. Relocations shall be approved by Landscape Architect prior to beginning or resuming construction operations.

3.04 EXCAVATION

A. General: Excavation within protection zones shall be by pneumatic operations according to requirements in Section 31 2000 "Earth Moving."

B. Excavation near Trees: Where excavation is required within protection zones, pneumatically excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or piercing. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots under direct supervision of arborist and as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots under direct supervision of arborist and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.05 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
   1. Notify arborist. All excavation and root pruning shall occur under direct supervision of a certified arborist.
   2. Cut roots manually by hand or pneumatically digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
   3. Cut Ends: Do not paint cut root ends.
   4. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
   5. Cover exposed roots with burlap and water regularly.
   6. Backfill immediately according to requirements in Section 31 2000 "Earth Moving."

3.06 CROWN PRUNING

A. Crown or branch pruning shall be limited to that required for clearance of new light poles and fixtures. Branches to be pruned shall be marked for approval of Architect and arborist prior to pruning.

B. Prune branches approved branches under direct supervision of certified arborist as follows:
   1. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
      a. Type of Pruning: Cleaning, Raising, Reduction.
   2. Cut branches with sharp pruning instruments; do not break or chop.
   3. Do not apply pruning paint to wounds.

C. Remove pruning debris and legally dispose of off-site.

3.07 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.08 REPAIR, REPLACEMENT AND MITIGATION

A. Damage to trees, shrubs, and other vegetation will be taken very seriously and require mitigation at the Contractor’s expense. Actively and aggressively protect all existing trees and vegetation during construction.

B. Repair, replacement, and mitigation for damaged trees and other vegetation will be determined solely by the Architect and Owner based on the severity of immediate and long-term damage.

3.09 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

END OF SECTION 01 5639

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 01 6000

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; 2022, with Errata (2021).

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 01 7000

SECTION 01 7327 - CUTTING AND PATCHING OF SINGLE PLY ROOFING

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes procedural requirements for cutting and patching.
   1. Related Sections include the following:
      a. Divisions 2 through 28 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.02 DEFINITIONS

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.03 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
   1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
   2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
   3. Products: List products to be used and firms or entities that will perform the Work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
   6. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

B. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
   1. If possible, retain original Installer to cut and patch exposed Work listed below:
      a. EPDM Single Ply Membrane Roofing
      b. TPO Single Ply Membrane Roofing

C. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.04 WARRANTY

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. Existing Roof: The existing roof is a roof system which is still under warranty. Comply with the following requirements when modifying the existing roof and adding new penetrations:
      a. Notify original roof manufacturer prior to beginning any work and comply with all manufacturer guidelines and requirements.

b. Provide original roof manufacturer with a brief description of the proposed work, including any required submittals.
c. Work shall not begin until written approval is received from original roof manufacturer.
d. Work must be done by an approved manufacturer's contractor.
e. Original roof manufacturer shall inspect all modifications to the original roof system.

PART 2 - PRODUCTS

2.01 MATERIALS

A. General: Comply with requirements specified in other Sections of these Specifications.
B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.
B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

3.03 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. Review proposed procedures with original Roof Installer; comply with original Installer's written recommendations.
   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. Temporarily cover openings when not in use.
   2. Proceed with patching after construction operations requiring cutting are complete.

3.04 ROOF FLASHING INSTALLATION AROUND NEW PENETRATIONS

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.
B. Apply bonding adhesive to substrate and underside of flashing sheet at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.
C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing as recommended by manufacturer.
D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.
F. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.
    1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
    2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into adjoining construction in a manner that will eliminate evidence of patching and refinishing.

END OF SECTION 01 7327

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 01 7329

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 01 7800

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 01 7900

SECTION 01 9113 – COMMISSIONING REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 23 Sections Mechanical.
2. Division 26 Sections Electrical.

1.02 DESCRIPTION

A. Purpose

1. Verify operation and functional performance of the mechanical and electrical systems for compliance with the Owners Project Requirements (OPR) and the Basis of Design (BoD).
2. Document systems tests and inspections.
3. Verify application of operation and maintenance manuals, record documents, spare parts listing, special tools listing and other items as may be specified herein for support of systems and equipment.
4. Coordinate and direct training of personnel for operation and maintenance of equipment and systems.

B. General

1. Furnish labor and material to accomplish complete commissioning as specified herein.
2. Complete interim commissioning of HVAC systems during initial season operation and follow up commissioning of required HVAC systems during additional season operation.

1.03 QUALITY ASSURANCE

A. References: ASHRAE Guideline 0-2019, "The Commissioning Process," Guideline 1.2-2019, " Technical Requirements for The Commissioning Process for Existing HVAC&R Systems and Assemblies." Guideline 1.5-2019, “The Commissioning Process for Smoke Control Systems.” and Standard 202-2018, “Commissioning Process for Buildings and Systems.”

B. International Electrical Testing Association – NETA Acceptance Testing Specifications – ATS–2017.

1.04 **RESPONSIBILITIES**

A. Contractor

1. The Contractor shall assure participation and cooperation of subcontractors (mechanical, electrical, temperature controls, TAB, etc.) under his jurisdiction, and suppliers (air handling units, boilers, pumps, fire alarm, etc.), as required for the commissioning process. *NOTE: PERSONNEL ASSIGNED TO PERFORMING OR PARTICIPATING IN FUNCTIONAL TESTING SHALL HAVE NO OTHER DUTIES OR ASSIGNMENTS DURING THE DURATION OF THE TESTING.*

2. The Contractor shall be responsible for providing labor, material, equipment, etc., required to facilitate the commissioning process.

3. Attend the commissioning meetings (to be held, depending on progress and as required for the systems to be commissioned) which include the Contractor, the Owner, the Commissioning Authority, and appropriate subcontractors and suppliers. The purpose of these meetings shall be to coordinate and schedule commissioning activities. The Contractor shall coordinate the attendance of the appropriate subcontractors and suppliers.

4. Incorporate in the project construction schedule those elements related to commissioning activities.

5. Prepare system test reports (pipe pressure tests, duct pressure/leak tests, etc.), submit to commissioning authority for review, and insert in appropriate location of the commissioning manual.

6. Prepare equipment/system installation and start-up reports for each piece of equipment/system to be commissioned. Submit completed reports to commissioning authority for review and insert reports in appropriate location of the commissioning manual.

7. Maintain and update the cloud based project commissioning manual (CxAlloy). Contractor shall have access to the project commissioning manual used by the commissioning team throughout the project. Contractor shall upload all required test reports prepared by the Contractors, equipment installation reports prepared by the Contractors, and equipment start-up reports prepared by the Contractor under the related asset identification of the cloud based commissioning manual. At the completion of the commissioning process, the Cx Authority shall generate a Final Cx Report and the contractor shall be required to provide any missing information regarding warranty related start-up documentation.

8. Coordinate, schedule and perform start-up and functional testing of equipment and systems. *NOTE: ADDITIONAL TIME OR TRAVEL EXPENSES INCURRED BY THE COMMISSIONING AUTHORITY DUE TO CANCELLED OR POSTPONED TESTING, OR DUE TO EQUIPMENT NOT BEING READY FOR FUNCTIONAL TESTING WHEN SCHEDULED SHALL BE PAID TO THE COMMISSIONING AUTHORITY BY THE CONTRACTOR.*

9. Perform functional tests as directed by the Commissioning Authority. Document functional testing results, noting actual performance versus design requirements. Functional tests will demonstrate operation of every item in the control sequences under all normal operation modes, including part and full load, occupied, unoccupied and emergency conditions.

10. Coordinate the training of Owner personnel. Refer to Division 01 and the individual specification Sections for Owner training requirements. In addition to the Owner training specified in the individual specification Sections, provide two (2) Owner training sessions, each four (4) hours in length, on the operation of the system as a whole.

11. Assemble/develop complete Operations and Maintenance Manuals. A draft copy of the O & M shall be submitted early in project and be available on site during commissioning. Final copy shall be submitted prior to substantial completion of the project.

B. Commissioning Authority:

1. Develop the commissioning manual.
2. Participate in critical construction progress meetings, and review all construction progress meeting notes.
3. The Commissioning Authority shall hold regular commissioning meetings (to be held, depending on progress and as required for the systems to be commissioned). The Commissioning Authority shall schedule the meetings, notify the Owner and the Contractor, and record and submit minutes from these meetings to the Owner for distribution to the Contractor.
4. Participate in the review of document clarification requests.
5. Participate in the review of field orders and bulletins.
6. Participate in compliance reviews of submittal documents (shop drawings and submittals).
7. Provide construction progress observations, with documentation and recommendations to the Owner's Project Construction Representative.
8. Verify testing by witnessing the tests, or verify testing by reviewing documentation of testing witnessed by others.
9. Participate in the observation and review of functional tests on systems being commissioned.
10. Review final record documents (i.e., operation and maintenance manuals, as-built drawings, etc.).

C. Owner:

1. Establish contracts:
   a. Owner-Engineer Agreement for design.
   b. Owner-Contractor Contract for construction.
   c. Owner-Commissioning Authority Agreement for observation and review of the commissioning process.
2. Attend the commissioning meetings.
3. Verify testing by witnessing the tests, or verify testing by reviewing documentation of testing witnessed by others.
4. Participate in the observation and review of functional tests on systems being commissioned.
5. Review final record documents (i.e., operation and maintenance manuals, as-built drawings, etc.).
6. Participate in Owner Training provided by the Contractor.

1.05 **SUBMITTALS**

A. Submit under provisions of Division 01 and as supplemented in this section.

B. Prepare system test reports (pipe pressure tests, duct pressure/leak test, electrical tests, etc.), submit to commissioning authority for review, and insert in appropriate location of the commissioning manual.

C. Prepare equipment/system installation and start-up reports for each piece of equipment/system to be commissioned. Submit completed reports to commissioning authority for review and insert reports in appropriate location of the commissioning manual.

D. The Contractor shall submit Owner training plans.

E. The Contractor shall show in the Project schedule the order and timing of the Commissioning Plan for each of the systems to be commissioned.

F. Draft copy of the project O & M manuals shall be submitted early in the construction phase and be available on site for use during commissioning.

1.06 **PROJECT RECORD DOCUMENTS**

A. Submit electronic copies of the as-built Commissioning Manual after completion of commissioning. As-built Commissioning Manual shall include:

1. Completed (initialed) Commissioning Plan/Sign-off List for each system which was commissioned.
2. As-built description of operation for each system which was commissioned.
3. Completed (checked-off) functional test plan/checklist for each system which was commissioned.
4. Piping system certified pressure test report (where applicable) for each system which was commissioned.
5. Piping system flushing and cleaning report (where applicable) for each system which was commissioned.
6. Inspection Certificates (where applicable) for each system which was commissioned.
7. Manufacturer on-site start-up test reports (where applicable) for equipment of commissioned systems.
8. Documentation of the dates and times during which Owner training took place for each system which was commissioned.

PART 2 PRODUCTS

2.01 **INSTRUMENTATION**

A. Instrumentation shall be provided by the Contractor performing tests.

PART 3 EXECUTION

3.01 **SYSTEMS/EQUIPMENT TO BE COMMISSIONED**

A. Mechanical Systems:

1. Exhaust Fans (EF-1 through EF-2)
2. Unit Heaters (UH-1 thru UH-2)
3. Electric Unit Heaters (EUH-1)
4. Cabinet Unit Heaters (CUH-1 through CUH-3)
5. Domestic Water Heaters (EWH-1)
6. Domestic Water Recirculation Pump (CP-1)
7. Vertical Unit Ventillators (VUV-1 through VUV-7)

B. Electrical Systems:

1. Lighting Controls

3.02 **COMMISSIONING PLAN**

A. The following is a general outline of the commissioning plan. It includes, but is not limited to the following items, as applicable:

1. Submit shop drawings and product data.
2. Submit Commissioning Manuals for review, prior to beginning the commissioning process. Refer to the "SUBMITTALS" portion of this section for requirements.
3. Submit draft copies of Operations and Maintenance manuals for review.
4. Submit Training Plan.
5. Submit verification that all pressure testing, flushing and cleaning has been completed for piping systems.
6. Submit Inspection Certificates.
7. Submit verification of start-up tests for equipment and systems.
8. Submit air and water balance report.
9. Complete testing of the functional performance of all components of each system to be commissioned. (Note Requirements in paragraph 1.04.A.9 in this section)
10. Any test which cannot be accomplished for seasonal or other reasons, or for which acceptable performance is not achieved, shall be rescheduled to a time when it can be accomplished.
11. Participate in substantial completion walk-through.
12. Submit warranties.
13. Submit record documents, including but not limited to as-built drawings, final operations and maintenance manuals and completed Commissioning Manual.
14. Conduct training of Owner personnel.

B. At the end of the process, every mode of the commissioned systems operation, all commissioned system equipment and components, and every item in the control sequences shall have been proven operational under all normal operational modes, including part and full load, and under normal and emergency conditions.

END OF SECTION

SECTION 01 9114 - COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 GENERAL

1.01SUMMARY

A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Provider's (CxP's) responsibilities for commissioning:
   1. Verify that the work is installed in accordance with Contract Documents and the manufacturer’s recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this verification.
   2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests performed by Contractor and witnessed by the CxP are utilized to achieve this verification.
   3. Verify that operation and maintenance manuals submitted to Owner are complete: Detailed O&M data submittals are specified.
   4. Verify that the Owner’s operating personnel are adequately trained: Formal training conducted by Contractor is specified.

B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Substantial Completion.

C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

B. Building envelope.
   1. Air tightness.

C. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.

1.03 DEFINITIONS

A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.

B. Commissioning Provider (CxP): The qualified entity responsible for delivery of the commissioning process. See required qualifications specified in this section under QUALITY ASSURANCE.

C. Commissioning Process: Quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.

D. Deferred Tests: Tests performed after Date of Substantial Completion, with Owner's approval, due to seasonal requirements, site conditions , or both, that prohibit the tests from being performed prior to achieving Substantial Completion.

E. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Contract Documents.

F. Integrated System Test: Test of multiple systems that are designed to dynamically function and operate in coordinated and properly sequenced fashion. Tests are intended to be conducted under various modes and through every specified sequence of operations.

1.04 REFERENCE STANDARDS

A. ASHRAE Guideline 1.1 - Application of the Commissioning Process to New HVAC&R Systems; 2025.

1.05 SUBMITTALS

A. Commissioning Plan:
   1. Submit preliminary draft for review by Owner and Architect within 30 days after commencement of Commissioning Provider contract.
   2. Submit revised draft to be included in the construction Contract Documents, not less than 4 weeks prior to bid date.
   3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.

B. List of Prefunctional Checklists to be developed:
   1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
   3. Submit final list not more than 60 days after start of construction.

C. Prefunctional Checklists:
   1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
   3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.

D. List of Functional Test procedures to be developed:
   1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in Contract Documents; this is intended to be a list of titles, not full description of the tests.
   3. Submit final list not more than 60 days after start of construction.

E. Functional Test Procedures:
   1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
   2. Submit revised draft for review by Owner and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
   3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.

F. Training Plan.

G. Recommissioning Manual: Submit within 60 days after receipt of Owner's instructions to proceed with preparation.

H. Commissioning Process Record: Submit to Contractor for inclusion with O&M manuals. Include, at a minimum the following:

I. Final Commissioning Report: Submit to Owner. Include the following:

PART 3 EXECUTION

2.01 COMMISSIONING PLAN

A. Prepare and implement the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
   1. Call and chair meetings of the Commissioning team when appropriate.
   2. Give Contractor sufficient notice for scheduling commissioning activities.

3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
4. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
5. Avoid replication of information included in the construction Contract Documents to the greatest extent possible.

B. Review the construction Contract Documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of Commissioning Provider (CxP) in preparing the Commissioning Plan.

C. Commissioning Schedule:
1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
2. Contractor's scheduling responsibilities are specified in the construction Contract Documents.
3. Revise and re-issue schedule monthly.
4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.

2.02 CONSTRUCTION CONTRACT DOCUMENTS

A. General Commissioning Specifications: Review Architect's general commissioning specifications and submit comments to Owner.
1. These specifications include:
a. Procedures applicable to all types of items to be commissioned.
2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction Contract Documents by Architect:
a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
b. Additional Owner personnel training.
c. Additional operation or maintenance data that should be submitted.

B. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
2. The Checklist forms are intended to be part of the Contractor's Contract Documents.

C. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by Owner and Architect.
1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.
2. The forms the Commissioning Provider will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.

D. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction Contract Documents.

E. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction Contract Documents

2.03 PREFUNCTIONAL CHECKLISTS

A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with Contract Documents and the manufacturer’s recommendations and instructions, and that it receives adequate operational checkout prior to startup.
   1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
   2. Identify each Checklist by using Contract Documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
   3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
   4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
   5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
   6. Include line items for each physical inspection to be performed.
   7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
   8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
   9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.

B. Prefunctional Checklists - Format:
   1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
   2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.
   3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
      a. "This Checklist is submitted for approval with no exceptions."
      b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
   4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
   5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

2.04 FUNCTIONAL TEST PROCEDURES

A. Develop test procedures in sufficient detail to demonstrate that functional performance is in accordance with Contract Documents, including proper operation through specified modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load regimes.
   1. Obtain assistance and review by installing subcontractors.

2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
3. Include test setup instructions, description of tools and apparatus, special cautions, and.
4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring, or manual functional testing.
6. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.

B. Functional Test Forms: Prepare and distribute forms in advance of testing. Use a consistent format to the greatest degree practicable. For each form, include the following:
1. Signature Block: Signature of the designated commissioning lead and the system and equipment installer attesting that the recorded test results are accurate.

2.05 CONSTRUCTION PHASE

A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.

B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.

C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review proposed commissioning schedule, activities, and responsibilities with parties involved. Require attendance by every member of the Commissioning Team.

D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and Owner personnel; hold meetings at least monthly.

E. Submit periodic progress reports to Owner and Contractor.

F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that Owner's responsibilities are clearly defined in warranties.

G. Review and approve submittals directly related to commissioning.

H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.

I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.

J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.

K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.

L. HVAC Commissioning:
1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
4. Review TAB Plan prepared by Contractor.

5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
7. Analyze trend logs and monitoring data to verify performance.

M. Witness and document testing of systems and components over which the Commissioning Provider does not have direct control, such as smoke control systems, tests contracted directly by Owner, and tests by manufacturer's personnel; include documentation in O&M manuals.

N. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Provider rather than the Contractor, perform such testing without assistance of Contractor.

O. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.

P. Operation and Maintenance Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.

Q. Notify Contractor and Owner of deficiencies in procedures or results; suggest solutions.

2.06 TRAINING

A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.
1. Include a ____-hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
2. Include ____-hour session by CxP on the use of the blank Prefunctional Checklists and Functional Test forms for re-commissioning purposes.
3. Establish criteria for determining satisfactory completion of training.

B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.

2.07 CLOSEOUT

A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
1. Include the Final Commissioning Plan and Final Report.
2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
   a. Design intent documentation, furnished by Architect or others.
   b. Detailed operational sequences.
   c. Startup plan and approved startup reports.
   d. Filled out Prefunctional Checklists.
   e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
   f. Training plan and training records.
   g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.

B. Final Commissioning Report: Include:
1. Executive summary.
2. List of participants and roles.
3. Brief facility description.
4. Overview of commissioning scope and general description of testing and verification methods.
5. For each item commissioned, an evaluation of adequacy of:
   a. The product itself; i.e. compliance with Contract Documents.
   b. Installation.

c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
d. O&M documentation, including design intent.
e. Operator training.

6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.

C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

2.08 POST-OCCUPANCY PHASE

A. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
B. On-Site Review: 10 months after Substantial Completion conduct on-site review with Owner's staff.
1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
3. Make suggestions for improvements and for recording these changes in the O&M manuals.
4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION 01 9114

SECTION 02 4100 - DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

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

1.03 REFERENCE STANDARDS

A. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).
B. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.04 SUBMITTALS

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

1.05 QUALITY ASSURANCE

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

PART 2 PRODUCTS - NOT USED

2.01 MATERIALS

A. Fill Material: As specified in Division 31.

PART 3 EXECUTION

3.01 SCOPE

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

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with other requirements specified in Section 01 7000.
B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Comply with applicable requirements of NFPA 241.
   3. Prior to start of demolition operations, perform an engineering survey of building condition to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures.
   4. Use of explosives is not permitted.
   5. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.

6. Provide, erect, and maintain temporary barriers and security devices.
7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
8. Do not close or obstruct roadways or sidewalks without permit.
9. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

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

D. Do not begin removal until built elements to be salvaged or relocated have been removed.

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

F. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

G. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, PCB's, and mercury.

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

3.03 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
1. Where concrete cannot be cut full depth, cut concrete to a depth of at least 3/4 inch. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
1. Refer to Section 04 2000 - Unit Masonry for salvaging brick.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.

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

E. Carpet: Remove carpet and adhesive according to industry standard and below. Do not use methods requiring solvent-based adhesive strippers.
1. Remove carpet in managable sections and dispose.
2. Using a floor scraper, scrape residual of carpet and adhesive from concrete.
3. Sand the floor by mechanical means starting with a heavy grit to remove the bulk of the left adhesive and then a finer grit (approx 300) for the finish sand to allow new finish to be applied.

3.04 EXISTING UTILITIES

A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.

B. Protect existing utilities to remain from damage.

C. Do not disrupt public utilities without permit from authority having jurisdiction.

D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

3.05 SELECTIVE DEMOLITION FOR ALTERATIONS

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

3.06 SALVAGED ITEMS

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

3.07 REMOVED AND REINSTALLED ITEMS

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

D. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.08 EXISTING ITEMS TO REMAIN

A. Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete

3.09 DEBRIS AND WASTE REMOVAL

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

END OF SECTION 02 4100

SECTION 03 3000 – CAST IN PLACE CONCRETE

PART 1 GENERAL

1.01 SUMMARY

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

1.02 ACTION SUBMITTALS

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

1.03 INFORMATIONAL SUBMITTALS

A. Material certificates
B. Material test reports

1.04 QUALITY ASSURANCE

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

1.05 PRECONSTRUCTION TESTING

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

1.06 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

1.07 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 CONCRETE, GENERAL

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

2.02 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.03 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
B. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.
C. Deformed-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, flat sheet.
D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice."

2.04 CONCRETE MATERIALS

A. Cementitious Materials:
   1. Portland Cement: ASTM C 150/C 150M, Type I, gray.
   2. Portland Cement: ASTM C595 Type IL Portland Limestone Cement.
   3. Fly Ash: ASTM C 618, Class F or C.
   4. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.
B. Normal-Weight Aggregates: ASTM C 33/C 33M, graded.
   1. Maximum Coarse-Aggregate Size: 1 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
C. Air-Entraining Admixture: ASTM C 260/C 260M.
D. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Refer to 03 3003 for Moisture Vapor Reducing Admixture.
E. Water: ASTM C 94/C 94M and potable.

2.05 CURING MATERIALS

A. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
B. Water: Potable.
C. All interior slab on grade concrete shall be moisture cure only.

2.06 RELATED MATERIALS

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

2.07 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
B. Cementitious Materials: Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
C. Admixtures: Use admixtures according to manufacturer's written instructions.
   1. Use water-reducing admixture in concrete, as required, for placement and workability.

2.08 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Refer to structural general notes.

2.09 FABRICATING REINFORCEMENT

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

2.10 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
B. Moisture Vapor Reduction Admixture (MVRA):
   a. Where required add admixture as recommended in ACI 211.1 and at rates required by manufacturer.

PART 3 EXECUTION

3.01 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
C. Chamfer exterior corners and edges of permanently exposed concrete.

3.02 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.03 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
   1. Lap joints 6 inches and seal with manufacturer's recommended tape.
   2. Vapor Retarder Over Granular Fill: Install compactible granular fill before placing vapor retarder as indicated on drawings.

3.04 STEEL REINFORCEMENT INSTALLATION

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

3.05 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.
B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

3.07 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces not exposed to public view.
B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:
   1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
   2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.

3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.08 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish and measure surface, so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinnest method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.09 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after

loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.10 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

3.11 FIELD QUALITY CONTROL

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

END OF SECTION 03 3000

SECTION 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. Reinforcing and jointing requirements for cast-in-place concrete floor slabs receiving hard tile floor finishes.
D. Floor flatness and levelness tolerances; slabs on grade and suspended slabs.
E. 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/E1155M - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers; 2023.
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 - 15 mils: 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) 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.

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.

C. Measure F(F) Floor Flatness and F(L) Floor Levelness in accordance with ASTM E1155/E1155M (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 03 3003

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. Precast architectural concrete units set in masonry; furnished by Section 03 4500 - Precast Architectural Concrete.
   2. Cast stone units set in masonry; furnished by Section 04 7200 - Cast Stone Masonry.
   3. Loose steel lintels in unit masonry; furnished by Section 05 5000 - Metal Fabrications.
   4. Manufactured reglets embedded in unit masonry; furnished by Section 07 6200 - Sheet Metal Flashing and Trim.
I. Products furnished under this section:
   1. Dovetail anchor slots for connecting masonry to cast-in-place concrete; installed by Section 03 3000 - Cast-in-Place Concrete.
   2. 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; 2025a.
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; 2024.
J. ASTM C90 - Standard Specification for Dry-Cast Loadbearing Concrete Masonry Units; 2024a.
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); 2024.
N. ASTM C270 - Standard Specification for Mortar for Unit Masonry; 2019a, with Editorial Revision.
O. ASTM C404 - Standard Specification for Aggregates for Masonry Grout; 2024.

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 C 1329 - Standard Specification for Mortar Cement - 2016.
S. ASTM C1714/C1714M - Standard Specification for Preblended Dry Mortar Mix for Unit Masonry; 2019a.
T. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2025.
U. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.
V. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls; 2017.
W. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).

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. 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.
F. 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.
G. Manufacturer's Qualification Statement.
H. Installer's Qualification Statement.
I. 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) Best Block Company: www.bestblock.net.
            (b) Consumers Concrete Corp.: www.consumersconcrete.com.
            (c) Echelon by Oldcastle: www.echelonmasonry.com.
            (d) Fendt Builder’s Supply, Inc.: www.fendtproducts.com.
            (e) Grand Blanc Cement Products: www.grandblanccementproducts.com.
            (f) Michigan Certified Products, Inc.: www.micertconcrete.com.
            (g) National Block Company: www.nationalblock.com.
            (h) 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: Brick Tech - Agent.
1) Substitutions: Not permitted.
b. ASTM C216, Type FBS, Grade SW.
c. Size (Actual): 3-5/8 inches wide by 2-1/4 inches high by 7-5/8 inches long (Modular).
d. Color/Blend: Olde Windsor.
e. Texture: Velour.

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. Color(s): As selected by Architect from manufacturer's full range.
2. 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. 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.
H. 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; Multi-Flash SS: 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. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 SALVAGING BRICK

A. General: Comply with Section 02 4100 - Demolition.

B. Where indicated, remove and salvage existing brick.
1. Carefully remove brick by hand. Cut out full units from joint to joint.
    a. If required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.
2. Salvage as many whole, undamaged bricks as needed for new construction.
3. Salvage damaged brick that may be cut and used where cut units are required.
4. Take care not to chip, crack or otherwise damage surrounding masonry.

C. Remove mortar, loose particles and soil from salvaged brick by cleaning with hand chisels, brushes and water. Store brick for reuse.

D. Clean remaining masonry at edges of removal areas by removing mortar, dust, and loose debris in preparation for new construction.

E. Support and protect remaining masonry that surrounds removal area. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

3.02 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.

3.03 PREPARATION

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

3.04 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.
F. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

3.05 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. Existing Masonry: Match coursing and bonding of existing masonry unless otherwise indicated.
D. 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.
E. Brick Units: Unless otherwise indicated:
    1. Bond: Running.
    2. Coursing: Three units and three mortar joints to equal 8 inches.
    3. Mortar Joints: Concave.
    4. Mortar Joint Thickness: 3/8 inch.

3.06 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. Interlock intersections and external corners.
E. Tooth-in new masonry work with existing, unless otherwise indicated on Drawings.
F. Tooth-in cutting and patching masonry work unless otherwise indicated on Drawings.
G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
I. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.
J. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

K. 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.
L. 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.

3.07 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.

3.08 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.

3.09 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.

3.10 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.

3.11 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.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 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.

3.18 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.

3.19 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.

3.20 FIELD QUALITY CONTROL

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

3.21 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.
F. Ground-Face CMU: Refer to Section 07 1900-Water Repellent Acrylic Penetrating Sealer for field applied sealer.

END OF SECTION 04 2000

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Grout.

1.02 DEFINITIONS

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

1.03 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.04 ACTION SUBMITTALS

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

1.05 INFORMATIONAL SUBMITTALS

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

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
B. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303.
   2. AISC 360.
   3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

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

2.02 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.
B. Channels, Angles-Shapes: ASTM A 36/A 36M.
C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade C, structural tubing.
E. Welding Electrodes: Comply with AWS requirements.

2.03 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
   1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.
C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   1. Finish: Plain.
E. Threaded Rods: ASTM A 36/A 36M.
   1. Finish: Plain.
F. Steel Rod Bracing System: Stainless steel rod system. Basis of design is Halfen DETAN Rod System. Alternate suppliers/systems may be submitted for owner approval.
   1. Tension Rods
      a. Material: Stainless steel, A4, Type 316 with 51,500 psi yield strength. [ASTM A666]
      b. Finish: Electropolished or Hand polished.
      c. Diameter: As required for design loads.
   2. Couplers: 5-1/2 inches
      a. Material: Stainless steel with 235 MPa (34,000 psi) minimum yield strength [ASTM A666]
   3. Anchor Discs:
      a. Material: Stainless steel A4 with 235 MPa (34,000 psi) minimum yield strength [ASTM A666]
   4. Connecting Plates:
      a. Material: Stainless steel, Type 316 with 205 MPa (30,000 psi) minimum yield strength, ASTM A666. Finned for welding to steelwork

2.04 PRIMER

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

2.05 GROUT

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

2.06 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

2.07 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: Snug tightened.
B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
   1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.09 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded.
   3. Surfaces of high-strength bolted, slip-critical connections.
   4. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."
   3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.10 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   3. Ultrasonic Inspection: ASTM E 164.
   4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate.

3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

3.03 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Snug tightened.

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

3.04 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

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

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.
1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
a. Liquid Penetrant Inspection: ASTM E 165.
b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

END OF SECTION 05 1200

SECTION 05 2100 – STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. K-series steel joists.
   2. Joist accessories.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.
B. Shop Drawings:
   1. Include layout, designation, number, type, location, and spacing of joists.
   2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Manufacturer certificates.
C. Mill Certificates: For each type of bolt.
D. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
   1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.
B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications.
B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.06 SEQUENCING

A. Deliver steel bearing plates to be built into masonry construction.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Use ASD; data are given at service-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Roof Joists: Vertical load deflection of 1/240 of the span.

2.02 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
   1. Joist Type: K-series steel joists.
B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
C. Provide holes in chord members for connecting and securing other construction to joists.
D. Camber joists according to SJI's "Specifications.

E. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches (1:48).

2.03 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.04 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Furnish ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface unless otherwise indicated.

C. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.
   1. Finish: Plain

D. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.05 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

B. Apply one coat of shop primer to joists and joist accessories.

PART 3 EXECUTION

3.01 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Space, adjust, and align joists accurately in location before permanently fastening.
   3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.02 FIELD QUALITY CONTROL

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

B. Visually inspect field welds according to AWS D1.1/D1.1M.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

END OF SECTION 05 2100

SECTION 05 3100 – STEEL DECKING

PART 1 GENERAL

1.01 GENERAL

A. SUMMARY
   1. Section Includes:
      a. Roof deck.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.
B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Welding certificates.
B. Product Certificates: For each type of steel deck.
C. Evaluation reports.
D. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
   1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.02 ROOF DECK

A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating.
   2. Deck Profile: As indicated, Type WR, wide rib.
   3. Profile Depth: 1-1/2 inches.
   4. Design Uncoated-Steel Thickness: 0.0358 inch.

2.03 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
F. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
G. Galvanizing Repair Paint: ASTM A 780/A 780M SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.
H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
B. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
C. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
D. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
E. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
F. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.
G. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.
    1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.
H. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.
    1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
I. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
J. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.02 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
B. Field welds will be subject to inspection.
C. Prepare test and inspection reports.

3.03 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.
B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint..

END OF SECTION 05 3100

SECTION 05 4000 - COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Load-bearing formed steel stud exterior wall and interior wall framing.

1.02 RELATED REQUIREMENTS

A. Section 09 2216 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; 2012.
B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
D. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.
E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2020 (Reapproved 2024).
F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
G. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide data on standard framing members; describe materials and finish, product criteria, and limitations.
C. Shop Drawings: Indicate component details, framed openings, bearing, anchorage, loading, welds, and type and location of fasteners, and accessories or items required of related work.
    1. Indicate stud layout.
    2. Describe method for securing studs to tracks and for bolted and welded framing connections.
    3. Design data:
        a. Shop drawings signed and sealed by a professional structural engineer.
D. Designer's Qualification Statement.
E. Manufacturer's Qualification Statement.

1.05 QUALITY ASSURANCE

A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum 5 years of documented experience.
C. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience and approved by manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Metal Framing:
    1. ClarkDietrich Building Systems: www.clarkdietrich.com.
    2. Jaimes Industries: www.jaimesind.com/#sle.
    3. MarinoWARE: www.marinoware.com.
    4. MBA Building Supplies, Inc.: www.mbastuds.com.
    5. State Building Products; www.statebp.com

6. Steel Stud Solutions, LLC; www.steelstudsolutions.com
7. The Steel Network, Inc: www.SteelNetwork.com.
8. Telling Industries; www.buildstrong.com.
9. Substitutions: See Section 01 6000 - Product Requirements.

B. Framing Connectors and Accessories:
1. Same manufacturer as metal framing.

2.02 FRAMING SYSTEM

A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.

B. Design Requirements: Provide completed framing system having the following characteristics:
1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
3. Design Loads: As indicated on the drawings.
4. Live load deflection meeting the following, unless otherwise indicated:
a. Floors: Maximum vertical deflection under live load of 1/480 of span.
b. Roofs: Maximum vertical deflection under live load of 1/360 of span.
c. Exterior Walls:
1) Maximum horizontal deflection under wind load of 1/720 of span for walls with masonry veneer.
2) Maximum horizontal deflection under wind load of 1/360 of span for all walls without masonry veneer.
d. Interior Walls:
1) Maximum horizontal deflection under a horizontal load of 5 psf shall be 1/720 of span for walls with masonry veneer.
2) Maximum horizontal deflection under a horizontal load of 5 psf shall be 1/240 of span for all walls without masonry veneer.
e. Design non-axial loadbearing framing to accommodate not less than 1/2 in vertical deflection.
5. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
6. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
1. Gage: Not less than 18 gage, 0.0478 inch.
2. Depth: As indicated.
3. Flange Width: 2 inches.
4. Galvanized in accordance with ASTM A653/A653M, G90/Z275 coating.

B. Framing Connectors: Factory-made, formed steel sheet.
1. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
2. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
a. Where continuous studs bypass elevated floor slab, connect stud to slab in manner allowing vertical and horizontal movement of slab without affecting studs; allow for minimum movement of 1/2 inch.

b. Where top of stud wall terminates below structural floor or roof, connect studs to structure in manner allowing vertical movement of slab without affecting studs; allow for minimum movement of 1/2 inch.

3. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
4. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections as indicated in the shop drawings.

C. Slotted Deflection Track: Head-of-wall slotted vertical deflection track.
1. Basis-of-Design Product: ClarkDietrich Building Systems; MaxTrak Slotted Deflection Track: www.clarkdietrich.com.

D. Fire Stop Slotted Deflection Track: Head-of-wall slotted vertical deflection track with intumescent firestopping strips on each leg.
1. Basis-of-Design Product: ClarkDietrich Building Systems; Blazeframe Fire Stop Deflection Track: www.clarkdietrich.com.

2.04 FASTENERS

A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
B. Anchorage Devices: Powder actuated and Drilled expansion bolts.
C. Welding: Comply with AWS D1.1/D1.1M.

2.05 ACCESSORIES

A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
B. Sill Plate Gaskets: Closed-cell neoprene foam.
1. Thickness: 1/4 inch.
2. Width: To match width of bottom track.

C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION OF STUDS

A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
B. Align floor and ceiling tracks; locate to wall layout. Secure in place by welding or with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
C. Install sill plate gaskets continuously under bottom tracks.
D. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method.
1. Secure studs to top and bottom runner tracks at both inside and outside flanges.

E. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
F. Install load-bearing studs full length in one piece. Splicing of studs is not permitted.
G. Install load-bearing studs, brace, and reinforce to develop full strength and achieve design requirements.
H. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.
I. Install intermediate studs above and below openings to align with wall stud spacing.

J. Provide deflection allowance in stud track, directly below horizontal building framing at non-load bearing framing.
K. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
L. Touch-up field welds and damaged galvanized surfaces with primer.

3.03 TOLERANCES

A. Maximum Variation from True Position: 1/4 inch.
B. Maximum Variation of any Member from Plane: 1/8 inch.

END OF SECTION 05 4000

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. Other items as indicated on Drawings.

B. Prefabricated metal items, including:

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; 2022.

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; 2024.

F. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.

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; 2025a.

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; 2024.

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 Qulaification 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.

2.07 MISCELLANEOUS

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

2.08 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.

2.09 FABRICATION TOLERANCES

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

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 INSTALLATION - GENERAL

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

3.04 BENT METAL RESTRAINTS

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

3.05 MISCELLANEOUS FRAMING AND SUPPORTS

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

3.06 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 05 5000

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum pipe and tube railings.
B. Includes:
   1. Stair railings and guardrails.

1.02 REFERENCE STANDARDS

A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
C. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
D. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
E. ASTM B241/B241M - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube; 2022.
F. ASTM B429/B429M - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube; 2020.
G. ASTM B483/B483M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Tube and Drawn Pipe for General Purpose Applications; 2021.
H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2020.
I. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
J. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
K. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

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:
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 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 ALUMINUM RAILING SYSTEM

A. Aluminum Pipe: Schedule 40; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.
B. Aluminum Tube: Minimum wall thickness of 0.127 inch; ASTM B429/B429M, ASTM B241/B241M, or ASTM B483/B483M.
C. Solid Bars and Flats: ASTM B211/B211M.
D. Non-Weld Mechanical Fittings: Slip-on cast aluminum, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
E. Straight Splice Connectors: Concealed spigot; cast aluminum.
F. Exposed Fasteners: No exposed bolts or screws.

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. 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.

2.05 ALUMINUM FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

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.
C. Apply one coat of bituminous paint to concealed aluminum surfaces that will be in contact with cementitious or dissimilar materials.

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 05 5213

SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

A. AWC (WFCM) - Wood Frame Construction Manual for One- and Two-Family Dwellings; 2024, with Errata.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
C. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
D. ASTM D2898 - Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing; 2010 (Reapproved 2024).
E. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Wood Structural Panels (Plywood or Oriented Strand Board) to Wood Based Floor System Framing; 2019a.
F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.
G. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
H. PS 20 - American Softwood Lumber Standard; 2025.

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.
C. 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.

1.05 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.

1.06 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Stainless steel for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.
   3. Anchors:
      a. Toggle bolt type for anchorage to hollow masonry.
      b. Expansion shield and lag bolt type for anchorage to solid masonry or concrete.
      c. Bolt or ballistic fastener for anchorages to steel
B. Joist Hangers: Hot dipped galvanized steel, sized to suit framing conditions.
   1. For contact with preservative treated wood in exposed locations, provide minimum G185 galvanizing complying with ASTM A653/A653M.
   2. Manufacturers:
      a. MiTek Industries, Inc.: www.mitek-us.com.
      b. Nu-Vue Industries, Inc.: www.nu-vueindustries.com.
      c. Simpson Strong-Tie Company Inc.: www.strongtie.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.
C. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.
   1. Products:
      a. Owens Corning Insulating Systems, LLC; ProPink ComfortSeal Sill Gasket: www.owenscorning.com.
      b. Dupont/Dow; Sill Seal Foam Gasket: www.dupont.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.
D. Subfloor Adhesives: Waterproof, air cure type, cartridge dispensed; adhesives designed for subfloor applications and complying with either ASTM C557 or ASTM D3498.
   1. Manufacturers:
      a. Franklin International, Inc; Titebond GREENchoice Weatherproof Subfloor Adhesive: www.titebond.com.
      b. Liquid Nails, a brand of PPG Industries, Inc.; LN-902 Subfloor & Deck Construction Adhesive (Low VOC): www.liquidnails.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.
E. Construction Adhesives: Adhesives complying with ASTM C557 or ASTM D3498.
   1. Manufacturers:
      a. Franklin International, Inc; Titebond GREENchoice Heavy Duty Construction Adhesive: www.titebond.com.
      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.

1.07 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

2.01 PREPARATION

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

2.02 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.

2.03 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.

2.04 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.

2.05 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.

2.06 ROOF-RELATED CARPENTRY

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

2.07 INSTALLATION OF CONSTRUCTION PANELS

A. Subflooring: Glue and screw to framing; staples are not permitted.
B. Roof Sheathing: Secure panels with long dimension perpendicular to framing members, with ends staggered and over firm bearing.
   1. Screw panels to framing; staples are not permitted.

2.08 SITE APPLIED WOOD TREATMENT

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

2.09 TOLERANCES

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

2.10 CLEANING

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

END OF SECTION 06 1000

SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Cabinets and millwork - specially fabricated.
   1. Plastic-laminate clad cabinets and millwork.
B. Countertops.- Specified In 12 3600 Countertops
C. Miscellaneous items including:
   1. Window stools
   2. Closet and utility shelving.
   3. Other items as indicated on Drawings.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.
B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.
D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
E. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
F. BHMA A156.9 - Cabinet Hardware; 2020.
G. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.
H. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
I. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
K. PS 1 - Structural Plywood; 2023.
L. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data for the following:
   1. Anchors and fasteners.
   2. Adhesives.
   3. Shop finishing materials.
   4. Fire retardant treatment.
   5. Wood preservative treatment.
C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories. Include the following:
   1. Information required by AWI/AWMAC/WI (AWS).
   2. Dimensioned plans, elevations, and sections.
   3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
   4. Show locations and sizes of cutouts and holes for items installed in architectural woodwork.
D. Samples: Three samples of each of the following:
   1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish.
   2. Transparent Wood Finishes:
      a. 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. 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. Substitutions: Not permitted.
   2. Colors, Patterns, and Finishes:
      a. PL-1Wilsonart; Solar Oak 7816-60.

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. Formica Corporation: www.formica.com.
      c. Substitutions: Not permitted.
   2. Colors, Patterns, and Finishes:
      a. SS-1Durat, 730-00.
      b. SS-2 Dupont Corian; Cameo 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 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.

2.06 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.

2.07 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. 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.

2.08 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 {\id\#1000020} - {\t\#1000020} 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 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.

3.05 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.

3.06 ADJUSTING

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

3.07 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 06 4023

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. 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 07 1113

SECTION 07 2100 - THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Board insulation.
B. Batt insulation.

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 C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
B. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
C. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.
E. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.
F. 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: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
   1. Type: Type IV.
   2. Compressive Strength: 25 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 25 SE; www.diversifoam.com.
   b. Dow Building Solutions, Dow Chemical Company; Styrofoam Brand Square Edge Insulation: www.dow.com.
   c. Kingspan Insulation LLC; GreenGuard XPS TYPE IV 25 PSI: www.trustgreenguard.com.
   d. Owens Corning; Foamular 250: www.owenscorning.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.

B. 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.

C. 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 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.

2.03 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 07 2100

SECTION 07 2500 - WEATHER BARRIERS

PART 2 PRODUCTS

END OF SECTION 07 2500

SECTION 07 2726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Vapor-retarding, 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; 2025a.

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; 2024.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.

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 - AIR AND VAPOR BARRIER

A. Air and Vapor 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: 0.1 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 I: www.master-builders-solutions.basf.us
      b. Carlisle Coatings & Waterproofing; Fire Resist Barritech NP: www.carlisleccw.com.
      c. GCP Applied Technologies; Perm-a-Barrier NPL 10: www.gcpat.com.
      d. Henry Company; Air-Bloc 16MR: www.henry.com.
      e. Prosoco Inc.; R-Guard VB: www.prosoco.com.
      f. Sto Corp.; StoGuard VaporSeal: www.stocorp.com.
      g. Tremco Inc.; EXOAIR 130: www.tremcosealants.com.
      h. W.R. Meadows; Air-Shield LSR: 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 07 2726

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; 2025a.
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 - CONCEALED FASTENERS

A. Flush Panels:

1. Profile: Flush flat.
2. Panel Coverage (Width): 12 inches, minimum.
3. Panel Depth: 1 to 1-1/2 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: To match Architect's sample.
11. Basis-of-Design: Centria; IW-10A: www.centria.com. Provide either the named product or a comparable product by one of the following:
    a. AEP Span; Flush Panel www.aepspan.com.
    b. Berridge Manufacturing Company; FW-12: www.berridge.com.
    c. Fabral; 12-RO: www.fabral.com.
    d. Metal Sales Manufacturing Corp.; Flush Face Series-12, TLC-1: www.metalsales.us.com.
    e. Morin Corp., a Kingspan Group Company; Concealed A-12: www.morincorp.com.
    f. Petersen Aluminum Corporation; Flush Wall Panel: www.pac-clad.com.
    g. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SOFFIT PANELS

A. Soffit Panels:

1. Profile: 2 segment, v-groove, flat panels.
2. Panel Coverage (Width): 12 inches.
3. Panel Depth: 1/2 inch.
4. Ventilation: Half 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.
10. Basis-of-Design: Elevate; UNA-CLAD UC-750: www.holcimelevate.com. Provide either the named product or a comparable product by one of the following:
    a. ATAS International, Inc.; Wind-Lok Soffit Panels: www.atas.com.
    b. Merchant & Evans, Inc.; PS-8b, 150-12 Soffit Panels: www.ziprib.com.
    c. Petersen Aluminum Corporation; PAC-750 Soffit: www.pac-clad.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

2.04 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.

2.05 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.

2.06 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.
    1. Color: As selected from manufacturer’s standards.

2.07 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 structural substrate is ready to receive panel system.
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 07 4213

SECTION 07 5323 - EPDM MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ethylene-propylene-diene-terpolymer (EPDM) roofing assembly; fully adhered. Including, but not limited to, the following:
   1. Cover board.
   2. Insulation, flat and tapered.
   3. Vapor barrier.
   4. Substrate board.
   5. Walkway pads.

1.02 ABBREVIATIONS

A. EPDM: Ethylene-propylene-diene-terpolymer.

1.03 REFERENCE STANDARDS

A. ASTM C1278/C1278M - Standard Specification for Fiber-Reinforced Gypsum Panel; 2017.
B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
D. ASTM D1876 - Standard Test Method for Peel Resistance of Adhesives (T-Peel Test); 2008 (Reapproved 2023).
E. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
F. ASTM D5602/D5602M - Standard Test Method for Static Puncture Resistance of Roofing Membrane Specimens; 2018 (Reapproved 2022).
G. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane; 2015, with Editorial Revision (2022).
H. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
I. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
J. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
K. FM (AG) - FM Approval Guide; Current Edition.
L. 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.
M. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2024).
N. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
O. FM DS 1-49 - Perimeter Flashing; 2016.
P. NRCA (RM) - The NRCA Roofing Manual; 2023.
Q. NRCA (WM) - The NRCA Waterproofing Manual; 2021.

1.04 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.

1.05 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide data indicating membrane materials, flashing materials, cover boards, insulation, vapor barrier, substrate board, adhesives, and fasteners.
C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, 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 barrier, substrate board, and walkway pads.
E. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
F. Manufacturer's Qualification Statement.
G. Installer's Qualification Statement.
H. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.
I. Field Quality Control 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 performing the work of this section with minimum 5 years documented experience, and approved by manufacturer.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in manufacturer's original containers, dry, undamaged, with seals and labels intact.
B. Store products 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.
E. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.

1.08 FIELD CONDITIONS

A. Do not install roofing assembly during unsuitable weather and temperatures 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.

1.09 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
B. Manufacturer Warranty: Provide 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 rood edge metals.
C. Installer Warranty: Provide installation warranty where Installer agrees to correct defective Work within a 2 year period after Date of Substantial Completion; includes failure to prevent penetration of water.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Roof Assembly shall be provided by by one of the following:
   1. Carlisle SynTec Systems; www.carlislesyntec.com.
   2. Holcim Elevate (formerly Firestone Building Products); www.holcimelevate.com.
   3. Johns Manville; www.jm.com.
   4. Substitutions: Not permitted.

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 ASSEMBLY

A. Single-ply membrane roofing assembly consisting of the following:
   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. Vapor barrier.
   5. Substrate board; mechanically fastened.
   6. 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. Minimum Insulation Requirements: Excluding tapered insulation.
      a. Minimum Layers of Insulation: Two.
      b. Minimum R-value: 30.
   3. 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.

2.03 ROOF MEMBRANE

A. Membrane: Ethylene-propylene-diene-terpolymer (EPDM); internally reinforced with fabric or scrim; complying with minimum properties of ASTM D4637/D4637M.
   1. Thickness: 0.060 inch (60 mil), nominal.
   2. Color: Black.

2.04 COVER BOARD

A. Faced Polyisocyanurate Cover Board: High compressive strength board, conforming to ASTM C1289, Type II, Class 4 - Faced with coated or uncoated polymer-bonded glass fiber mat facers on both major surfaces of the core foam.
   1. Grade and Compressive Strength: Grade 1, 80 psi.
   2. Board Size: 4 by 4, or 4 by 8 feet.

3. Board Thickness: 1/2 inch.
4. Insulation Thermal Resistance, R-value: 2.5, nominal.
5. Products:
   a. Carlisle SynTec Systems; SecurShield HD Plus: www.carlislesyntec.com.
   b. Holcim Elevate (formerly Firestone Building Products); ISOGARD HD Cover Board: www.holcimelevate.com.
   c. Johns Manville; ProtectoR HD: www.jm.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.05 INSULATION

A. Polyisocyanurate Board Insulation: Rigid cellular foam, conforming to ASTM C1289.
   1. Classifications:
      a. Type II:
         1) Class 2 - Faced with coated polymer-bonded glass fiber mat facers on both major surfaces of core foam.
         2) Compressive Strength: Grade 2 - 20 psi (138 kPa), minimum.
         3) Long Term Thermal Resistance (LTTR) R-value: At 1 inch thick; 5.7 at 75 degrees F.
   2. Board Size: 4 by 4, or 4 by 8 feet.
   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. Carlisle SynTec Systems; SecurShield: www.carlislesyntec.com.
      b. Holcim Elevate (formerly Firestone Building Products); Resista: www.holcimelevate.com.
      c. Johns Manville; Enrgy 3 CGF:www.jm.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.06 VAPOR BARRIER

A. Self-Adhering-Sheet Vapor Barrier: 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 (formerly Firestone Building Products); V-Force: www.holcimelevate.com.
      c. Johns Manville; JM Vapor Barrier SA: www.jm.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

2.07 SUBSTRATE BOARD

A. Substrate Board: ASTM C1177/C1177M, glass-mat, water-resistant gypsum board or ASTM C1278/C1278M, fiber-reinforced gypsum board.

1. Thickness: 1/2 inch.
2. Size: 4 by 4, or 4 by 8 feet.
3. Products:
   a. Georgia-Pacific Gypsum: DensDeck Prime Roof Board: www.gp.com.
   b. National Gypsum Company; DEXcell Brand FA Glass Mat Roof Board: www.nationalgypsum.com.
   c. United States Gypsum Co.; USG Securock Brand Gypsum-Fiber Roof Board; www.usg.com.
   d. Substitutions: See Section 01 6000 - Product Requirements.

2.08 WALKWAYS

A. Flexible Walkways: 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. Holcim Elevate (formerly Firestone Building Products); 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. Flexible Flashing Material: Same material as roofing membrane.
   1. Thickness: Same as roofing membrane unless otherwise recommended by roof membrane manufacturer.
   2. Uncured, unless otherwise recommended by roof membrane manufacturer.
C. 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.
D. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel bars, approximately 1 by 1/8 inch thick; with anchors.
E. Membrane and Flashing Adhesive: As recommended by membrane manufacturer.
F. Seaming Materials: Manufacturer's standard splice tape with release film.
G. Insulation Adhesive: As recommended by insulation manufacturer and as follows:
   1. Full-spread, spray-applied, low-rise, two-component urethane adhesive.
H. 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
I. Sealants and Pourable Sealers: As recommended by membrane manufacturer.
J. Surface Conditioner for Adhesives: Compatible with membrane and adhesives.
K. Vapor Barrier Primer: As recommended by vapor barrier 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 INSTALLATION - GENERAL

A. Perform work in accordance with manufacturer's instructions, NRCA (RM), and NRCA (WM) applicable requirements.
B. Do not apply roofing membrane during unsuitable weather.
C. Do not apply roofing membrane when ambient temperature is outside the temperature range recommended by manufacturer.
D. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
E. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.

3.03 SUBSTRATE BOARD INSTALLATION

A. Install substrate boards with long joints in continuous straight lines and end joints staggered not less than 24 inches on center between board rows.
B. At metal deck, install substrate board at right angle to flutes of deck.
   1. Locate end joints over crests of metal deck.
C. Tightly butt substrate boards together.
D. Cut substrate board to fit tight around penetrations and projections.
E. Fasten substrate board to top flanges of metal deck according to roof assembly manufacturer's instructions and FM (AG) Factory Mutual requirements.

3.04 VAPOR BARRIER INSTALLATION

A. Self-Adhering-Sheet Vapor Barrier: 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.

3.05 INSULATION INSTALLATION

A. Ensure vapor barrier is clean and dry, continuous, and ready for application of insulation.
B. Attachment of Insulation: Includes tappered insulation.
   1. Mechanically fasten first layer of insulation to deck in accordance with roof assembly manufacturer's instructions and FM (AG) Factory Mutual requirements.
   2. Embed each subsequent layer of insulation in adhesive in accordance with roof assembly manufacturers' instructions and FM (AG) Factory Mutual requirements.
   3. Lay subsequent layers of insulation with joints staggered minimum 6 inch from joints of preceding layer.
C. Cover Boards:
   1. Adhere cover board to insulation using adhesive according to roof assembly manufacturer's instructions and FM (AG) Factory Mutual requirements.
D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
E. On metal deck, place boards perpendicular to flutes with insulation board ends bearing on deck flutes.

F. Lay boards with edges in tight contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
   1. Gaps between boards and adjacent materials shall not exceed 1/4 inch.
G. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 24 inches.
H. Do not apply more insulation than can be covered with membrane in same day.

3.06 MEMBRANE INSTALLATION

A. Fully adhere membrane roofing system in accordance with manufacturer's recommendations and NRCA (RM) 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. Accurately align roof membrane, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.
   1. Overlap edges and ends and seal seams by splice tape. Seal permanently waterproof.
E. At intersections with vertical surfaces:
   1. Fully adhere flexible flashing over membrane and up to nailing strips.
   2. Secure flashing to nailing strips at 4 inches on center.
F. At gravel stops, extend membrane under gravel stop and down face of wall behind gravel stop fascia. Secure with fasteners to nailing strips.
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.

3.07 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.

3.08 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.

3.09 FIELD QUALITY CONTROL

A. See Section 01 4000 - Quality Requirements, for general requirements for field quality control and inspection.
B. Require site attendance of roof assembly manufacturer daily during installation of the 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

3.10 CLEANING

A. Clean all dirt, footprints, overspray, spillage, debris, and other construction waste materials from the roof assembly.
B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their documented instructions.
C. Repair or replace defaced or damaged finishes caused by work of this section.

3.11 PROTECTION

A. Protect installed roofing and flashings from construction operations.

END OF SECTION 07 5323

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. Drip edges.
   4. Gutters and downspouts.
   5. Precast splash blocks.
   6. 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/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.

C. ASTM B32 - Standard Specification for Solder Metal; 2020.

D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.

E. FM DS 1-49 - FM Global Property Loss Prevention Data Sheet - Perimeter Flashing; 2016.

F. NRCA (RM) - The NRCA Roofing Manual; 2023.

G. 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/A666M, 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 GUTTER AND DOWNSPOUT FABRICATION

A. Material: Pre-finished aluminum.
B. Gutters: SMACNA (ASMM) Rectangular profile; matching Style A.
    1. Expansion Joints: Lap type.
C. Downspouts: Rectangular profile.
D. Gutters and Downspouts: Size for rainfall intensity determined by a storm occurrence of 1 in 10 years in accordance with SMACNA (ASMM), unless otherwise indicated.
E. Anchorage Accessories: Profiled to suit gutters and downspouts.
    1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
    2. Gutter Supports: Continuous cleat and straps.
    3. Downspout Supports: Straps.
F. Downspout Boots: Plastic, unless otherwise indicated.
G. Seal metal joints.

H. Accessories:
1. Continuous, removable leaf screen; sheet metal frame and hardware cloth screen.
2. Valley baffles.

2.05 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.

2.06 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.

2.07 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.

2.08 PRECAST CONCRETE SPLASH BLOCKS

A. Precast Concrete Splash Block:
1. Size: Approximately 12 inches wide by 30 inches long by 4 inches deep.
2. Color: Gray.
3. Weight: Approximately 50 pounds.
4. Manufacturers: Available manufacturer's include, but are not limited to, the following:
a. The Century Group: www.centurygrp.com.
b. Modern Pre-Cast, Inc.: www.modernprecast.com.
c. NuCast Precast Company: www.nucastprecast.com.

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 GUTTERS AND DOWNSPOUTS

A. Secure gutters and downspouts in place with concealed fasteners.
    1. Gutter Supports: Space 30 inches on center, maximum.
    2. Downspout Supports: Locate at top and bottom of downspout and 60 inches on center, maximum.
B. Slope gutters 1/4 inch per 10 feet, minimum, unless otherwise indicated.
C. Where indicated, connect downspouts to downspout boots, and seal connection watertight.
D. Where gutters spill on grade, provide precast concrete splash block at each downspout discharge.

3.05 DRIP EDGES

A. Install at bottom edges of roof slopes, roof rakes, and elsewhere as indicated.
B. Fasteners: Space 18 inches on center, maximum.

3.06 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.

3.07 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.

3.08 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 07 6200

SECTION 07 7100 - ROOF SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured roof specialties, including:
   1. Copings.
   2. Fascia/gravel stops.
   3. Roof expansion joint cover assemblies.
   4. Gutters and downspouts.

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; 2025.
D. NRCA (RM) - The NRCA Roofing Manual; 2023.

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. Copings.
      b. Roof edges/gravel stops.
      c. Roof expansion joint cover assemblies.
      d. Gutters and downspouts.

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. Copings: Factory fabricated to sizes required; corners mitered; concealed fasteners.
   1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness, and finish as cap; concealed stainless steel fasteners.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
   3. Material: Formed aluminum sheet, 0.063 inch thick, minimum.
   4. Finish: PVDF coating; 70 percent polyvinylidene fluoride.
   5. Color: Two or three coat custom color to match Architect's sample.
   6. Products:
      a. Architectural Products Co.; AP Snap Tight Coping: www.archprod.com.
      b. ATAS International, Inc.; Rapid-Lok Coping: www.atas.com.
      c. Carlisle SynTec Systems; SecureEdge 200 Coping: www.carlislesyntec.com.
      d. Firestone Building Products; Firestone Gold Coping: www.firestonebpco.com.
      e. Johns Manville; Presto Lock Coping System: www.jm.com.

f. Metal-Era; Perma-Tite Coping: www.metalera.com.
g. OMG Roofing Products; PermaSnap: www.omgroofing.com.
h. Petersen Aluminum Corp.; PAC-TITE Coping: www.pac-clad.com.
i. Sika Sarnafil; Wall Grip Coping: usa.sarnafil.sika.com.
j. Substitutions: See Section 01 6000 - Product Requirements.

B. 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. Firestone Building Products; Firestone EdgeGard - Snap-On: www.firestonebpco.com.
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.

C. 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 1 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. Rating: 2 hours
3. Accessories: Include the following:
a. Manufacturer's standard moisture barrier.
4. 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 GUTTERS AND DOWNSPOUTS

A. Secure gutters and downspouts in place with concealed fasteners.
   1. Gutter Supports: Space 30 inches on center, maximum.
   2. Downspout Supports: Locate at top and bottom of downspout and 60 inches on center, maximum.
B. Seal metal joints.
C. Slope gutters 1/4 inch per 10 feet, minimum, unless otherwise indicated.
D. Where indicated, connect downspouts to downspout boots, and seal connection watertight.

3.05 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 07 7100

SECTION 07 7200 - ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof curbs.
B. Roof hatches.
C. Collapsible guard rail system.

1.02 REFERENCE STANDARDS

A. 29 CFR 1910.23 - Ladders; Current Edition.
B. 29 CFR 1926.502 - Fall protection systems criteria and practices; Current Edition.
C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2024.
D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
E. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

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.
   1. Snow Guards: Submit design calculations for loadings and spacings based on manufacturer testing.
   2. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in the State in which the Project is located.
D. Samples:
   1. For each material and finish, submit three samples 4 by 4 inch in size illustrating metal finish color.
E. Warranty Documentation:
   1. Submit manufacturer warranty.
   2. Ensure that forms have been completed in Owner's name and registered with manufacturer.
   3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

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.

1.05 WARRANTY

A. See Section 01 7800 - Closeout Submittals for additional warranty requirements.
B. Source Limitations: Provide related roofing assembly components include rood edge metals from either the roof membrane manufacturer or one of the listed product manufacturers; subject to approval of roof membrane manufacturer.
C. Correct defective Work within a five year period after Date of Substantial Completion.

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: 36 by 36 inches.
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.

2.04 ROOF HATCHES AND VENTS, MANUAL AND AUTOMATIC OPERATION

A. Sound Rated Roof Hatch Manufacturers:

B. 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. Dur-Red Products: www.dur-red.com.
6. LMCurbs: www.lmcurbs.com.
7. Milcor, Inc., Hart & Cooley Inc.: www.milcorinc.com.
8. Nystrom, Inc: www.nystrom.com.
9. The Pate Company; www.patecurbs.com
10. Substitutions: See Section 01 6000 - Product Requirements.

C. Smoke and Heat Vent Manufacturers:
1. Acudor Products Inc; _____: www.acudor.com/#sle.
2. Babcock-Davis; SafeMax: www.babcockdavis.com/#sle.
3. BILCO Company; Type DSH - Double Leaf: www.bilco.com/#sle.
4. Kingspan Light + Air, LLC; formerly Bristolite Daylighting Systems, Inc; Bristol Smoke Vent SVAA: www.bristolite.com/#sle.
5. Nystrom, Inc; SmokEscape (double leaf): www.nystrom.com/#sle.

D. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
1. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
2. Curb Height: __ inches from surface of roof deck, minimum.

E. Safety Railing System: Roof hatch manufacturer's standard accessory safety rail system mounted directly to curb.
1. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.

F. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
1. 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.
2. Hinges: Heavy duty pintle type.
3. Hold open arm with vinyl-coated handle for manual release.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior.
6. Locking: Padlock hasp on interior.

2.05 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
1. Design Loadings and Configurations: As required by applicable codes.
2. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
4. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.

2.06 COLLAPSIBLE GUARD RAIL SYSTEM

A. Collapsible Guard Rails: Provide collapsible portable guard rail section with one-way pivot assembly that allows guardrail to fold down to horizontal surface for clean sightlines; requires no penetrations in substrates for installation.
1. 1.Guard rail system shall meet or exceed OSHA (Standards - 29 CFR) 1926.501 and29 CFR 1926.502.
a. Structural Load: 200 lbs., minimum, in any direction in accordance with OSHA Regulations 29 CFR 1910.23 and 29 CFR 1926.502.

2. Guard rail shall lock in upright position
3. Guard Rail Height: 42 inches.
4. Railings: 1-5/8 inch O.D. hot rolled pickled electric weld tubing.
5. Bases: Class 30 gray iron; 108 lbs. base weight and 48 lbs. per square foot.
6. Finish: Factory finished powder coat paint.
   a. Color: Safety Yellow.

B. Protection Pads: Provide protection pads under bases to protect roof assembly.
   1. Comply with requirements of Section 07 5323 - EPDM Membrane Roofing.

C. Bais of Design Product: Subject to compliance with requirements, provide StealthRail 2000 Guardrail System as manufactured by BlueWater Mfg., Inc.; www.bluewater-mfg.com, or a comparable product by one of the following:
   1. Approved equal.

2.07 SNOW GUARDS

A. Pipe Type Snow Guard: Continuous snow guard; manufacturer's standard dual pipe set in brackets with snow plates to restrict migration of snow beneath pipes.
   1. Brackets: Aluminum.
   2. Pipe or Square Tube: Aluminum, mill finish.
      a. Outside Diameter, Round: 1 inch, nominal.
   3. Supplemental Plates and Clips: Attached to horizontal component; match finish of pipe.
   4. Clamps for Standing Seam Roof: Aluminum clamps attached to standing seams of roof panels; for attachment of pipe type snow guard.
      a. Seam Profile: Selected by Architect from manufacturer's full range; match profile of metal roof.
      b. Secure clamps to metal roof with stainless-steel set screws incorporating round nonpenetrating point.
   5. Finish: Mill finish.
   6. Products:
      a. Ace Clamp, PMC Industries, Inc.; A2 2 Bar Snow Guard System: www.aceclamp.com.
      b. Alpine SnowGuards; ASG4025 Two-Pipe Snow Guard: www.alpinesnowguards.
      c. Metal Roof Innovations, Ltd., S-5! Attachment Solutions; X-Gard 2.0: www.s-5.com.
      d. Substitutions: See Section 01 6000 - Product Requirements.

B. Fence Type Snow Guard: Continuous snow guard; manufacturer's standard fence rail with pre-finished sheet metal insert, set in brackets with snow plates to restrict migration of snow beneath fence.
   1. Brackets: Aluminum.
   2. Fence Rail: Manufacturer's standard extruded aluminum fence with insert for pre-finished sheet metal trim.
      a. Pre-finished Sheet Metal Insert: Provided by Section 07 4113 - Metal Roof Panels.
   3. Supplemental Plates and Clips: Attached to horizontal component; match finish of fence rail.
   4. Clamps for Standing Seam Roof: Aluminum clamps attached to standing seams of roof panels; for attachment of fence type snow guard.
      a. Seam Profile: Selected by Architect from manufacturer's full range; match profile of metal roof.
      b. Secure clamps to metal roof with stainless-steel set screws incorporating round nonpenetrating point.
   5. Finish: Mill finish.
   6. Products:
      a. Ace Clamp, PMC Industries, Inc.; Color Snap A2 Snow Rail System: www.aceclamp.com.
      b. Alpine SnowGuards; SimpleGuard Standing Seam Fence-Style Snow Guard: www.alpinesnowguards.

c. Metal Roof Innovations, Ltd., S-5! Attachment Solutions; Colorgard: www.s-5.com.
d. Substitutions: See Section 01 6000 - Product Requirements.

2.08 ROOF SNOW AND ICE MELTING SYSTEMS

A. Roof Snow and Ice Melting Systems: Self-regulating heating cable system for roof and gutter applications to melt snow and ice.
1. Application: Shingle roofing system with gutter.
2. Provide cable spacing and number of heating circuits and accessories in accordance with manufacturer's written requirements.
3. Supply Voltage: 110-120 VAC with ground-fault protection as required by authorities having jurisdiction (AHJ).
4. Manufacturers:
a. Thermon Manufacturing Company; _____: www.thermon.com/#sle.

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.
D. Snow Guard Installation:
1. Space rows as recommended by manufacturer.
2. Install brackets to vertical ribs in straight rows.
3. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.

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 07 7200

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; 2024.
B. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2024.
C. ASTM E2174 - Standard Practice for On-Site Inspection of Installed Firestop Systems; 2024.
D. ASTM E2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers; 2024.
E. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-Story Test Apparatus; 2025.
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, with Editorial Revision (2024).
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 07 8400

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 MANUFACTURERS

A. Precompressed Foam Seals:
   1. Balco, Inc: www.balcousa.com/#sle.
   2. Construction Specialties, Inc.: www.c-sgroup.com
   3. EMSEAL Joint Systems, Ltd: www.emseal.com/#sle.
   4. Inpro Corporation: www.inprocorp.com
   5. Watson Bowman Acme Corporation: www.watsonbowmanacme.com/#sle.
   6. Willseal LLC: www.willseal.com/#sle.
   7. Substitutions: See Section 01 6000 - Product Requirements.

2.02 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 weathertight 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/#sle.
      b. Construction Specialties, Inc.; VF Series: www.c-sgroup.com
      c. EMSEAL Joint Systems, Ltd; Seismic Colorseal: www.emseal.com/#sle.

d. Inpro Corporation; 1200 Series Foam Seals: www.inprocorp.com
e. Watson Bowman Acme Corporation; Wabo Seismic WeatherSeal SWS : www.watsonbowmanacme.com/#sle.
f. Willseal LLC; Willseal Color Coreseal V: www.willseal.com/#sle.
g. Substitutions: See Section 01 6000 - Product Requirements.

2.03 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 07 9100

SECTION 07 9200 - JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
E. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2025.
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 2025).
J. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).

1.03 SUBMITTALS

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

1. Provide 1/2 inch wide joint sealant samples formed between two 4 inch long strips of material matching appearance of exposed surfaces adjacent to joint sealants.

F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

G. Field Quality Control Plan: Submit at least two weeks prior to start of installation.

H. Field Quality Control Log: Submit filled out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.

1.04 QUALITY ASSURANCE

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

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

C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.

1. Adhesion Testing: In accordance with ASTM C794.
2. Compatibility Testing: In accordance with ASTM C1087.
3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
4. Allow sufficient time for testing to avoid delaying the work.
5. Deliver to manufacturer sufficient samples for testing.
6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

D. Owner may employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.

1. Contractor shall cooperate with testing agency and repair failures discovered.
2. Otherwise, if Owner does not employ an independent testing agency, Contractor shall perform its own field quality control measures including the following:
   a. Field Quality Control Plan and Log.
   b. Field Adhesion Test Procedures.

E. Field Quality Control Plan:

1. Visual inspection of entire length of sealant joints.
2. Non-destructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
   a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 120 inches thereafter.
   b. If any failures occur in the first 10 linear feet, continue testing at 48 inch intervals at no extra cost to Owner.

F. Field Adhesion Test Procedures:

1. Allow sealants to fully cure as recommended by manufacturer before testing.
2. Have a copy of the test method document available during tests.
3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
4. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
5. Non-Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
   a. Record results on Field Quality Control Log.

b. Repair failed portions of joints.

1.05 WARRANTY

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

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
   a. Wall expansion and control joints.
   b. Joints between door, window, and other frames and adjacent construction.
   c. Joints between different exposed materials.
   d. Openings below ledge angles in masonry.
   e. Other joints as indicated.
2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
   a. Joints between door, window, and other frames and adjacent construction.
   b. Other joints as indicated.
3. Do not seal the following types of joints.
   a. Intentional weepholes in masonry.
   b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
   c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
   d. Joints where installation of sealant is specified in another section.
   e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

1. Control and Expansion Joints in Concrete Paving: Self-leveling silicone traffic-grade sealant.

C. Interior Joints: Use non-sag acrylic emulsion latex sealant, unless otherwise indicated.

1. Interior Sides of Aluminum Framing in Exterior Walls: Use non-sag non-staining silicone sealant, unless otherwise indicated.
   a. Includes, but is not limited to, curtain walls, storefronts, and metal-framed skylights.
2. Control Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
3. Column Isolation Joints in Interior Concrete Slabs: Self-leveling silicone "traffic grade" sealant.
4. Floor Joints in Wet Areas: Self-leveling silicone "traffic grade" sealant; not for continuous liquid immersion
5. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; clear, unless otherwise indicated.
6. Joints between countertops and walls: Mildew-resistant silicone sealant; clear, unless otherwise indicated.

D. Interior Wet Areas: Includes, but is not limited to, toilet rooms, showering areas, locker rooms, kitchens, and food service areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.02 NONSAG JOINT SEALANTS

A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, M and O; not expected to withstand continuous water immersion or traffic.

1. Movement Capability: Plus and minus 50 percent, minimum.

2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Hardness Range: Comply with one of the following:
   a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
   b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
5. Color: Custom color(s) to match Architect's sample(s).
6. Cure Type: Single-component, neutral moisture curing.
7. Service Temperature Range: Minus 40 to 250 degrees F.
8. Products:
   a. Momentive Performance Materials, Inc./GE; SCS9000 SilPruf NB: www.siliconeforbuilding.com.
   b. Pecora Corporation; 890NST: www.pecora.com.
   c. Sika Corporation; Sikasil WS-295 FPS: www.usa.sika.com.
   d. Tremco, Inc.; Spectrem 3: www.tremcosealants.com.
   e. Dow Chemical Company; DOWSIL 790 Silicone Building Sealant: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
   f. Substitutions: See Section 01 6000 - Product Requirements.

B. Traffic Grade Silicone Sealant: ASTM C920, Grade NS, Type S, Uses T, M, and O; not expected to withstand continuous water immersion.
1. Movement Capability: Plus 100 percent, minus 50 percent, minimum
2. Hardness Range: Comply with one of the following:
   a. 5 to 15, Shore A, when tested in accordance with ASTM C661.
   b. 85, Shore 00, when tested in accordance with ASTM C661.
3. Color: To be selected by Architect from manufacturer's full range.
4. Cure Type: Single-component, neutral moisture curing.
5. Service Temperature Range: Minus 40 to 250 degrees F.
6. Products:
   a. Dow Corning; NS Parking Structure Sealant: www.dowcorning.com.
   b. Pecora Corporation; 311NS: www.pecora.com.
   c. Sika Corporation; Sikasil - 728 NS: www.usa.sika.com.
   d. Tremco, Inc.; Spectrem 800: www.tremcosealants.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.

C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Type S, Uses NT, A, G, and O; mildew resistant; not expected to withstand continuous water immersion or traffic.
1. Movement Capability: Plus and minus 25 percent, minimum.
2. Hardness Range: Comply with one of the following:
   a. 15 to 35, Shore A, when tested in accordance with ASTM C661.
   b. 25 to 35, Shore A, when tested in accordance with ASTM D2240.
3. Color: Clear.
4. Cure Type: Single-component, acetoxy or neutral moisture curing .
5. Service Temperature Range: Minus 40 to 300 degrees F.
6. Products:
   a. Dow Corning; 786 Sealant M: www.dowcorning.com.
   b. Momentive Performance Materials, Inc./GE; SCS1700 Sanitary: www.siliconeforbuilding.com.
   c. Pecora Corporation; 898NST: www.pecora.com.
   d. Sika Corporation; Sikasil - GP: www.usa.sika.com.
   e. Tremco, Inc.; Tremsil 200 with fungicide: www.tremcosealants.com.
   f. Substitutions: See Section 01 6000 - Product Requirements.

D. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use. Siliconized.
1. Color: To be selected by Architect from manufacturer's full range.

2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).
3. Products:
   a. Franklin International Inc; Titebond Painter's Plus Caulk: www.titebond.com.
   b. Pecora Corporation; AC-20 +Silicone: www.pecora.com.
   c. Sherwin Williams; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com.
   d. Tremco, Inc.; Tremflex 834: www.tremcosealants.com.
   e. Substitutions: See Section 01 6000 - Product Requirements.

2.03 SELF-LEVELING SEALANTS

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

2.04 ACCESSORIES

A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
   1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
   3. Bi-Cellular: 25 to 33 percent larger in diameter than joint width.

B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.

D. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

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

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
B. Perform installation in accordance with ASTM C1193.
C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
D. Install bond breaker backing tape where backer rod cannot be used.
E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.
I. Installation of Two-Stage Joints at Precast Architectural Concrete Units:
    1. Joint system consists of two back-to-back sealant joints at each precast architectural concrete unit joint with a weep at the bottom of the unit joint per Precast/Prestressed Concrete Institute (PCI) recommendations and as follows:
        a. Inner (Secondary) Seal: Inner secondary backer rod and sealant joint is installed a minimum of 2 to 2-1/2 inches beyond the exposed face of the precast architectural concrete panels within the panel joint itself.
        b. Exterior (Primary) Seal: Following the installation of the secondary joint, the outer primary backer rod and sealant joint is installed at the face of the precast architectural concrete panels with a weep at the bottom of the joint. Leave open continuous air space between the primary backer rod and inner secondary seal.
        c. Install 3/8 inch minimum weep openings in the exterior seal to allow water penetrating the exterior seal and contained by the inner seal to exit the cavity between joint seals.
            1) Do not install weeps below finish grades.
        d. Near the junction of horizontal and vertical joints, the inner seal must turn out to the plane of the exterior seal at regular intervals to force water out of the joint.

3.04 FIELD QUALITY CONTROL

A. Owner may employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
B. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
C. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.

END OF SECTION 07 9200

SECTION 07 9513 - EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies for wall 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 - Specification for Anodized Architectural Aluminum; 2024.
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 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).

2.03 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.

2.04 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 07 9513

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. Thermally insulated hollow metal doors with frames.
E. 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; 2024.
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; 2025.
F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
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; 2023, with Editorial Revision.
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; 2025.
M. BHMA A156.115 - Hardware Preparation in Steel Doors and 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; 2025.
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. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.

4. Door Edge Profile: Beveled, both sides.
5. Typical Door Face Sheets: Flush.
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. 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.
8. 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. Exterior Doors: Thermally insulated, Non-Fire Rated.
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
   a. Level 3 - Extra Heavy-duty.
   b. Physical Performance Level A 1 000 000 cycles; in accordance with ANSI/SDI A250.4.
   c. Model 2 - Seamless.
   d. Door Face Metal Thickness: 20 gauge, 0.032 inch, minimum.
   e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
2. Door Core Material: Polyurethane, 1.8 lbs/cu ft minimum density.
3. Door Thermal Resistance: R-Value of 8.7 minimum for installed thickness of polyurethane.
4. Weatherstripping: Refer to Section 08 7100.

C. 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.

D. 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. Exterior Door Frames: Full profile/continuously welded type.
1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
3. Weatherstripping: Separate, see Section 08 7100.
D. 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.
E. 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.
F. 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.
G. 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.
H. Transom Bars: Fixed, of profile same as jamb and head.
I. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.

J. Frames in Masonry Walls: Size to suit masonry coursing with head member 4 inches high to fill opening without cutting masonry units.
K. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
L. 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. Louvers: Roll formed steel with overlapping frame; finish same as door components; factory-installed.
1. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.
2. Style: Sightproof inverted V or Y blades.
3. Louver Free Area: 50 percent.
4. Fasteners: Concealed fasteners.
B. Glazing: As specified in Section 08 8000.
C. 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.
D. Astragals for Double Doors: Specified in Section 08 7100.
E. 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.
F. 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.
G. Filler: Two-component, non-shrinking resin, autobody filler.
1. Available Products:
a. 3M/Bondo; Professional Gold Body Filler: www.bondo.com.
H. 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 08 1113

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; 2024.
B. ITS (DIR) - Directory of Listed Products; Current Edition.
C. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
D. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
E. UL (DIR) - Online Certifications Directory; Current Edition.
F. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
G. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.03 SUBMITTALS

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

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Masonite Architectural; Cendura Standard Wood Veneer Doors : www.architectural.masonite.com/#sle.
   2. Mohawk Doors, Masonite Architectural: https://architectural.masonite.com.
   3. Oshkosh Door Company: www.oshkoshdoor.com.
   4. VT Industries, Inc: www.vtindustries.com.
   5. Substitutions: See Section 01 6000 - Product Requirements.
B. High Pressure Decorative Laminate (HPDL) Faced Doors:
C. Lead-Lined Wood Doors:
D. Sound-Rated Wood Doors:

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

2.03 DOOR CORES

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

2.04 DOOR FACINGS

A. Veneer Facing for Transparent Finish:
   1. Species and Cut:
      a. Species: Red Oak.
      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. Veneer Facing for Opaque Finish: Closed grain hardwood veneer, in compliance with indicated quality standard.

C. Facing Adhesive: Type II - water resistant.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:
   1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.
   2. Provide solid blocking for other throughbolted hardware.
   3. Provide 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: Wheat, WH18.
      c. Sheen: Satin.

B. Seal door top edge with color sealer to match door facing.

2.07 ACCESSORIES

A. Wood Door Frames: As specified in Section 06 4023 - {\t\#1000008}.

B. Hollow Metal Door Frames: As specified in Section 08 1113 - Hollow Metal Doors and Frames.

C. Metal Louvers:
   1. Material and Finish: Roll formed steel; pre-painted finish to color as selected.
   2. Louver Blade: Inverted V or Y blade, sight proof.
   3. Louver Free Area: 50 percent.
   4. Frame: Overlapping style with tamper proof fasteners.
   5. In Fire-Rated Doors: UL (DIR) or ITS (DIR) listed fusible link louver, same rating as door.

D. Glazing: See Section 08 8000.

E. 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.

F. 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 08 1416

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 - Voluntary Specification for Pile Weatherstripping and Replaceable Fenestration Weatherseals; 2011.
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; 2024.
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 (Reapproved 2023).
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; 2023, with Editorial Revision.
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 a Barcol Impressor; 2025.
S. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.
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.
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.
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 MISCELLANEOUS COMPONENTS

A. Louvers: Blades and frame of extruded aluminum, minimum 0.06 inch thick; size as indicated.
1. Style: Sightproof inverted V or Y blades

2.07 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.
2. Color: Two or three-coat custom color to match Architect's sample.
B. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.08 ACCESSORIES

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

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

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

3.03 INSTALLATION

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

3.04 FIELD QUALITY CONTROL

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

3.05 TOLERANCES

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

3.06 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.07 CLEANING

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

3.08 PROTECTION

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

END OF SECTION 08 1610

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; 2023, with Editorial Revision.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.

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 08 3100

SECTION 08 4313 - ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront.
B. Insulated infill panels.
C. Aluminum doors and frames.
D. Operable vents/sashes.

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; 2024.
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 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.
N. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
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 (Reapproved 2023).

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. Thermally Broken Storefront Products:
   1. Basis of Design: Kawneer North American, an Arconic company; Trifab VG 601UT 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. EFCO Corporation, an Apogee Enterprises, Inc. company; Series 406: www.efcocorp.com.
      b. Manko Window Systems, Inc.; 2600 XPT Series: www.mankowindowsystems.com.
      c. Tubelite Inc, an Apogee Enterprises, Inc. company; 24650 Series: www.tubeliteinc.com.
      d. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. 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. YKK AP America, Inc.; YES 40 FS: www.ykkap.com.
      f. Substitutions: Refer to Section 01 6000 - Product Requirements.

C. Swing Door Manufacturers:
   1. Any of the manufacturers specified for storefront 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. YKK AP America, Inc.; YES SSG Vent Zero Sightline: www.ykkap.com.
      e. Substitutions: Refer to Section 01 6000 - Product Requirements.

E. 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: Custom color to match Architect's sample.
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.
14. Minimum Thickness of Outer Wall for Door Frame Jambs: .125 inches (3.175mm)

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: 0.36 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.
   4. Extruded Sill Flashing
   5. Extruded Receiver Channel

B. Glazing: See Section 08 8000.

C. Infill Panels: Insulated, aluminum, with edges formed to fit glazing channel and sealed.
   1. Total Nominal Thickness: 1 inch.
   2. Overall Thickness: 1 inch.
   3. Face Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.

4. Core: Rigid polystyrene (EPS) insulation core with R-value of 4.
5. Back Sheet: 0.32 inch thick smooth aluminum on 3 mm thick corrugated polypropylene substrate.
6. Finish: Same as storefront.
7. 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: 10 inches wide.
6. Glazing Stops: Square.
7. Finish: Same as storefront.

2.04 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.
E. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
F. Concealed Flashings: Stainless steel, 26 gauge, 0.0187 inch minimum thickness.
G. Glass and Glazing Accessories: As specified in Section 08 8000.

2.05 FINISHES

A. 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: Two or three-coat custom color to match Architect's sample.

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 flashings, water-resistive and/or air barrier seal materials are ready to receive work of this section.
1. Notify Architect immediately of any deficient locations.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.
B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

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

3.03 TOLERANCES

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

3.04 FIELD QUALITY CONTROL

A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
B. See Section 01 4000 - Quality Requirements for general testing and inspection requirements.
C. Water-Spray Test: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
    1. Perform a minimum of three tests in each designated area as directed by Architect.
    2. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.
D. Owner may engage an independent inspection agency to perform additional tests and inspections as follows:
    1. Provide field testing of installed storefront system by independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
        a. Perform a minimum of three tests in each designated area as indicated on drawings.
        b. Conduct tests in each area prior to 10 percent, 50 percent, and 90 percent completion of this work.
        c. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 8 psf.
            1) Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
        d. Field test for air leakage in accordance with ASTM E783 with uniform static air pressure difference of 6.20 psf.
            1) Maximum allowable rate of air leakage is 0.09 cfm/sq ft.
E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

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

END OF SECTION 08 4313

SECTION 08 7100 - DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hardware for hollow metal, wood, aluminum and FRP-faced aluminum doors.

B. Electrically operated and controlled hardware.

C. Cylinders for doors or locks specified in other Sections.

1.02 RELATED REQUIREMENTS

A. Section 08 7100.01 - Door Hardware Sets: Door hardware schedules.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).

C. DHI (KSN) - Keying Systems and Nomenclature 1989.

D. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames 2004.

E. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors 1993; also in WDHS-1/WDHS-5 Series, 1996.

F. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

G. ITS (DIR) - Directory of Listed Products current edition.

H. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

I. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2019.

J. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

K. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2019.

L. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2017.

M. UL (DIR) - Online Certifications Directory Current Edition.

N. UL 1034 - Standard for Burglary-Resistant Electric Locking Mechanisms 2015.

O. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.

P. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

Q. UL 294 - Access Control System Units Current Edition, Including All Revisions.

R. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.

B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.

C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:

1. Architect.
2. Hardware Installer.
3. Owner's Security Consultant.

D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.

E. Keying Requirements Meeting:

1. All keying requirements will be provided by the Owner’s locksmith.

1.05 SUBMITTALS

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

B. Hardware Schedules:

1. To facilitate checking, follow scheduling sequence specified in hardware Sets, and as outlined in Sequence and Format for the Hardware Schedule published by DHI.
2. “Vertical” scheduling format only. “Horizontal” schedules will be returned “Not Approved”.
3. Include all notes and operational descriptions associated with each hardware Set.

C. Product Data: Submit product data for all door hardware and components listed in the Hardware Sets.

D. Shop Drawings: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.

1. List and describe each opening separately; include doors with identical hardware, except hand, in single heading. Include door number, room designations, degree of swing, and hand.
2. List hardware items; include manufacturer's name, quantity, product name, catalog number, size, base metal, finish, fasteners and related details where applicable.
3. List related details; include dimensions, door and frame material and other conditions affecting hardware.
4. Electrified Door Hardware:
    a. Submit diagrams for power, signal, and control wiring for electrified door hardware that include details of interface with building safety and security systems. Provide elevations and diagrams for each electrified door opening as follows:
        1) Submit front and back elevations of each door opening showing electrified devices with connections installed.

2) Submit operations narrative describing how opening operates from either side at any given time.

3) Submit point-to-point wiring diagram that shows each device in door opening system with related colored wire connections to each device.

E. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.

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

G. Maintenance Materials and Tools: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Lock Cylinders: Ten for each master keyed group.

3. Tools: One set of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least five years of documented experience and approved by manufacturer.

1. The installer will be responsible to modify, patch and repair the existing frames and doors for the proper installation of the new doors and hardware.

2. The installer will be responsible to field verify all existing conditions and include all modifications required in their installation proposal.

C. Single Source Responsibility.

1. Obtain each category of hardware (hinges, latch and locksets, exit devices, closers, etc.) from a single manufacturer.

D. Supplier Qualifications.

1. An established finish hardware supplier who is a factory authorized distributor for all products required, and has qualified personnel trained and experienced in preparing Hardware Schedules, issuing templates, ordering, furnishing, and servicing finish hardware for architecturally designed projects.

2. This supplier will be responsible for field verifying all existing doors and frames for compatibility with the new doors and hardware specified. Furnish custom strike plates for existing frame applications if required.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 WARRANTY

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

B. Warranty against defects in material and workmanship for period indicated, from Date of Substantial Completion.

1. Butt Hinges: One year, minimum.
2. Flush Bolts: One year, minimum.
3. Exit Devices and Trim: Three years, minimum.
   a. Electrified Exit Device Components: One year, minimum.
4. Locksets and Cylinders: Three years, minimum.
   a. Electrified Lockset Components: One year, minimum.
5. Closers: Thirty years, minimum.
6. Overhead stops and holders: One year, minimum.
7. Automatic Operators: Two years, minimum.
8. Other Hardware: One year, minimum.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.

B. Provide individual items of single type, of same model, and by same manufacturer.

C. Provide door hardware products that comply with the following requirements:

1. Applicable provisions of federal, state and local codes.
2. Accessibility: ADA Standards and ICC A117.1.
3. Applicable provisions of NFPA 101.
4. Fire-Rated Doors: NFPA 80, listed and labeled by qualified testing agency for fire protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
5. Hardware on Fire-Rated Doors: Listed and classified by UL (DIR) or ITS (DIR) as suitable for application indicated.
6. Hardware for Smoke and Draft Control Doors: Provide door hardware that complies with local codes, and requirements of assemblies tested in accordance with UL 1784.
   a. Air Leakage Rate: Tested in accordance with UL 1784, with air leakage rate not to exceed 3.0 cfm/sf of door opening at 0.10 inch of water for both ambient and elevated temperature tests.
7. Listed and certified compliant with specified standards by BHMA (CPD).
8. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
9. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
10. Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified.

D. Electrically Operated and/or Controlled Hardware: Provide necessary power supplies, power transfer hinges with wire harness connectors, wire harnesses, relays, and interfaces as required for proper operation; provide wiring between hardware and control components and to building power connection in compliance with NFPA 70.

E. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
    a. Aluminum fasteners are not permitted.
    b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Fire-Rated Applications: Comply with NFPA 80.

2.02 BUTT HINGES

A. Manufacturers:

1. Basis-of-Design: 5BB1HW and 5BB1; Ives (IVE); an Allegion company: www.us.allegion.com.
    a. Equal product from any B.H.M.A. member will also be acceptable.

B. Butt Hinges: Comply with BHMA A156.1, Grade 1.

1. Templated Hinges: Comply with BHMA A156.7.

2.03 FLUSHBOLTS

A. Manufacturers:

1. Basis-of-Design: FB Series. Ives (IVE); an Allegion company: www.us.allegion.com.
    a. Equal product from any B.H.M.A. member will also be acceptable.

B. Flush Bolts: Complying with BHMA A156.16, Grade 1.

1. Provide the following:
    a. Automatic flush bolts; meets BHMA A156.3.
    b. Constant latching flush bolts; meets BHMA A156.3.
    c. Manual flush bolts.
2. Flush bolt Throw: 3/4 inch, minimum.
3. Provide flush bolts in leading edge of inactive door leaves.
    a. One top bolt into top of frame and, where indicated, one bottom bolt into floor or threshold.
    b. Standard rod length shall be 12 inches. At oversized doors, provide extended rod lengths as required to accommodate actual door heights.
4. Provide dustproof floor strike for bolt into floor, and at metal thresholds.

5. Constant Latching Flush Bolts: Automatically latch upon closing of door; manually retracted top bolt, automatically retracted bottom bolt; located on inactive leaf of pair of doors.
6. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.

2.04 EXIT DEVICES

A. Manufacturers:
   1. Basis-of-Design: Sargent (SAR) 80 Series.
   2. Accepted alternates include: Von Duprin 98 Series and Precision APEX 2000 Series.

B. Exit Devices: Complying with BHMA A156.3, Grade 1.
   1. Provide exit devices in functions as specified in hardware sets.
   2. Lever design to match lever design of locks and latches.

2.05 ELECTRIC STRIKES

A. Manufacturers:
   1. Basis-of-Design: HES 1006 series.
   2. Von Duprin 6400 series will also be accepted.

2.06 CYLINDERS AND CORES

A. All hardware components capable of being locked will be provided with a large format, interchangeable core housing cylinder. Furnish mortise or rim type as required by the locking device. Provide cams or tail pieces as required.
   1. Furnish Sargent cylinder housing capable of accepting Owner's Medeco 6-pin large format interchangeable core system.
      a. No substitutions per district's standards.
   2. Owner to provide final cores and keying.
      a. Final cores shall be Medeco X4, 6-pin, large format interchangeable core, Part #322401N (formatted for Sargent cylinder housings only).
      b. Hardware supplier shall contact McElheney Security Solutions (Owner's Locksmith) prior to ordering cylinder housings to coordinate compatibility with final cores.
         1) McElheney Security Solutions: 419-244-5851
      c. Installation of final cores to be provided by the installing contractor.
   3. Furnish construction cores as required by the Construction Manager.

2.07 MORTISE LOCKSETS

A. Manufacturers:
   1. Basis-of-Design: Sargent (SAR) 8200 Series Mortise Locks with L Trim and LN Rose. (No substitutions per district standards)
   2. Furnish locks and latches with custom strikes for existing frames if required.

2.08 COORDINATORS

A. Manufacturers:

1. Basis-of-Design: COR Series.; Ives (IVE); an Allegion company: www.us.allegion.com.
    a. Equal product from Rpckwood and ABH will also be acceptable.

B. Coordinators:

1. Complying with BHMA A156.3.
2. Type: Bar, unless otherwise indicated.
    a. Provide filler bar to cover remaining length of door stop.
    b. Provide mounting brackets to accommodate other stop applied hardware.
3. Material: Aluminum, unless otherwise indicated.
4. Provide on door pairs having closers, overlapping astragal, self-latching or automatic flushbolts or other hardware requiring inactive door leaf to close before active door leaf.
5. Ensure that coordination of other door hardware affected by placement of coordinator is applied properly for proper door operation.

2.09 CLOSERS

A. Manufacturers:

1. Basis-of-Design: 4040XP Series; LCN.
2. Approved Alternate: Sargent 281 Series with heavy duty arms.

B. Closers: Complying with BHMA A156.4, Grade 1.

1. Review the door, frame and plan details to determine the proper length of arm, and the degree of swing. State the degree of door swing in the Hardware Schedule. Provide accessories such as drop and adapter plates, panel adapters, thick-hub shoes, blade stop spacers and shoe supports as required to install the closers correctly.

2.10 LOW ENERGY AUTOMATIC DOOR OPERATORS

A. Manufacturers:

1. Basis-of-Design: 4600 Series; LCN.
2. Approved Alternates: Besam SW200i, Stanley Magic Force.

B. Actuator Controls:

1. Furnish actuators as listed in hardware sets.

2.11 OVERHEAD STOPS AND HOLDERS

A. Manufacturers:

1. Basis-of-Design: 100/900 Series; Glynn-Johnson (GLY); an Allegion company: www.us.allegion.com.
    a. Equal product from any B.H.M.A. member will also be acceptable.

2.12 PROTECTION PLATES

A. Manufacturers:

1. Basis-of-Design: 8400 Series; Ives (IVE); an Allegion company: www.us.allegion.com.
    a. Equal product from any B.H.M.A. member will also be acceptable.

B. Protection Plates - General: Complying with BHMA A156.6.
1. Metal Properties: Stainless steel.
    a. Metal, Standard Duty: Thickness 0.05 inch, minimum.
2. Fasteners: Countersunk screw fasteners.

C. Kick Plates:
1. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
    a. Size: 10 inch high by 2 inch less door width (LDW) on push side of door.

2.13 RAIN DRIP GUARDS

A. Manufacturers:
1. Basis-of-Design: 16A; National Guard Products (NGP), Inc.: www.ngpinc.com.
2. Other acceptable manufacturers:
    a. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
    b. Hager Companies: www.hagerco.com.
    c. Reese Enterprises, Inc.; www.reeseusa.com.
    d. Zero International, Inc., an Allegion company: www.zerointernational.com.
    e. Substitutions: See Section 01 6000 - Product Requirements.

B. Rain Drip Guards:
1. Provide drip guards at head of exterior doors where indicated.
2. Drip guard shall be continuous across entire length of door.
3. Provide non-corroding fasteners at all locations.

2.14 WALL STOPS

A. Manufacturers:
1. Basis-of-Design: WS33; Ives (IVE); an Allegion company: www.us.allegion.com.
2. Other acceptable manufacturers:
    a. Rockwood; an Assa Abloy Group company: www.assaabloydss.com.
    b. Hager Companies: www.hagerco.com.
    c. Trimco: www.trimcohardware.com.
    d. Substitutions: See Section 01 6000 - Product Requirements.

2.15 REMOVABLE MULLIONS

A. Manufacturers:
1. Basis-of-Design: Special-Lite “SL” series. (No substitutions)

2.16 ASTRAGALS

A. Manufacturers:

1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
2. Hager Companies: www.hagerco.com.
3. National Guard Products, Inc.: www.ngpinc.com.
4. Reese Enterprises, Inc.; www.reeseusa.com.
5. Zero International, Inc., an Allegion company: www.zerointernational.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. Astragal Seals: Complying with BHMA A156.22.

1. Basis-of-Design: 115NA; National Guard Products, Inc.(NGP): www.ngpinc.com.
   a. Provide either the named product or a comparable product by one of the other manufacturers specified.
2. Where indicated, provide surface mounted astragal seals to cover or fill space between pairs of doors for full door height.
3. Comply with ASTM E283 for air infiltration.
4. Comply with UL 10B and UL 10C for fire rated doors.
5. Provide non-corroding fasteners at exterior locations.

2.17 THRESHOLDS

A. Manufacturers:

1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
2. Hager Companies: www.hagerco.com.
3. National Guard Products, Inc: www.ngpinc.com.
4. Reese Enterprises, Inc.; www.reeseusa.com.
5. Zero International, Inc., an Allegion company: www.zerointernational.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. Thresholds - Saddle: Complying with BHMA A156.21.

1. Basis-of-Design - Standard Threshold: 425; National Guard Products, Inc (NGP).: www.ngpinc.com.
   a. Where indicated provide an applied stop strip equal to 4N; National Guard Products, Inc.: www.ngpinc.com.
   b. Provide either the named product or a comparable product by one of the other manufacturers specified.
2. Basis-of-Design - Heavy Duty Threshold: 4825; National Guard Products, Inc (NGP).: www.ngpinc.com.
   a. Where indicated provide an applied stop strip equal to 4N; National Guard Products, Inc.: www.ngpinc.com.

b. Provide either the named product or a comparable product by one of the other manufacturers specified.

3. Provide threshold at each exterior door, unless otherwise indicated.
4. Type: Saddle.
   a. Provide heavy duty threshold; 10,000 pound load test.
5. Material: Aluminum.
6. Threshold Surface: Fluted horizontal grooves across full width.
7. Comply with ICC A117.1 for barrier free threshold requirements.
8. Stop Strip: Where indicated, provide an applied stop strip.
   a. Weatherstripping material: Santoprene.
   b. Comply with ASTM E283 for air infiltration.
9. Field cut threshold to profile of frame and width of door sill for tight fit.
10. Provide non-corroding fasteners at all locations.
11. Provide threshold at each exterior door, unless otherwise indicated.
12. Field cut threshold to profile of frame and width of door sill for tight fit.
13. Provide non-corroding fasteners at all locations.

2.18 WEATHERSTRIPPING AND GASKETING

A. Manufacturers:
   1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
   2. Hager Companies: www.hagerco.com.
   3. National Guard Products, Inc: www.ngpinc.com.
   4. Reese Enterprises, Inc.; www.reeseusa.com.
   5. Zero International, Inc., an Allegion company: www.zerointernational.com.
   6. Substitutions: See Section 01 6000 - Product Requirements.

B. Weatherstripping: Complying with BHMA A156.22.
   1. Basis-of-Design: 700NA; National Guard Products, Inc (NGP).: www.ngpinc.com.
      a. Provide either the named product or a comparable product by one of the other manufacturers specified.
   2. Head and Jamb Type: Encased in retainer.
   3. Material: Aluminum, with neoprene weatherstripping
   4. Comply with ASTM E283 for air infiltration.
   5. Comply with UL 10B and UL 10C for fire rated doors.
   6. Provide weatherstripping on each exterior door at head and jambs, unless otherwise indicated. Weatherstripping shall be continuous without gaps.

C. Fire and Smoke Gasketing: Complying with BHMA A156.22.

1. Basis-of-Design: 2525C; National Guard Products, Inc. (NGP): www.ngpinc.com.
    a. Provide either the named product or a comparable product by one of the other manufacturers specified.
2. Head and Jamb Type: Self-adhesive.
3. Comply with ASTM E283 for air infiltration.
4. Comply with UL 10B and UL 10C for fire rated doors.
5. Provide gasketing on each fire or smoke rated door at head and jambs, unless otherwise indicated. Gasketing shall be continuous without gaps.

D. Sound and/or Light Seals: Complying with BHMA A156.22.

1. Basis-of-Design: 700NA plus 5025C; National Guard Products, Inc.(NGP): www.ngpinc.com.
    a. Provide either the named products or a comparable product by one of the other manufacturers specified.
2. Head and Jamb Type: Encased in retainer plus self-adhesive type.
3. Material: Aluminum, with neoprene weatherstripping, plus TPE double batwing seal.
4. Provide sound and/or light gasketing where indicated. Gasketing shall be continuous without gaps.

2.19 SWEEPS, DOOR BOTTOMS, AND SHOES

A. Manufacturers:

1. Pemko; an Assa Abloy Group company: www.assaabloydss.com.
2. Hager Companies: www.hagerco.com.
3. National Guard Products, Inc: www.ngpinc.com.
4. Reese Enterprises, Inc.; www.reeseusa.com.
5. Zero International, Inc., an Allegion company: www.zerointernational.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

B. Bottom Sweeps: Complying with BHMA A156.22.

1. Basis-of-Design: C699A; National Guard Products, Inc (NGP).: www.ngpinc.com.
    a. Provide either the named product or a comparable product by one of the other manufacturers specified.

2.20 ELECTRIC POWER TRANSFERS

A. Manufacturers:

1. Basis-of-Design: EL-CEPT series; Sargent (SAR).

B. Electrified Power Transfer: Provide concealed mortised electric power and data transfer device; provide connection between frame and door with sufficient number and gage of conductors to accommodate function of hardware specified.

C. Furnish wire harnesses and connectors as indicated in the Hardware Sets.

2.21 ELECTROMAGNETIC DOOR HOLDERS

A. Manufacturers:

1. LCN: SEM7850 Magnetic Hold Open. (Basis of design.)
2. Rixson,; 900 Series.
3. Dorma; EM Series.

B. Electromagnetic Door Holders: Comply with BHMA A156.15.

1. Type: Wall mounted, single unit, standard duty, with strike plate attached to door.
2. Holding Force, Standard Duty: 35 lbs-force, minimum.
3. Voltage: 12 VDC / 24 VDC, and provide power supplies by same manufacturer as holders.
4. Provide interface with fire detectors and fire-alarm system for fire-rated door assemblies.

2.22 FINISHES

A. Finishes: As indicated in the Hardware Sets.

B. Comply with BHMA A156.18.

2.23

1.1 MISCELLANEOUS

A. Furnish items not categorized in the above descriptions but by specified manufacturer’s name in Hardware Sets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

B. Verify that electric power is available to power operated devices and of correct characteristics.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. This supplier will field verify all existing doors and frames prior to ordering any material.

3.02 INSTALLATION

A. Install hardware in accordance with manufacturer's instructions and applicable codes.

B. Install hardware on fire-rated doors and frames in accordance with applicable codes and NFPA 80.

C. Install hardware for smoke and draft control doors in accordance with NFPA 105.

D. Use templates provided by hardware item manufacturer.

E. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.

1. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
2. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
3. Mounting heights in compliance with ADA Standards:

F. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.

3.03 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Section 01 4000 - Quality Requirements.

B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

1. AHC shall be provided by Contractor.

2. AHC shall provide a written inspection report.

3.04 ADJUSTING

A. Adjust work under provisions of Section 01 7000 - Execution and Closeout Requirements.

B. Adjust hardware for smooth operation.

C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.

3.05 CLEANING

A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.

3.06 PROTECTION

A. Protect finished Work under provisions of Section 01 7000 - Execution and Closeout Requirements.

B. Do not permit adjacent work to damage hardware or finish.

C.

3.07 HARDWARE SETS

HARDWARE SUPPLIER NOTE: WHEN APPLICABLE, IT IS THE RESPONSIBILITY OF THE HARDWARE SUPPLIER TO FIELD VERIFY ALL EXISTING DOORS AND FRAMES AND PROVIDE A WRITTEN REPORT OF ANY DEFICIENCIES OF THE HARDWARE SPECIFIED DUE TO EXISTING FIELD CONDITIONS. FURNISH CUSTOM STRIKES FOR EXISTING FRAMES AS REQUIRED. FURNISH STRIKE FILLER PLATES FOR LOCATIONS WHERE NEW DOORS WITH PANIC/FIRE EXIT HARDWARE IS REPLACING MORTISE LOCKS WHEATHER INDICATED IN SETS OR NOT.

HW SET: 01

8	EA	HINGE	5BB1HW 5 X 4.5	652	IVE
2	EA	FIRE EXIT HARDWARE	43-12-NB-8715-ETL	626	VON
2	EA	SURFACE CLOSER	4040XP.REGARM	689	LCN
2	EA	MAGNETIC HOLD-OPEN	SEM7850	AL	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW	630	IVE
1	SET	SEALS	2525C	CHR	NGP
1	EA	ASTRAGAL SEAL	5070B	BRN	NGP
1	EA	FIRE PANEL POWER	BY FIRE ALARM CONTRACTOR		B/O

NOTE: THE ELECTROMAGNETIC HOLDERS WILL BE POWERED BY THE FIRE ALARM PANEL POWER SUPPLY AND WILL CUT POWER TO PERMIT THE DOORS TO CLOSE AND LATCH UPON ACTIVATION.

HW SET: 02

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ INDICATOR	V20-LB-8265-LNL	626	SAR
1	EA	WALL STOP	WS33	626	IVE

HW SET: 03

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ INDICATOR	V20-LB-8265-LNL	626	SAR
1	EA	SURFACE CLOSER	4040XP.REGARM	689	LCN
1	EA	WALL STOP	WS33	626	IVE

HW SET: 04

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	EA	FIRE EXIT HARDWARE	43-12-60-8804-ETL	626	SAR
1	EA	SURFACE CLOSER	4040XP.SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	SET	SEALS	2525C	CHR	NGP

HW SET: 05

6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	SET	CONST LATCHING BOLT	FB61P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	60-8204-LNL	626	SAR
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	SURFACE CLOSER	4040XP.REGARM	689	LCN
2	EA	OVERHEAD STOP	900S	630	GLY
2	EA	UL ARMOR PLATE	8402 34" X 1" LDW	630	IVE
1	SET	SEALS	2525C	CHR	NGP
1	EA	ASTRAGAL SEAL	5070B	BRN	NGP

HW SET: 06

3	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	60-8204-LNL	626	SAR
1	EA	SURFACE CLOSER	4040XP.REGARM	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW	630	IVE
1	EA	WALL STOP	WS33	626	IVE
1	SET	SEALS	2525C	CHR	NGP

HW SET: 07

3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
1	EA	STOREROOM W/ DEADBOLT	60-V20-LB-8251-LNL	626	SAR
1	EA	ELECTRIC STRIKE	1006CDB FAIL SECURE 24VDC	630	HES
1	EA	SURFACE CLOSER	4040XP.SCUSH	689	LCN
1	SET	WEATHER SEAL	BY FRAME SUPPLIER		B/O
1	EA	DOOR SWEEP	C699A	AL	NGP
1	EA	THRESHOLD	8425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
1	EA	DOOR POSITON SWITCH	BY SECURITY CONTRACTOR		B/O
1	EA	LOW VOLT. POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	REX MOTION SENSOR	BY SECURITY CONTRACTOR		B/O
1	EA	SCHEDULED UNLOCKING	BY SECURITY CONTRACTOR		B/O

OPERATION: THE DOOR IS UNLOCKED VIA THE CARD READER OR THE SCHEDULE OF THE ACCESS CONTROL SYSTEM. THE INSIDE HARDWARE WILL PERMIT FREE EGRESS AT ALL TIMES. THE DOOR POSITION SWITCH AND REX MOTION SENSOR WILL BE MONITORED BY THE ACCESS CONTROL SYSTEM.

NOTE: THE INSIDE THUMBTURN THROWS THE DEAD BOLT FOR PRIVACY WHEN THE ROOM IS OCCUPIED. THE DEADBOLT LOCKING CAN BE UNLOCKED BY A MECHANICAL KEY OVERRIDE.

HW SET: 08

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	POWER TRANSFER	EL-CEPT	630	SEC
1	EA	REM. CENTER POST	SL-61-KR	628	SPE
2	EA	PANIC HARDWARE	43-LD-55-56-60-8804-PSB	626	SAR
1	EA	CYLINDER HOUSING	MORTISE (REQ'D FOR REM. MULLION)	626	SAR
1	EA	SURFACE CLOSER	4040XP.SCUSH	689	LCN
1	EA	AUTO-EQUALIZER	4642	689	LCN
1	EA	OVERHEAD STOP	900S	630	GLY
1	SET	WEATHER SEAL	BY FRAME SUPPLIER		B/O
2	EA	DOOR SWEEP	C699A	AL	NGP
2	EA	THRESHOLD	8425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
2	EA	DOOR POSITON SWITCH	BY SECURITY CONTRACTOR		B/O
1	EA	LINE VOLTAGE	BY SECURITY CONTRACTOR		B/O
1	EA	LOW VOLT. POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	REMOTE LOCKDOWN	BY SECURITY CONTRACTOR		B/O
1	EA	SCHEDULED UNLOCKING	BY SECURITY CONTRACTOR		B/O
1	EA	WEATHER RING	8310-801		LCN
2	EA	ACTUATOR, WALL MOUNT	8310-853T		LCN
2	EA	FLUSH MOUNT BOX	8310-867F		LCN
2	EA	FRAME WIRE HARNESS	QC-1500P (FOR JUNCTION BOX)		MCK
2	EA	DOOR WIRE HARNESS	QC-CXXXP (FOR EXIT DEVICE)		MCK

OPERATION: THE DOOR IS UNLOCKED VIA THE CARD READER AND THE SCHEDULE OF THE ACCESS CONTROL SYSTEM. WHEN THE DOOR IS UNLOCKED ELECTRICALLY, THE OUSIDE ACTIVATION SWITCH WILL BE ENABLED FOR USE. THE INSIDE ACTIVATION SWITCH WILL UNLATCH THE DOOR PRIOR TO ACTIVATING THE OPERATOR. THE PANIC HARDWARE WILL PERMIT FREE EGRESS AT ALL TIMES. THE DOOR POSITION AND REQUEST TO EXIT SWITCHES ARE MONITORED BY THE ACCESS CONTROL SYSTEM. THE REMOTE LOCKDOWN WILL DISABLE POWER TO PREVENT ALL MEANS OF ELECTRONIC UNLOCKING.

NOTE: LOCATE THE KEY AND THE AUTO OPERATOR ON THE RHR DOOR LEAF.

HW SET: 09

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	630	IVE
2	EA	POWER TRANSFER	EL-CEPT	630	SEC
1	EA	REM. CENTER POST	SL-61-KR	628	SPE
2	EA	PANIC HARDWARE	43-LD-55-56-60-8804- PSB	626	SAR
1	EA	CYLINDER HOUSING	MORTISE (REQ'D FOR REM. MULLION)	626	SAR
1	EA	SURFACE CLOSER	4040XP.SCUSH	689	LCN
1	EA	AUTO-EQUALIZER	4642	689	LCN
1	EA	OVERHEAD STOP	900S	630	GLY
1	SET	WEATHER SEAL	BY FRAME SUPPLIER		B/O
2	EA	DOOR SWEEP	C699A	AL	NGP
2	EA	THRESHOLD	8425	AL	NGP
1	EA	CARD READER	BY SECURITY CONTRACTOR		B/O
2	EA	DOOR POSITON SWITCH	BY SECURITY CONTRACTOR		B/O
1	EA	LINE VOLTAGE	BY SECURITY CONTRACTOR		B/O
1	EA	LOW VOLT. POWER SUPPLY	BY SECURITY CONTRACTOR		B/O
1	EA	REMOTE LOCKDOWN	BY SECURITY CONTRACTOR		B/O
1	EA	ACTUATOR, JAMB MOUNT	8310-818T		LCN
1	EA	JAMB BOX ONLY	8310-819F		LCN
1	EA	FLUSH MOUNT BOX	8310-867F		LCN
1	EA	ACTUATOR, WALL MOUNT	8310-853T		LCN
2	EA	FRAME WIRE HARNESS	QC-1500P (FOR JUNCTION BOX)		MCK
2	EA	DOOR WIRE HARNESS	QC-CXXXP (FOR EXIT DEVICE)		MCK

OPERATION: THE DOOR WILL BE UNLOCKED VIA THE CARD READER AND THE SCHEDULE OF THE ACCESS CONTROL SYSTEM. WHEN THE DOOR IS UNLOCKED ELECTRICALLY, THE OUSIDE ACTIVATION SWITCH WILL BE ENABLED FOR USE. THE INSIDE ACTIVATION SWITCH WILL UNLATCH THE DOOR PRIOR TO ACTIVATING THE OPERATOR. THE PANIC HARDWARE WILL PERMIT FREE EGRESS AT ALL TIMES. THE DOOR POSITION AND REQUEST TO EXIT SWITCHES ARE MONITORED BY THE ACCESS CONTROL SYSTEM. THE REMOTE LOCKDOWN WILL DISABLE POWER TO PREVENT ALL MEANS OF ELECTRONIC UNLOCKING.

NOTE: LOCATE THE KEY AND THE AUTO OPERATOR ON THE LHR DOOR LEAF.

HW SET: 10

6	EA	HINGE	5BB1HW 4.5 X 4.5	652	IVE
2	EA	PULL	810-PTB		SAR
2	EA	DUMMY TOUCH BAR	43-8893	626	SAR
1	EA	SURFACE CLOSER	4040XP.SCUSH	689	LCN
1	EA	AUTO-EQUALIZER	4642	689	LCN
1	EA	OVERHEAD STOP	900S	630	GLY
1	EA	LINE VOLTAGE	BY SECURITY CONTRACTOR		B/O
2	EA	ACTUATOR, WALL MOUNT	8310-853T		LCN
2	EA	FLUSH MOUNT BOX	8310-867F		LCN

OPERATION: THE ACTIVATION SWITCHES ON BOTH SIDES OF THE DOOR WILL AUTMATICALLY OPEN THE DOOR FOR INGRESS / EGRESS. THE DUMMY TOUCH BAR WILL PERMIT FREE EGRESS AT ALL TIMES.

NOTE: LOCATE THE AUTO OPERATOR ON THE RHR DOOR LEAF.

HW SET: 11

6	EA	HINGE	5BB1HW 4.5 X 4.5 NRP	652	IVE
1	SET	AUTO FLUSH BOLT	FB41P	630	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	60-8204-LNL	626	SAR
1	EA	COORDINATOR	COR X FL	628	IVE
2	EA	MOUNTING BRACKET	MB SERIES	689	LCN
2	EA	SURFACE CLOSER	4040XP.SCUSH ST-2648	689	LCN
2	EA	UL ARMOR PLATE	8402 34" X 1" LDW	630	IVE
1	SET	SEALS	2525C	CHR	NGP
1	EA	ASTRAGAL SEAL	5070B	BRN	NGP

END OF SECTION 08 7100

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Monolithic glazing.
B. Insulating glass.
C. Fire rated glazing.
D. 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 2019).
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; 2025.
R. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
S. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2024.
T. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
U. GANA (GM) - GANA Glazing Manual; 2022.
V. GANA (SM) - GANA Sealant Manual; 2008.
W. GANA (LGRM) - Laminated Glazing Reference Manual; 2019.
X. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
Y. IGMA TB-3001 - Guidelines for Sloped Glazing; 2001.
Z. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).

AA. NFPA 251 - Standard Methods of Tests of Fire Resistance of Building Construction and Materials - 2006.
BB. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.
CC. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
DD. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
EE. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data on Glazing. Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
D. Samples: Submit three samples 12 by 12 inch in size for each glass type.
    1. Non-insulated types may be 4 by 4 inches in size.
E. Certificate: Certify that products of this section meet or exceed specified requirements.
F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

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

1.06 MOCK-UPS

A. See Section 01 4000 - Quality Requirements for additional requirements.
B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
    1. Install glazing in mockups specified in:
        a. Section 08 4435 - Protective Framed Glazing Assemblies.
        b. Section 08 4313 - Aluminum-Framed Storefronts.
        c. Section 08 4413 - Glazed Aluminum Curtain Walls.
        d. Section 08 5113 - Aluminum Windows.
        e. Section 08 6300 - Metal-Framed Skylights.
C. Mock-ups may remain as part of the Work.

1.07 FIELD CONDITIONS

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

1.08 WARRANTY

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

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

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

2.02 PERFORMANCE REQUIREMENTS

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

b. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
   1) Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 the short side length or 1 inch, whichever is less.
c. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
d. Glass thicknesses listed are minimum.

2. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
   a. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   b. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
   c. Solar Optical Properties: Comply with NFRC 300 test method.

B. Probability of Breakage: Design glass for a probability of breakage not greater than 0.008 (8 lites per 1000) for glass not more than 15 degrees from vertical.

C. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

D. Insulating Glass:
1. Insulating Glass Certification Program: Provide insulating glass units that are certified by the Insulating Glass Certification Council (IGCC).
   a. Provide permanent markings with appropriate certification label of IGCC on either the spacer or one lite of each insulated unit.

E. Safety Glazing:
1. Complies with ANSI Z97.1 and 16 CFR 1201; test requirements for Class A/Category II.
2. Markings for Safety Rated Glazing: Provide permanent markings on safety-rated glazing in compliance with applicable safety glazing standards, ICC (IBC), local building code, and authorities having jurisdiction.

F. Fire Rated Glazing:
1. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with NFPA 80, NFPA 252, NFPA 257, UL 9, UL 10B, and UL 10C.
   a. Fire protection rated glazing with a 20 minute rating shall be exempt from the hose-stream test.
2. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire protection ratings indicated; tested in accordance with ASTM E119, NFPA 80, NFPA 251, NFPA 252, NFPA 257, UL 9, UL 10B, UL 10C, and UL 263.
3. Labeling: Provide permanent markings on fire rated glazing in compliance with ICC (IBC), local building code, and authorities having jurisdiction.
   a. "W" Label: Meets wall assembly criteria of ASTM E119 or UL 263 fire test standards.
   b. "OH" Label: Meets fire window assembly criteria including hose stream test of NFPA 257 or UL 9 fire test standards.
   c. "D" Label: Meets fire door assembly criteria of NFPA 252, UL 10B, or UL 10C fire test standards.
   d. "H" Label: Meets fire door assembly hose stream test of NFPA 252, UL 10B, or UL 10C fire test standards.
   e. "T" Label: Meets temperature rise of not more than 450 degrees F above ambient at end of 30 minutes fire exposure in accordance with NFPA 252, UL 10B, or UL 10C fire test standards.

f. "XXX" Label - Placeholder that represents fire protection or fire resistance rating period, in minutes.

4. Accessories:

a. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with fire rated glazing and each other, and that are approved for use with fire rated glazing by testing agencies that listed and labeled fire rated glazing.

G. Glass Thickness: Indicated glass thicknesses are minimums. Provide glass that complies with performance requirements and load designs, and is not less than the thickness indicated.

H. Glass Strength:

1. Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with performance requirements.
2. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with performance requirements.

I. Glass Distortion Tolerances:

1. Roller Wave: Maximum 0.003 (0.076 mm) from peak to valley within the main body of the sheet and maximum 0.008 (0.2 mm) within 10.5 inches of a leading or trailing edge.
2. Localized Warp: Maximum 0.03 inch (0.8 mm) over any 12 inch (305 mm) span, but limited to 0.31 inch (8 mm).

2.03 FLOAT GLASS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.

1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
4. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.

a. Glass Tints: Provide the following:

1) Color: Gray.

(a) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc.; Optigray, or a comparable product from any of the manufacturers specified for float glass.

2.04 LAMINATED GLASS

A. Laminated Glass: Float glass laminated in accordance with ASTM C1172.

1. Unless otherwise indicated laminate glass shall consist of two plies of clear annealed float glass with a polyvinyl butyral interlayer.

a. Minimum Thickness of Each Glass Ply: 1/8 inch (3 mm), unless otherwise indicated.

b. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum, unless otherwise indicated.

1) Interlayer Color: Clear, unless otherwise indicated.

2.05 INSULATING GLASS

A. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.

B. General: Unless otherwise noted, Insulating Glass Unit Types shall comply with the following:

1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO.

a. Low-E Coating:

1) Basis-of-Design Product: Vitro Architectural Glass (formerly PPG Industries, Inc. ; Solarban 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 SPANDREL GLASS

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

B. Ceramic Frit Spandrel Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) type coatings on flat glass; coated spandrel glass, Kind CS.
   1. Color: Standard color as selected by Architect.
   2. Manufacturers: Any of the manufacturers specified for float glass.

2.07 FIRE RATED GLASS

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

d. Vetrotech Saint-Gobain North America; Pyroswiss 20: www.vetrotechusa.com.

B. Fire-Protection-Rated 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

2.08 ONE-WAY MIRRORED GLASS

A. One-Way Mirrored Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) type coatings on flat glass; coated vision glass, Kind CV.
   1. Allows privacy with clear vision into observed space.
   2. Light Level Ratio: 8:1 from bright (subject) side to dark (observer) side.
   3. Mirrored coating toward subject-side.
   4. Glass Tint: Gray.
   5. Visible Transmittance: 11 percent.
   6. Visible Reflectance - Coated Side: 68 percent.
   7. Visible Reflectance - Glass Side: 16 percent.

2.09 GLAZING COMPOUNDS

A. Butyl Sealant: Solvent-based; ASTM C1311; single component, nonsag, butyl sealant.
   1. Product:
      a. Pecora Corp.; BC-158: www.pecora.com.
      b. Tremco, Inc.; Butyl Sealant: www.tremcosealants.com.
      c. Substitutions: Refer to Section 01 6000 - Product Requirements.

B. General Glazing Silicone Sealant: Neutral-curing silicone glazing sealant complying with ASTM C920, Type S, Grade NS, Class 25 or 50, Use NT.
   1. Products:
      a. Dow Corning Corporation; 899 Silicone Glazing Sealant: www.dowcorning.com.
      b. GE/Momentive Performance Materials, Inc: SCS2800 SilGlaz II: www.siliconeforbuilding.com
      c. Pecora Corporation: 896: www.pecora.com.
      d. Tremco, Inc.: Spectrem 2: www.tremcosealants.com.
      e. Substitutions: Refer to Section 01 6000 - Product Requirements.
   2. Color: Black.

C. Structural Sealant Glazing (SSG) Adhesive: Neutral curing, silicone sealant formulated for SSG applications in compliance with ASTM C1184 and structural glazing industry guidelines, ASTM C1401.
   1. SSG adhesive in compliance with ASTM C920; Type S - Single-component, Grade NS, Class 25, Use NT, G, and A.
   2. Ultimate Tensile Strength: Minimum of 50 psi as determined by test method ASTM C1135 under the following conditions.
      a. Exposure to air temperatures of 190 degrees F and minus 20 degrees F.
      b. Water immersion for seven (7) days, minimum.
      c. Exposure to weathering for 5,000 hours, minimum.
   3. Sealant Design Tensile Strength: 20 psi, maximum.
   4. Hardness: 20 to 60 with Type A-2 durometer in compliance with test method ASTM C661.
   5. Color: Black.

6. SSG sealant tested for compatibility with glazing accessories in compliance with ASTM C1087, tested for accelerated weathering in compliance with ASTM C793, and in compliance with insulating glass secondary sealant design standards of ASTM C1249.
7. Products:
   a. Dow Corning Corporation; 995 Structural Glazing Sealant: www.dowcorning.com .
   b. GE/Momentive Performance Materials, Inc: SSG4000 UltraGlaze: www.siliconeforbuilding.com.
   c. Pecora Corporation: 895NST: www.pecora.com.
   d. Sika; SikaSil SG-20: www.sika.com.
   e. Tremco, Inc.: Proglaze SSG: www.tremcosealants.com.
   f. Substitutions: Refer to Section 01 6000 - Product Requirements.

2.10 ACCESSORIES

A. Setting Blocks: EPDM or neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: EPDM or neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
   1. Width: As required for application.
   2. Thickness: As required for application.

D. Glazing Gaskets and Splines: Resilient EPDM or polyvinyl chloride extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

E. Glazing Clips: Manufacturer's standard type.

2.11 VISION LITE KITS FOR FIRE RATED DOOR GLAZING

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

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

C. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
B. Use one or more of the specified glazing methods as recommended by GANA, glass manufacturer, and installer, and as required to comply with performance requirements.
C. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
D. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
E. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
F. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
G. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

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

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

3.06 INSTALLATION - DRY GLAZING METHOD (TAPE AND TAPE)

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

3.07 INSTALLATION - 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.

3.08 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.

3.09 PROTECTION

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

3.10 GLASS SCHEDULE

A. GL-1: Clear heat-strengthened laminated glass.
   1. Clear laminated safety glass.
   2. Minimum Thickness: 1/4 inch (6 mm).
   3. Safety glazing required.
B. GL-2: Low-E, Tinted heat-strengthen laminated insulating glass.
   1. Overall Unit Thickness: 1 inch.
   2. Outdoor Lite: Tinted heat-strengthen laminated float glass.
      a. Minimum Thickness: 1/4 inch (6 mm).
      b. Tint Color: Gray.
   3. Airspace:
      a. Width: 1/2 inch.
      b. Interspace Content: Air.
   4. Indoor Lite: Clear heat-strengthen laminated float glass.
      a. Minimum Thickness: 1/4 inch (6 mm).
      b. PVB Interlayer Color: Clear.
      c. Low-E Coating: On 3rd surface.
   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.

C. FRGL-1: 20 minute fire-protection-rated glazing.
   1. Specialty tempered float glass.
   2. Thickness: 1/4 inch.
   3. Fire Rating: 20 minutes.
D. FRGL-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.

END OF SECTION 08 8000

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; 2024.
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. Framed - Top and Bottom: Extruded aluminum J-trim with top mounting cleat and airspace behind mirror. Frameless sides. Bottom trim has raised rib to prevent moisture from being trapped in channel.
   1. Exposed Face: 5/16 inch.
   2. Finish: Satin anodized.
   3. Products:
      a. C.R. Laurence Co., Inc.; Cleat Mount System, www.crlaurence.com.
         1) Top J-trim: Model D645AA.
         2) Top Cleat: Model D1637M.
         3) Bottom J-trim: D645AA.
      b. Substitutions: See Section 01 6000 - Product Requirements.

C. 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. Framed - Top and Bottom:
    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 of 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 and press firmly into adhesive.
        a. Other than adhesive, verify that air space behind mirror is clear and free of debris.
    6. Install top J-trim on cleat; ensure that it snaps in place securely.
    7. Ensure that mirror is properly aligned and secured in framing without excessive movement or vibrations.
G. 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 08 8300

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 K6744: 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 08 9100

SECTION 09 0561 - COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 PRICE AND PAYMENT PROCEDURES

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

1.03 REFERENCE STANDARDS

A. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
B. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
D. ASTM F3010 - Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use Under Resilient Floor Coverings;2018.
E. 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. Material: Comply with ASTM F3010.
   2. Thickness: As required for application and in accordance with manufacturer's installation instructions.
   3. Provide resistance to up to 95 percent relative humidity and 15 pounds moisture vapor transmission.
   4. Provide resistant to alkalinity (pH) level of pH 14.
   5. 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 CONCRETE SLAB PREPARATION

A. Follow recommendations of testing agency.
B. Perform following operations in the order indicated:
   1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
      a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
      b. Removal of existing floor covering.
   2. Preliminary cleaning.

3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
6. Patching, smoothing, and leveling, as required.
7. Other preparation specified.
8. Adhesive bond and compatibility test.
9. Protection.

C. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

A. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 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.

3.04 MOISTURE VAPOR EMISSION TESTING

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

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

G. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

A. Internal relative humidity testing for concrete floor slabs.
   1. Test where adhesive applied floor finishes are to be installed, and where indicated.
      a. Including:
         1) Wood gymnasium flooring.
         2) Wood stage flooring.

B. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.

C. Where this specification conflicts with the referenced test method, comply with the requirements of this section.

D. Test in accordance with ASTM F2170 Procedure A and as follows.

E. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.

F. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
   1. After remedial floor coating has been applied, perform the test again.
      a. If test values exceed floor covering manufacturer's limits, notify Architect immediately and await further instructions. Do not install finish flooring.

G. Report: Report the information required by the test method.

3.06 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.

3.07 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.08 APPLICATION OF REMEDIAL FLOOR COATING

A. 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.

B. 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.

3.09 PROTECTION

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

END OF SECTION 09 0561

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; 2025a.
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; 2024.
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; 2024.
P. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.
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; unless products are 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, G60, hot-dip galvanized.
   2. Minimum Metal Thickness: 0.0329 inch (20 gage).
   3. Profiles:
      a. Studs: Manufacturer's standard C-H or C-T profile.
         1) Depth: As indicated.
      b. Runners: Manufacturer's standard J-profile track; matching studs in depth.
      c. Slotted Deflection Track: As specified in "Framing Materials" above.
   4. Fasteners and Associated Materials: As specified in "Framing Accessories" above.

2.06 SUSPENSION SYSTEMS

A. Carrying Channels: ASTM C955; cold-rolled galvanized steel sheet U-channel.
   1. Protective Coating: ASTM A653/A653M, G60, hot-dip galvanized.
   2. Minimum Metal Thickness: 0.064 inch (16 gage).
   3. Depth: 2 inches unless otherwise indicated.

B. Furring Channels:
   1. Hat-Shaped, Rigid Furring Channels: As specified in "Framing Materials" above.
   2. Resilient Furring Channels: As specified in "Framing Materials" above.

C. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch (16 gage) diameter or double strand of 0.048-inch (18 gage) diameter wire.

D. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch (8 gage) diameter.

E. Hanger Attachments to Concrete:
   1. Expansion Anchors: Fastener systems with evaluations based on ICC-ES AC193.
   2. Adhesive Anchors: Fastener systems with evaluations based on ICC-ES AC308.
   3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
   4. Material for Exterior Locations and Interior Wet/Humid Locations: Alloy Group 1 (A1) stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. At Contractor's option provide grid suspension system instead of traditional carrying and furring channels.
   2. Not permitted for multi-layer gypsum board systems.
   3. Manufacturers:
      a. Armstrong World Industries, Inc.; Drywall Grid Suspension System: www.armstrongceilings.com.
      b. CertainTeed/Saint-Gobain; Quickspan Locking Drywall Grid System: www.certainteed.com.
      c. Rockfon, Part of the Rockwool Group; Chicago Metallic Drywall Grid: www.rockfon.com.
      d. USG Corporation: Drywall Suspension System: www.usg.com
      e. Substitutions: See Section 01 6000 - Product Requirements

2.07 FABRICATION

A. Fabricate assemblies of framed sections to sizes and profiles required.
B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

3.02 INSTALLATION OF STUD FRAMING

A. Comply with requirements of ASTM C754.
B. Install framing, shaft wall framing, suspension systems, and related accessories and components in accordance with manufacturer's instructions.
C. Extend partition framing to structure where indicated and to 4 inches above ceiling in other locations unless otherwise indicated.
D. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling framing in accordance with details.
E. Partitions Terminating at Structure: Attach extended leg top runner to structure, maintain clearance between top of studs and structure, and brace both flanges of studs as indicated.
F. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
G. Align and secure top and bottom runners at 24 inches on center.
H. Fire-Resistance-Rated Partitions: Install framing, including shaft wall framing, to comply with fire-resistance-rated assembly indicated.
I. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
   1. At partitions indicated with an acoustic rating:
      a. Provide components and install as required to produce STC ratings indicated, based on published tests by manufacturer conducted in accordance with ASTM E90 with STC rating calculated in accordance with ASTM E413.
      b. Place two beads of acoustic sealant between runners and substrate, studs and adjacent construction.
J. Curved Partitions:
   1. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
   2. Begin and end each arc with a stud, and space intermediate studs equally along arcs.
K. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
L. Install studs vertically at 16 inches on center, unless otherwise indicated.

1. Install studs so flanges within framing system point in same direction

M. Align stud web openings horizontally.

N. Secure studs to tracks using fastener method. Do not weld.
   1. Secure studs to top and bottom runner tracks at both inside and outside flanges.

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 09 2216

SECTION 09 2900 - GYPSUM BOARD

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Gypsum wallboard.
B. Shaft wall liner panels.
C. Tile backing board.
D. Finishing materials.
E. Trim accessories.
F. Acoustic insulation.

1.02 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.
C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 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; 2024.
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; 2025.
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; 2024.

V. GA-226 - Application of Gypsum Board to Form Curved Surfaces; 2025.
W. GA-600 - Fire Resistance and Sound Control Design Manual; 2024.
X. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
   1. Include locations of control joints. Coordination drawings for proposed control joint locations may be annotated copies of Construction Documents architectural floor plans, reflected ceiling plans, and interior elevations. Submit prior to commencement of framing installation. Coordinate with requirements specified in Section 09 2216.
C. Product Data: Provide data on gypsum wallboard, shaft wall liner panels, tile backing panels, finishing materials, trim accessories, acoustical accessories, and fasteners and adhesives.
D. Samples:
   1. Submit three samples of each board type, 4 inches square in size.
   2. Submit three samples of each type of special trim, 4 inches in length.
E. Manufacturer's Qualification Statement.
F. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least 5 years of documented experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum 5 years documented experience.

1.05 FIELD CONDITIONS

A. Ambient Condition (Environmental Limitations): Comply with ASTM C840 and GA-216 requirements or gypsum board manufacturer's written instructions, whichever are more stringent

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Provide completed assemblies complying with ASTM C840 and GA-216.
B. Fire-Rated Assemblies: For fire-resistance-rated assemblies that incorporate gypsum board, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 and as follows:
   1. Provide construction equivalent to one of the following:
      a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
      b. Gypsum Association File Numbers: Provide construction complying with requirements of GA-600 for the particular assembly.
C. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
D. Shaft Walls: Provide completed assemblies with the following characteristics:
   1. Comply with requirements of Fire-Rated Assemblies.
   2. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
      a. Air Pressure Within Shaft: Sustained loads of 7.5 lbf/sq ft with maximum mid-span deflection of L/240; unless otherwise indicated.
      b. Acoustic Attenuation: STC of 40-44 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90; unless otherwise indicated.

E. Horizontal Deflection: For wall assemblies, limit maximum deflection of wall framing to L/240 at 5 psf .
   1. Exception: Limit deflection of walls to receive hard tile surfaces to L/360 at 5 psf.

2.02 GYPSUM WALLBOARD

A. Gypsum Wallboard: Paper-faced gypsum panels; ASTM C1396/C1396M.
   1. Thickness: 1/4 and 1/2 inch.
   2. Long Edges: Tapered with paper face wrapping edge.
   3. Short Edges: Square cut.
   4. Sized to minimize joints.
   5. Products:
      a. CertainTeed Corp.; Regular Gypsum Board: www.certainteed.com.
      b. Continental Building Products; Regular Drywall: www.continental-bp.com.
      c. Georgia-Pacific Gypsum; ToughRock Gypsum Board: www.gp.com.
      d. National Gypsum Company; Gold Bond Brand Gypsum Board: www.nationalgypsum.com.
      e. USG Corporation; Sheetrock Brand Gypsum Panels: www.usg.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

B. Gypsum Wallboard - Type X: Paper-faced gypsum panels with fire-resistant core; ASTM C1396/C1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered with paper face wrapping edge.
   3. Short Edges: Square cut.
   4. Sized to minimize joints.
   5. Type: Fire resistance rated Type X, UL or WH listed.
   6. Products:
      a. CertainTeed Corp.; Type X Gypsum Board: www.certainteed.com.
      b. Continental Building Products; Firecheck Type X: www.continental-bp.com.
      c. Georgia-Pacific Gypsum; ToughRock Fireguard X: www.gp.com.
      d. National Gypsum Company; Gold Bond Brand Fire-Shield Gypsum Board: www.nationalgypsum.com.
      e. USG Corporation; Sheetrock Brand Firecode X Panels: www.usg.com.
      f. Substitutions: See Section 01 6000 - Product Requirements.

C. Impact Resistant Gypsum Wallboard: Heavy paper-faced, mold and moisture resistant, gypsum panel with fire-resistant core; ASTM C1396/C1396M.
   1. Thickness:5/8 inch.
   2. Long Edges: Tapered with paper face wrapping edge.
   3. Short Edges: Square cut.
   4. Sized to minimize joints.
   5. Type: Fire resistance rated Type X, UL or WH listed.
   6. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   7. Surface Abrasion: Level 2, minimum, when tested in accordance with ASTM C1629/C1629M.
   8. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
   9. Soft Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   10. Hard Body Impact: Level 3, minimum, when tested in accordance with ASTM C1629/C1629M.
   11. Products:
      a. CertainTeed Corp.; Extreme Impact Resistant Gypsum Board: www.certainteed.com.
      b. Continental Building Products; Protecta HIR 300 Type X with Mold Defense: www.continental-bp.com.
      c. National Gypsum Company; Gold Bond Brand Hi-Impact XP Gypsum Board: www.nationalgypsum.com.

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

2.03 SHAFT WALL LINER PANELS

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

2.04 TILE BACKING BOARDS

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

B. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
1. Thickness: 5/8 inch.
2. Type: Fire resistance rated Type X, UL or WH listed.
3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
4. Locations: Non-wet areas and elsewhere as indicated on Drawings; including, but not limited to, the following:
a. Kitchens.
b. Laundry areas.
c. Locker rooms.
d. Toilet rooms.
5. Products:
a. CertainTeed Corp.; GlasRoc Diamondback Tile Backer: www.certainteed.com.
b. Georgia-Pacific Gypsum; DensShield Tile Backer: www.gp.com.
c. National Gypsum Company; Gold Bond Brand eXP Tile Backer: www.nationalgypsum.com.
d. USG Corporation; Durock Brand Glass-Mat Tile Backerboard: www.usg.com.

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

2.05 FINISHING MATERIALS

A. Joint Materials: ASTM C475/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 accommodate mullion deflection.
      2) Color: Light gray.
   f. Fasteners:
      1) Self Tapping or appropriate threaded fastener.
      2) Compatible with all materials fasteners will contact with and not causing galvanic corrosion.
   g. Snap Cover: Snap-on fastener cover
   h. Acoustical Sound Sealant: Acrylic latex based.
   i. Accessories: Provide necessary and related parts and tools to complete installation.
   j. Fabrication: Extrusions and generic profiles to be shipped in custom lengths as required to meet project requirements or shipped in standard incremental foot lengths and cut to exact length on jobsite.
   k. Finishes: Exposed surfaces of exposed aluminum extrusion:
   l. Aluminum: Architect to select from manufacturer's custom color offering to match adjacent storefront finish.

2.07 ACOUSTICAL ACCESSORIES

A. Acoustic Insulation: Provide one of the following types:
   1. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.
      a. Thickness: 3 inches, unless otherwise indicated.
      b. Density: 2.5 pcf.
      c. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
      d. Products:
         1) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.

2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
3) Rockwool; Safe'n'Sound: www.rockwool.com.
4) Substitutions: See Section 01 6000 - Product Requirements.

2. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
   a. Thickness: 3-1/2 inches, unless otherwise indicated.
   b. Products:
      1) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts: www.certainteed.com.
      2) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
      3) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
      4) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: www.owenscorning.com.
      5) Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Reduces airborne sound transmission through perimeter joints and openings in wall assemblies.
   1. Products:
      a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: www.titebond.com.
      b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
      c. Pecora Corporation; AC-20 FTR: www.pecora.com.
      d. Pecora Corporation; AIS-919: www.pecora.com.
      e. United States Gypsum Co.; USG Sheetrock Brand Firecode Smoke-Sound Sealant: www.usg.com.
      f. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: www.usg.com.
      g. Substitutions: See Section 01 6000 - Product Requirements.

2.08 FASTENERS AND ADHESIVES

A. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

B. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

C. Screws for Fastening of Cementitious Backer Board Products to Steel Studs: Use screws of type and size recommended by panel manufacturer

D. Anchorage to Other Substrates: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

E. Laminating Adhesive: For directly adhering gypsum-base, face-layer panels to backing-layer panels in multi-layer construction. Provide one of the following types:
   1. Joint Compound: As recommended by gypsum board manufacturer.
   2. Adhesives:
      a. Franklin International, Inc; Titebond GREENchoice Professional Drywall Adhesive; www.titebond.com.
      b. PPG Architectural Coatings; Liquid Nails DWP-24 Drywall Construction Adhesive: www.liquidnails.com.
      c. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

B. Control Joint Layout: Prior to commencement of framing and gypsum board installation, submit coordination drawings indicating proposed control joint locations in metal-framed gypsum board-sheathed partitions, walls, ceilings, bulkheads, fasciae, and soffits, for review and acceptance of Architect. Coordinate with requirements of Section 09 2216.

3.02 GENERAL INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. General: Apply acoustic accessories at all STC-Rated Assemblies and elsewhere as indicated on Drawings.
   1. Apply acoustic sealant at all smoke-tight assemblies.
   2. Fire-Rated Construction: Install acoustic accessories in strict compliance with requirements of assembly listing.

B. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
   1. Comply with ASTM C919.
   2. Place continuous bead at perimeter of each layer of gypsum board.
   3. Seal around all penetrations by conduit, pipe, ducts, rough-in boxes, and similar items, except where firestopping is provided.

3.04 BOARD INSTALLATION

A. Install to minimize butt end joints, especially in highly visible locations.
   1. Use screws for attachment of gypsum board.
   2. Use screws for attachment of cementitious backing board.

B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with long edges occurring over framing.
   1. Stagger joints on opposite sides of partitions.

C. Multi-Layer Non-Rated: Install first layer of gypsum board parallel to framing with long edges occurring over framing. Place second layer parallel to framing with long edges occurring over framing, and joints offset from joints of first layer.
   1. Offset face-layer joints at least one stud or furring member from base-layer joints.
   2. Stagger joints on opposite sides of partitions.
   3. Install additional layers beyond double layers similarly; maintain offset and staggered joints between layers.
   4. Apply laminating adhesive between layers of gypsum board for bonding of layers in addition to fasteners.

D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

E. Cementitious Backing Board: Install in accordance with ANSI A108.11 and manufacturer's instructions.

F. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
   1. Not more than 30 feet apart on walls and ceilings, unless otherwise indicated.
   2. Submit control joint locations to Architect for approval prior to installation.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim (LC or L Beads): Install at locations where gypsum board abuts dissimilar materials and as indicated, using longest practical lengths.

D. Special Trim: Install at indicated locations, and as follows.
   1. Wall End Caps: Provide at all exposed ends of wall assemblies not covered in wallboard and at locations of partition closures.

2. Use longest practical lengths.

E. Partition Closures: Locate at vertical junctures between end of wall assemblies and windows, glazing, and similar construction, unless otherwise indicated.
   1. Notch around horizontal mullions, sills, or other obstructions leaving appropriate gap for differential movement between the sound barrier wall end cap and the obstruction.
   2. Apply continuous bead of acoustical sealant to the unexposed side of extruded aluminum surface that will be in contact with the wall edge.
   3. Place sound barrier partition closure on the vertical surface of the wall partition and loosely install fasteners in the top and bottom slotted holes of the wall end cap.
   4. Plumb the partition closure leaving recommended gap spacing between the interior glass surface and the wall end cap. Foam gasket to be in contact with glass.
   5. Tighten top and bottom fasteners to secure partition closure.
   6. Install additional fasteners at 12 inches on center, minimum.
   7. Install snap cover to conceal fasteners.
   8. Apply color matched sealant at joints of dissimilar materials.

3.06 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying or setting type joint compound and finish with drying type joint compound.

B. Tile Backing Panels: Use fiberglass joint tape, embed and finish with tile setting material.
   1. Refer to Section 09 3000 - Hard Tiling for tile setting materials.

C. Glass Mat Faced Gypsum Board other than Tile Backing Panels: Use fiberglass joint tape, embed and finish with setting type joint compound.

D. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and in similar locations that shall not be painted or finished, and at tile backing board to receive tile finish.
   3. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
      a. Exception: Fire-Rated Construction shall comply with requirements of assembly listing.

E. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.
   2. Taping, filling and sanding is not required at base layers of multi-layer applications.

3.07 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION 09 2900

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, Uncoupling, and Crack Isolation Membranes.

1.02 REFERENCE STANDARDS

A. 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.
B. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
C. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2023.
D. ANSI A118.11 - American National Standard Specifications for EGP (Exterior Glue Plywood) Modified Dry-Set Mortar; 2017 (Reaffirmed 2022).
E. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2024).
F. ANSI A118.13 - American National Standard Specification for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014 (Reaffirmed 2024).
G. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2023.
H. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
I. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
J. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
K. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2025.

1.03 ADMINISTRATIVE REQUIREMENTS

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

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
D. Samples:
    1. Full-size units of each type of tile and each color and finish.
    2. Full-size units of each type of trim, threshold and accessory for each color and finish.
        a. Trim and Threshold Samples: 4 inches long, minimum.
E. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
    1. See Section 01 6000 - Product Requirements, for additional provisions.

2. Extra Tile: 2 percent of each size, color, and surface finish combination, but not less than one box of each type.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications: Company specializing in performing tile installation, with minimum of five years of documented experience.

C. Source Limitations for Setting Materials and Accessories: Obtain product of a uniform quality for each application condition from a single manufacturer:

D. Preinstallation Conference: Conduct conference at the Project Site.

1. Convene one week prior to commencing work of this section.
2. Require attendance of installation material manufacturer, tile supplier, tile installer, and intallers of related work. Review installation procedures and coordination required with related work.
3. Meeting agenda includes, but is not limited to:
   a. Surface preparation.
   b. Tile and installation material compatibility.
   c. Manufacturer and installer warranty duration and scope coverd by warranty.
   d. Edge protection, transition, and pre-fabricated movement joint profiles.
   e. Waterproofing techniques.
   f. Crack isolation techniques.

1.06 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.

1.07 FIELD CONDITIONS

A. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Floor Tile: Floor tile shall comply with the following:

1. Dynamic Coefficient of Friction (DCOF): 0.42 or greater when tested in accordance with DCOF AcuTest per ANSI A137.1.

2.02 HARD TILE

A. CT1 Wall Tile: ANSI A137.1 standard grade.

1. Size: 6 by 6 inch, nominal.
2. Thickness: 0.22 inch (9mm), nominal
3. Surface Finish: Plain Gloss.
4. Color(s): Plain Mouse Grey 16880
5. Joint Size: 1/8 inch.
6. Base: Schluter Systems, DILEX-AHK.
   a. Schluter-Systems: www.schluter.com.
   b. Substitutions: See Section01 6000-Product Requirements.
7. Products:
   a. Mosa; Global Collection: www.mosa.com/en-us.
   b. Manufacturer's Representative: Kathleen Black, 248.467.4362, Kathleen.Black@VirginiaTile.com.
   c. Substitutions: Not permitted.

B. CT2 Wall Tile: ANSI A137.1 standard grade.

1. Size: 6 by 6 inch, nominal. Stacked Mosaic.
2. Thickness: 0.22 inch(9mm), nominal.

3. Surface Finish: Plain Gloss.
4. Color(s): .
   a. CT2A Ruby Wine 19970.
   b. CT2B Golden Yellow 19950.
   c. [CT2C] [Plain Ivory Black 16850].
5. Joint Size: 1/8 inch.
6. Products:
   a. Mosa; Global Collection + Color Series: www.mosa.com/en-us.
   b. Manufacturer's Representative: Kathleen Black, 248.467.4362, Kathleen.Black@VirginiaTile.com.
   c. Substitutions: Not permitted.

C. CT3 Floor Tile: ANSI A137.1 standard grade.
1. Size: 12 by 24 inch, nominal.
2. Thickness: 5/16 inch.
3. Surface Finish: Matte.
4. Color(s): Designer White Speckle.
5. Joint Size: 1/8 inch.
6. Products:
   a. American Olean; Color Story Floor: www.americanolean.com.
   b. Manufacturer's Representative: Kathleen Black, 248.467.4362, Kathleen.Black@VirginiaTile.com.
   c. Substitutions: Not permitted.

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

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. THR-1Solid 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: Artista Beige

C. Applications:
1. At doorways where tile terminates.
2. Refer to door schedule for specific locations.

2.05 SETTING MATERIALS

A. Provide setting and grout materials from same manufacturer.

B. Latex-Portland Cement Thin-Set Mortar Bond Coat: ANSI A118.4, ANSI A118.11 andANSI A118.15 .
   1. Products:
      a. Bostik, Inc; Bostik PM: www.bostik.com.
      b. Custom Building Products; VersaBond Flex Professional Thin-Set Mortar: www.custombuildingproducts.com.
      c. H.B. Fuller Construction Products, Inc; Sturdi Flex Thin Set Mortar: www.tecspecialty.com/#sle.
      d. LATICRETE International, Inc; 253 Gold: www.laticrete.com.
      e. MAPEI Corp.; Porcelain Tile Mortar: www.mapei.com.
      f. Schluter Systems L.P.; All Set Thinset Morter; www.schluter.com
      g. Substitutions: See Section 01 6000 - Product Requirements.

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

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

2.06 METAL TRIM

A. Metal Trim: Provide metal profiles in heights to match tile and setting-bed thicknesses, designed specifically for hard tile applications.
   1. Profiles:
      a. Angle or L-shaped.
      b. Other shapes as indicated on Drawings.
   2. Material: Brushed stainless steel.
   3. Applications and Locations:
      a. Open edges of 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.

2.07 WATERPROOFING AND CRACK ISOLATION MEMBRANE

A. Waterproofing and Crack Isolation Membrane: Elastomeric liquid applied membrane complying with ANSI A118.10 and ANSI A118.12.
1. Applications: Use at the following locations:
a. All floor and traffic areas.
b. Shower walls and floors.
c. Shower pans and walls.
d. Other areas as indicated.
2. Thickness: As recommended by membrane manufacturer.
3. Crack Resistance: No failure at 1/8 inch gap, minimum.
4. Membrane system may or may not include fabric reinforcing.
5. Products:
a. Without Fabric Reinforcing:
1) Custom Building Products; RedGard: www.custombuildingproducts.com.
2) LATICRETE International, Inc; Hydro Ban: www.laticrete.com.
3) LATICRETE International, Inc; Hydro Barrier: www.laticrete.com.
4) MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
5) 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) MAPEI Corp.; Mapelastic AquaDefense: www.mapei.com.
4) TEC, H.B. Fuller Construction Products Inc; HydraFlex: www.tecspecialty.com.
5) Substitutions: See Section 01 6000 - Product Requirements.

2.08 WATERPROOFING - SHEET APPLIED MEMBRANE

A. Waterproofing Membrane: Sheet Applied membrane complying with ANSI A118.10 andANSI A118.12 .
1. Schluter Systems; L.P. KERDI / KERDI DS Membrane: www.schluter.com.

2.09 UNCOUPLING MEMBRANE

A. Waterproofing and Uncoupling Membrane: Elastomeric liquid membrane complying with ANSI A118.10 and as defined in the Tile Council on North America (TCNA) Handbook.
1. Schluter Systems; L.P. DITRA / DITRA XL Membrane: www.schluter.com.

2.10 UNCOUPLING MEMBRANE WITH BONDED SOUND REDUCTION

A. Waterproofing and Uncoupling Membrane: Elastomeric liquid membrane complying with ANSI A118.10, ANSI A118.13 and as defined in the Tile Council on North America (TCNA) Handbook.
1. Schluter Systems; L.P. DITRA DUO Membrane: www.schluter.com.

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. Sound tile after setting. Replace hollow sounding units.
O. Keep control and expansion joints free of mortar, grout, and adhesive.
P. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
Q. Grout tile joints unless otherwise indicated.
R. Joint Sealant:
    1. Use joint sealant at the following locations instead of grout.
        a. Tile changes in plane.
        b. Tile-to-tile control joints .
        c. Junctions of tile and dissimilar materials
        d. And elsewhere as required by TCNA (HB), EJ171 movement joint guidelines.
    2. Install joint sealant with bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

S. Grout Sealers:
1. Seal the following:
a. High performance grout joints only as recommended by grout manufacturer.

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

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

3.05 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.

3.06 CLEANING

A. Clean tile and grout surfaces.

3.07 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION 09 3000

SECTION 09 5100 - ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended acoustical ceilings including:
   1. Metal grid suspension systems.
   2. Acoustical insulation above ceiling.
B. Removal, salvaging, and reinstallation of existing suspended acoustical ceilings.

1.02 REFERENCE STANDARDS

A. ASTM B164 - Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire; 2014.
B. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
C. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2019 (Reapproved 2025).
D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
E. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
F. ASTM D610 - Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces; 2008 (Reapproved 2019).
G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.
H. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2024a.
I. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.
J. CISCA (CSH) - Ceiling Systems Handbook.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements for submittal procedures.
B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
C. Product Data: Provide data on suspension system components and acoustical panels.suspension system components and acoustical panels.
D. Samples:
   1. Acoustical Panels: Submit 3 samples, 6 by 6 inch in size, for each type and finish of acoustical panel.
   2. Metal Grid Suspension Systems: Submit 3 samples each, 12 inches long, for each type and finish of suspension system main runner, cross runner, perimeter molding, and fascia trim.
E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
   1. See Section 01 6000 - Product Requirements, for additional provisions.
   2. Extra Acoustical Panels: Quantity equal to 2 percent of total installed, but not less than one box for each type and finish.

1.05 QUALITY ASSURANCE

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

B. Acoustical Panel Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 5 years documented experience.

C. Installer Qualifications: Company experienced in performing acoustical ceiling installations, with minimum of 5 years of documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

1.07 WARRANTY

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

B. Warranties: Provide the following manufacturer warranties:

1. Acoustic Panel Warranty: Against defects in materials and workmanship.
   a. Warranty Length:
      1) 30 years.
2. Metal Grid Suspension Systems: Against defects in materials and workmanship.
   a. Warranty Length:
      1) 30 years.
3. Sag Warranty: Acoustic panels shall not show visible sag.
   a. Warranty Length: 30 years.
4. Mold and Mildew Warranty: Acoustic panels shall be free from mold and mildew growth.
   a. Warranty Length: 30 years.
5. Rust Warranty: Metal grid suspension systems shall be free from the occurrence of 50 percent red rust per ASTM D610.
   a. Warranty Length: 30 years.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acoustic Panels: Provide either the specified product or a comparable product by one of the following:

1. Armstrong World Industries, Inc: www.armstrongceilings.com.
2. CertainTeed Corporation: www.certainteed.com.
3. USG Corporation: www.usg.com.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Suspension Systems and Fascia Trim: Provide either the specified product or a comparable product by one of the following:

1. Armstrong World Industries, Inc: www.armstrong.com.
2. CertainTeed Corporation: www.certainteed.com.
3. Rockfon North America/Chicago Metallic: www.rockfon.com.
4. USG Corporation: www.usg.com.
5. Substitutions: See Section 01 6000 - Product Requirements.

C. Source Limitations: Obtain acoustic panels, suspension systems, and fascia trims from one manufacturer unless otherwise indicated or approved in writing by Architect.

2.02 ACOUSTICAL PANELS

A. Acoustical Panels - General: ASTM E1264, Class A.

B. ACT1 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:

1. Size: 24 by 24 inches.
2. Thickness: 3/4 inch.

3. Composition: Wet felted.
4. Light Reflectance: 0.90, determined in accordance with ASTM E1264.
5. NRC: 0.75, 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. USG Interiors, LLC; Mars Panels, No. 86185: www.usg.com.

C. ACT2 Acoustical Panels: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
1. Size: 24 by 24 inches.
2. Thickness: 1 inch.
3. Composition: Wet felted.
4. Light Reflectance: 0.90 percent, determined in accordance with ASTM E1264.
5. NRC: 0.80, determined in accordance with ASTM E1264.
6. Ceiling Attenuation Class (CAC): 40, determined in accordance with ASTM E1264.
7. Edge: Square.
8. Surface Color: White.
9. Suspension System: Exposed grid Type SG-1.
10. Products:
    a. USG Interiors, LLC; Mars High-NRC / High-CAC Panels 80/40, No. 86345: www.usg.com.

2.03 SUSPENSION SYSTEMS

A. Metal Grid Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, and perimeter moldings as required.

B. SG-1 Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled; intermediate-duty.
1. Profile: Tee; 15/16 inch wide face.
2. Construction: Double web.
3. Finish: White painted.
4. Products:
    a. USG Interiors, LLC; USG Donn Brand DX: www.usg.com.

2.04 ACCESSORIES

A. Provide all required accessories including perimeter moldings, splice plates, clips, and associated hardware, hangers, rivets, and fasteners.

B. Hanger Wire, Anchors, and Related Support Materials:
1. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
2. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.
3. Size attachment devices for five times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated.
4. Size hanger wire for three times hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, but not less than 0.106-inch diameter wire; three times the design load shall be less than yield stress of wire.

C. Perimeter Moldings: Same metal and finish as grid.
1. At Wall Perimeters: Provide L-shaped molding for mounting at same elevation as face of grid.
2. Provide inside and outside 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. Touch-up Paint: Type and color to match acoustical and grid units.

2.05 ACOUSTICAL ACCESSORIES

A. Acoustic Insulation: Provide one of the following types:
   1. Mineral Fiber/Rock Wool Batts: ASTM C665; preformed mineral fiber, friction fit type, unfaced.
      a. Thickness: 3 inches, unless otherwise indicated.
      b. Density: 2.5 pcf.
      c. Flame Spread/Smoke Developed: 0/0 per ASTM E84.
      d. Products:
         1) JohnsManville; Mineral Wool Sound Attenuation Fire Batts (SAFB): www.jm.com.
         2) Owens Corning; Thermafiber SAFB (Sound Attenuation Fire Batts): www.owenscorning.com.
         3) Rockwool; Safe'n'Sound: www.rockwool.com.
         4) Substitutions: See Section 01 6000 - Product Requirements.
   2. Fiberglass Batts: ASTM C665; preformed glass fiber, friction fit type, unfaced.
      a. Thickness: 3-1/2 inches, unless otherwise indicated.
      b. Products:
         1) CertainTeed Corporation/Saint-Gobain; NoiseReducer Sound Attenuation Batts: www.certainteed.com.
         2) Johns Manville; Formaldehyde-Free Fiberglass Insulation: www.jm.com.
         3) Knauf Insulation; EcoBatt Insulation with ECOSE Technology: www.knaufinsulation.com.
         4) Owens Corning Corporation; EcoTouch Sound Attenuation Batts: www.owenscorning.com.
         5) Substitutions: See Section 01 6000 - Product Requirements.

B. Acoustical Sealant: Nonsag, paintable, nonstaining latex sealant complying with ASTM C834; for use in conjunction with perimeter moldings of suspended ceiling systems.
   1. Products:
      a. Franklin International Inc; Titebond GreenChoice Professional Acoustical Smoke & Sound Sealant: www.titebond.com.
      b. PPG Architectural Coatings; Liquid Nails AS-825 Acoustical Sound Sealant: www.liquidnails.com.
      c. Pecora Corporation; AIS-919: www.pecora.com.
      d. United States Gypsum Co.; USG Sheetrock Brand Acoustical Sealant: www.usg.com.
      e. Substitutions: See Section 01 6000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

A. Install after major above-ceiling work is complete.

B. Coordinate the location of hangers with other work.

3.03 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. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions, unless otherwise indicated.
H. Lay acoustical insulation continuously across top of acoustical panel ceiling system without gaps where indicated.

3.06 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 09 5100

SECTION 09 6500 - RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 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.

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 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 TILE FLOORING

A. RTF1Quartz Tile: Homogeneous, color and pattern throughout thickness.
   1. Products:
      a. Kahrs; Quartz Mosaic: www.kahrs.com/en-uscommercial/.
      b. Substitutions: Not permitted.
      c. Manufacturer's Representative: Brandon Lyons, 502.552.4420, blyons@spartansurfaces.com.
   2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
   3. Size: 24 by 24 inch nominal.

4. Total Thickness: 0.08 inch (2.0 mm).
5. Installation Pattern: As indicated on Drawings.
6. Colors: .
   a. RFT1A 8303 Gabbro Grey.
   b. RFT1B 8317 Zebra Jasper.
   c. RFT1C 8329 Amber Yellow.
7. Water-jet cutting required for circles and curves. Field tiles adjacent to circles and curves may be field cut using a template. Water-jet cutting shall be performed by Creative Edge.
   a. Creative Edge, 601 S. 23rd Street, Fairfield, IA 52556, 800-394-8145: www.https://www.creativeedgeia.com.

2.02 ACCESSORIES

A. Subfloor Filler: Cement based rapid drying smoothing and finishing compound; type recommended by adhesive manufacturer. Moisture resistant, Low VOC.

B. Ardex; Feather Finish: www.ardexamericas.com.
   1. As recommended by manufacturer to build up RFT1 in classrooms to create a seamless transition between CPT2 and RFT1. Refer to drawings for locations.

C. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.

D. Floor Moldings, Stair Coverings, and Resilient Base: Refer to Section 09 6513 - {\t\#1000017}.

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. For field cutting of RFT1 field tile use manufacturer recommended blades to perform this work.

1. Altro Floors; Heavy Duty Trimming Knife Blade, HDB.1 Straight.
2. Altro Floors; Heavy Duty Trimming Knife Blade, HBD. 3 Concave.
   a. Manufacturer recommends concave blade for cutting of field tiles adjacent to circles or curves.

I. Coordinate with Section 09 6513 - {\t\#1000017} for installation of floor moldings, stair coverings, and resilient base.

3.04 INSTALLATION - TILE FLOORING

A. Mix tile from containers to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Installed floor tile shall be without open cracks, bubbling, telegraphing of adhesive spreader marks, and other imperfections.

C. Install resilient tile in floor patterns indicated.

D. Where no patterns are indicated, lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

3.05 CLEANING

A. Remove excess adhesive from floor surfaces without damage.

B. Clean in accordance with manufacturer's written instructions.

C. Clean resilient flooring not more than 5 days prior to Substantial Completion in accordance with resilient flooring manufacturer's instructions

3.06 PROTECTION

A. Prohibit traffic on resilient flooring for 48 hours after installation.

B. After cleaning, place protective coverings over finish floors; do not remove coverings until Date of Substantial Completion.

END OF SECTION 09 6500

SECTION 09 6513 - RESILIENT BASES AND ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient base.
B. Floor moldings.

1.02 REFERENCE STANDARDS

A. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021 (Reapproved 2025).

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. Verification Samples:
   1. Resilient Base and Floor Moldings: Submit 3 samples, 12 inches long illustrating color, pattern, and profile for each accessory specified.
D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
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 Wall Base: Quantity equal to 2 percent of total installed, but not less than 8 linear feet of each type and color.
   3. 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. RB-1Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, cove, for hard surface flooring and Style A, straight, for carpet, unless otherwise indicated.
   1. Manufacturers: Provide products from one of the following:
      a. Armstrong Flooring Inc.: www.armstrongflooring.com.
      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: Black.

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 or vinyl as is standard with manufacturer.
   3. Profiles: As standard with manufacturer and as appropriate for floor finishes, unless otherwise indicated.
   4. Provide floor moldings at the following locations unless otherwise indicated:
      a. Open perimeters of resilient flooring; reducer strips.
      b. Open perimeters of carpeting; edge guards.
      c. Changes in floor finishes from resilient flooring to carpeting; transition strips.
      d. Other areas as indicated or required for complete floor finish installations.
   5. Colors: As selected by Architect.

2.03 ACCESSORIES

A. Primers and Adhesives: Waterproof; types recommended by accessories manufacturer.
B. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are flat to tolerances acceptable to stair covering manufacturer, free of cracks that might telegraph through stair coverings, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of stair coverings to substrate.
B. Verify that surfaces are flat, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of floor moldings to substrate.
C. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 PREPARATION

A. Clean substrates.

3.03 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's written instructions.
B. Adhesive-Applied Installation:
   1. Fully adhere resilient base and floor moldings, to substrates using a full spread of adhesive completely covering substrate.
   2. Spread only enough adhesive to permit installation of materials before initial set.
   3. Fit joints and butt seams tightly.
C. Install floor moldings at unprotected or exposed edges, where flooring terminates, and where indicated.
   1. Resilient Strips: Attach to substrate using adhesive.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
B. Install with minimal amount of joints; tops of adjacent pieces shall be aligned.

C. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
D. Install base on solid backing. Bond tightly to wall and floor surfaces.
E. At masonry and other irregular substrates fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
F. Scribe and fit to door frames and other interruptions.

3.05 INSTALLATION - FLOOR MOLDINGS

A. Install floor moldings in one piece for full width of installation, where possible.
B. Where joints are unavoidable, fit tightly together and align adjacent molding profiles.
C. Adhere over entire surface. Fit accurately and securely.

3.06 CLEANING

A. Remove excess adhesive from floor, base, and wall surfaces without damage.

3.07 PROTECTION

A. Prohibit traffic on resilient stair coverings and floor moldings for 48 hours after installation.

END OF SECTION 09 6513

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; 2025.
C. CRI 104 - Standard for Installation of Commercial Carpet; 2018.
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.
   3. For Locker Carpet Tile: Provide 10 additional, cut tiles.

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. Tarkett; Abrasive Action II 02578: www.commercial.tarkett.com.
      b. Substitutions: Not permitted.
      c. Manufacturer's Representative: Paul Brown, 810.908.4344, Paul.Brown@tarkett.com.
   2. Construction: Accuweave Patterned Loop. Manufactured in one color dye lot..

3. Tile Size: 24 x 24 inch, nominal.
   a. Provide CPT1 at bottom of each locker, in addition to locations noted on drawings.
   b. CPT1 at lockers to be factory cut. Field cuts are not allowed. Tiles must fully cover bottom surface of locker and allow door to fully close. Contractor to field measure lockers for sizing.
4. Thickness: 0.328 inch.
5. Color: 19103 Winter Gray
6. Installation Pattern: Monolithic.
7. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
8. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
9. Fiber Content: TDX Nylon.
10. Dye Method: 100 percent solution dyed.
11. Secondary Backing Material: Ethos Modular with Omnicoat Technology.

B. CPT2Tile Carpeting:
1. Product:
   a. Interface; Open Air 401 Stria 1397500AK00: www.interface.com/US..
   b. Substitutions: Not permitted.
   c. Manufacturer's Representative: Cara Bogosian, 248.214.2707, cara.bogosian@interface.com.
2. Construction: Tufted, manufactured in one color dye lot.
3. Tile Size: 9.845 by 39.38 inch, nominal.
4. Thickness: 1/4 inch.
5. Color: 103229 Mist
6. Installation Pattern: Ashlar.
7. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
8. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
9. Fiber Content: Aquafil, 100 percent recycled nylon.
10. Dye Method: 100 percent solution dyed.
11. Secondary Backing Material: GlasBac.

C. CPT3Tile Carpeting:
1. Product:
   a. Interface; Open Ended 131400AK00: www.interface.com/US..
   b. Substitutions: Not permitted.
   c. Manufacturer's Representative: Cara Bogosian, 248.214.2707, cara.bogosian@interface.com.
2. Construction: Tufted, manufactured in one color dye lot.
3. Tile Size: 9.845 by 39.38 inch, nominal.
4. Thickness: 1/4 inch.
5. Color: 103180 Bordeaux
6. Installation Pattern: Ashlar.
7. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
8. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
9. Fiber Content: Aqualfil, 100 percent recycled nylon.
10. Dye Method: 100 percent solution dyed.
11. Secondary Backing Material: GlasBac.

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.
I. At lockers, no adhesive to be used; including glue, tape or velcro.

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 09 6813

SECTION 09 7200 - WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall coverings.
B. Vinyl Architectural Film

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.

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 and vinyl architectural film, 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.
C. Installer Qualifications for 3M Di-Noc: Installation shall be performed by a 3M Endorsed installed. List of installers available at 3M.com/AMD or 3M Commercial Solutions, 1-888-650-3497.

1.05 MOCK-UP

A. Provide panel, 1 complete beam, full height and width, illustrating installed 3M Di-Noc.
B. Locate where directed.
C. Mock-up may remain as part of the Work, if approved.

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. AWC1Wall Covering: Acoustical wall covering.
   1. Products:
      a. Designtex; Wannabe Stripe: www.designtex.com.
      b. Substitutions: Not permitted.
      c. Manufacturer's Representative: Tanya Romanelli, 810.444.8797, tromanelli@designtex.com
   2. Color/Pattern: 8630-801, Gravel.
   3. Fiber Content: 100 percent polyester.
   4. Weight: 20.5 oz/sq yd.
   5. Thickness/Gage: 0.13 inches (3.25 mm).
   6. Width: 52 inches.
   7. Backing: None.
   8. Installation Method: Straight hang, random match.
   9. Metal Trim: Provide metal profiles in heights to match full extent of wallcovering. Metal trim to be provided at all exposed edges of wallcovering.
      a. Profiles:
         1) Schluter Systems; Jolly: www.schluter.com
         2) Substitutions: See Section01 6000-Product Requirements.
      b. Material: Brushed stainless steel.
      c. Applications and Locations:
         1) Outside Corner
         2) Open edges of wallcovering.

C. VAF1Vinyl Architectural Film: Vinyl-film with Pressure-Sensitive Acrylic Permanent Adhseive and Silicone-Coated Poly Paper Release Liner with Fine Wood Apperance.
   1. Products:
      a. 3M; Di-Noc Fine Wood: https://designtex.com/di-noc/.
      b. Substitutions: Not permitted.
      c. Manufacturer's Representative: Tanya Romanelli, tromanelli@designtex.com, 810.444.8797.
   2. Color/Pattern: FW-1738.
   3. Material Content: Vinyl.
   4. Width: 48 inches.
   5. Thickness/Gage: 8 mils nominal, not including release liner..
   6. Release Liner: Silicone-coated poly liner, 6.2 mils (157 microns)..
   7. Adhesive: Pressure-sensitive acrylic with air release channels, permanent.
   8. Comply with ASTM E84 as follows:
      a. Rating: Class A
      b. Flame-Spread Index: 25 or less
      c. Smoke-Developed Index: 450 or less

D. Termination Trim: Extruded plastic, clear.

E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

F. Substrate Primer and Sealer: Water-based type recommended by wall covering manufacturer to suit application to substrate. Allows for easy removal of wall coverings.

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. For architectural vinyl film locations, examine substrates for compliance with requirements for non-porous, smooth surface and other conditions affecting the installation requirements as listed by manfacturer.
C. 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.
D. 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.
E. Proceeding with installation implies installer's acceptance of substrate and conditions.

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.
B. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
C. Apply two coats of primer sealer to substrate surfaces in accordance with manufacturer's instructions. Allow to dry. Lightly sand smooth.
D. Vacuum clean surfaces free of loose particles.
E. Surface preparation for vinyl architectural film:
    1. Test and prepare application surfaces per instructions in the 3M DI-NOC Installation Guide.
        a. Use the 3M Wall Adhesion Test to determine the compatibility of the application surface with the Product.
        b. Use the 3MEnhanced Cleaning Method to ensure that the application surface is ready to receive and hold the Product.
        c. Repair damaged application surfaces per instructions in the 3M DI-NOC Installation Guide.
        d. Re-clean application surfaces with a lint-free cloth and 70/30 IPA cleaning solution, or use the 3M Enhanced Cleaning Method in the 3M DI-NOC Installation Guide

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.
B. Refer to the 3M Di-Noc Installation Guide fpr specific application instructions of architectural vinyl film.
C. Razor trim edges on flat work table. Do not razor cut on gypsum board surfaces.
D. For architectural vinyl film, measure the application surface and cut film to size with a minimum 1/2 inch extra on all sides for trimming.
E. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface.
F. For architectural vinyl film, remove air bubbles, wrinkles, and blisters. Use approved procedures to prevent the formation of bubbles, wrinkles, blisters and other defects.
G. Butt edges tightly.
H. No exposed joints on corners or other "open" type joints permitted.
I. Horizontal seams are not acceptable, unless otherwsie indicated.
J. Do not seam within 2 inches of internal corners or within 6 inches of external corners.
K. Install termination trim at wall covering locations.
L. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.
M.

3.04 CLEANING

A. Clean wall coverings and architectural vinyl film 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 or achitectural vinyl film areas.

END OF SECTION 09 7200

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
   1. Exposed surfaces of steel lintels and ledge angles.
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 DEFINITIONS

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

1.03 REFERENCE STANDARDS

A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
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/NACE No.3 - Commercial Blast Cleaning; 2006.

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.
   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.

1.05 MOCK-UPS

A. See Section 01 4000 - Quality Requirements, for general requirements for mock-up.
B. Locate where directed by Architect.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the 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. Paints:

1. PPG Paints: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

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

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.

1. 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 primed metal and Galvanized Steel.

1. Two top coats and one coat primer.
2. Top Coat(s): Exterior Latex; MPI #10.
   a. Products:
      1) Pittsburgh Paints Speedhide Exterior Latex, 6-610XI Series, Flat. (MPI #10)
      2) Substitutions: See 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. Water Based Primer for Galvanized Metal; MPI #134.
   a. Products:
      1) Pittsburgh Paints Pitt-Tech Plus EP DTM Industrial Primer, 90-1912 Series. (MPI #134)
      2) Sherwin-Williams DTM Primer/Finish (MPI #134)
      3) Substitutions: See Section 01 6000 - Product Requirements

2. Rust-Inhibitive Water Based Primer; MPI #107.
   a. Products:
      1) Pittsburgh Paints Pitt-Tech Plus EP DTM Industrial Primer, 90-1908. (MPI #107)
      2) Sherwin-Williams Pro Industrial Pro-Cryl Universal Primer. (MPI #107)
      3) Substitutions: See 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.
      b. Substitutions: See 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 affect proper application.

D. Test shop-applied primer for compatibility with subsequent cover materials.

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. 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 methods recommended in writing by paint manufacturer and blast cleaning in accordance with SSPC-SP 6/NACE No.3. Protect from corrosion until coated.

G. 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.

D. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.

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. Adhesion Test to be performed per ASTM D3359 Method A (5mils or less) or B (over 5mils).
C. 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.
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.

3.05 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 COLOR SCHEDULE

A. PT-2
    1. Refer to Color and Finish Schedule

END OF SECTION 09 9113

SECTION 09 9123 - INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.
B. Field application of paints.
C. Specification for Canyon Tone for clear block sealer is in Specification 07 1900 Water Repellent Acrylic Penetrating Sealer.
D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, 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; 2024.
C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020 (Reapproved 2025).
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).
G. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.04 SUBMITTALS

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

D. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.

1.05 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. Pittsburgh Paints: www.ppgpaints.com/#sle.
2. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
3. Benjamin Moore; www.benjaminmoore.com/#sle

D. Primer Sealers: Same manufacturer as top coats.

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

2.02 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.

3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
5. Supply each paint material in quantity required to complete entire project's work from a single production run.
6. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
   a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
   b. Architectural coatings VOC limits of the State in which the Project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.

D. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
2. Extend colors to surface edges; colors may change at any edge as directed by Architect.
3. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.
4. In utility areas, finish equipment, piping, conduit, and exposed duct work in colors according to the color coding scheme indicated.
5. During bidding, price accent walls as low-hide colors. Include pricing for additional prep and coats as required.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, concrete masonry units, wood, uncoated steel, shop primed steel, and galvanized steel.
1. Two top coats and one coat primer.
2. Top Coat(s): Interior Latex; MPI #44, 53, 54.
   a. Products:
      1) Benjamin Moore Super Hide Zero VOC Interior Latex Flat 355 (MPI #53).
      2) Benjamin Moore Super Hide Zero VOC Interior Latex Low Sheen 356 (MPI #44)
      3) Benjamin Moore Super Hide Zero VOC Interior Latex Semi-Gloss 358 (MPI # 53)
      4) Benjamin Moore Ultra Spec 500 Interior Latex, Flat T535 (MPI #53) (Dark Colors)
      5) Benjamin Moore Ultra Spec 500 Interior Latex, Low Sheen Eggshell T537 (MPI #44) (Dark Colors)
      6) Benjamin Moore Ultra Spec 500 Interior Latex, Semi-Glass T546 (MPI # 54) (Dark Colors)
      7) Pittsburgh Paints Speedhide Zero Interior Latex, 6-4110XI Series, Flat. (MPI #53)
      8) Pittsburgh Paints Speedhide Zero Interior Latex, 6-4310XI Series, Eggshell. (MPI #44)
      9) Pittsburgh Paints Speedhide Zero Interior Latex, 6-4510XI Series, Semi-Gloss. (MPI #54)

10) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Flat B30W12651 (MPI #53).
11) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Semi-Gloss. (MPI #43)
12) Sherwin-Williams ProMar 200 Zero VOC Interior Latex, Eggshell. (MPI #52)

3. Top Coat Sheen:
   a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
   b. Eggshell: MPI gloss level 3; use this sheen at gypsum board, except at ceilings and wood.
   c. Satin: MPI gloss level 4; use this sheen for items subject to frequent touching by occupants, including door frames and railings.
   d. Semi-Gloss: MPI gloss level 5; use this sheen at masonry and metals .
4. Primer: As recommended by top coat manufacturer for specific substrate.

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals:
1. Medium duty applications include 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) Benjamin Moore Pre-Catalyzed Waterborne Epoxy Semi-Glass, V341 (MPI #141)
      2) Pittsburgh Paints Pure Performance Interior Latex, 9-510XI Series, Semi-Gloss. (MPI #141)
      3) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46W01151 Semi-Gloss. (MPI #141)
      4) Substitutions: See Section 01 6000 - Product Requirements
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) Benjamin Moore Ultra Spec HP DTM Acrylic Semi-Glass HP29 (MPI #153)
      2) Pittsburgh Paints Pitt-Tech Plus WB DTM Industrial Enamel. 4216 HP Series, Semi-Gloss. (MPI #153)
      3) 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, concrete masonry units, and Structural Glazed Facing Tile.
1. Drawing Designation EP.
2. Two top coats and one coat primer.
3. Top Coat(s): High Performance Architectural Interior Latex; MP #141.
   a. Products:
      1) Benjamin Moore Pre-Catalyzed Waterborne Epoxy, Eggshell V342 (MPI #138)
      2) Benjamin Moore Pre-Catalyzed Waterborne Epoxy, Semi-Glass V341 (MPI #141)
      3) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Eg-Shel. (MPI #139)
      4) Sherwin-Williams Pro Industrial Pre-Catalyzed Waterbased Epoxy, Semi-Gloss. (MPI #141)

D. Paint I-TR-DE - Interior Surfaces to be Finished with Dry Erase Coating.
1. Intermediate Coat Dry Erase Two coats
   a. PPG; Speedhide Zero Interior Zero-VOC Latex Semi-Gloss, 6-4500 Series; MPI #54

b. Sherwin Williams; ProMar 200 Zero VOC Interior Latex Egg-Shel, B20-2600 Series MPI #52

2. Top Coat(s): Dry Erase White Coating, Waterbased Polyurethane.
   a. Drawing Designation DEC1.
   b. Products:
      1) MDC; FUSE Dry Erase Coating; DFT 4.0 mils.
      2) IdeaPaint; IdeaPaint Create White; DFT 5.0 mils.
      3) Substitutions: Section 01 6000 - Product Requirements.
3. Sheen: Gloss.
4. Level 5 wall finish required at all DEC1 locations.

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.

1. Alkali Resistant Water Based Primer - Structural Glazed Facing Tile and Hard Tile, Insulated Piping , Insulated Ductwork, Existing Brick, Previously Painted Surfaces, and Concrete ; MPI #3.
   a. Products:
      1) Benjamin Moore Ultra Spec Int/Ext 100% Acrylic Sealer 608 (MPI #3)
      2) Pittsburgh Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #3)
      3) Sherwin-Williams Loxon Concrete and Masonry Primer Sealer (Existing Brick), LX02W50. (MPI #3)
      4) Sherwin Williams; PrepRite ProBlock Interior/Exterior Latex Primer/Sealer, B51-W60020 Series (MPI #3).
      5) Substitutions: Section 01 6000 - Product Requirements.
2. Interior/Exterior Latex Block Filler; MPI #4.
   a. Products:
      1) Benjamin Moore Ultra Spec High Build Masonry Int/Ext Block Filler 571 (MPI #4)
      2) Pittsburgh Paints Speedhide Masonry Hi Fill Latex Block Filler, 6-15XI . (MPI #4)
      3) Sherwin-Williams PrepRite Interior/Exterior Latex Block Filler, B25W00025. (MPI #4)
      4) Substitutions: Section 01 6000 - Product Requirements.
3. Interior Latex Primer Sealer - Gypsum Board; MPI #50.
   a. Products:
      1) Benjamin Moore Super Hide Zero VOC Interior Latex Primer 354 (MPI #50)
      2) Pittsburgh Paints Pure Performance Interior Latex Sealer, 9-900. (MPI #50).
      3) Sherwin Williams; ProMar 200 Zero VOC Interior Latex Primer, B28W02600 (MPI 50).
      4) Substitutions: Section 01 6000 - Product Requirements.
4. Alkali Resistant Water Based Primer - Dry Erase Primer Gypsum; MPI #3.
   a. Products:
      1) Benjamin Moore Super Hide Zero VOC Interior Latex Primer 354
      2) PPG Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #3)
      3) 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) Benjamin Moore Ultra Spec HP Acrylic Metal Primer HP04 (MPI #107)
      2) Pittsburgh Paints Pitt-Tech Plus Interior/Exterior DTM Waterborne Acrylic Primer/Finish, 4020 PF Series.
      3) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #107)
      4) Substitutions: Section 01 6000 - Product Requirements.

6. Interior Water Based Primer Galvanized Metal; MPI #134.
   a. Products:
      1) Benjamin Moore Ultra Spec HP Acrylic Metal Primer HP04 (MPI#134)
      2) Pittsburgh Paints Pitt-Tech Plus Interior/Exterior DTM Waterborne Acrylic Primer/Finish, 4020 PF Series. (MPI #134)
      3) Sherwin-Williams Pro-Cryl Universal Primer. (MPI #134)
      4) Substitutions: Section 01 6000 - Product Requirements.
7. Stain Blocking Primer, Water Based; MPI #137.
   a. Products:
      1) Benjamin Moore High Hiding All Purpose Primer 046 (MPI #137)
      2) Pittsburgh Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #137)
      3) Sherwin Williams; Multi-Purpose Latex, B51W00450 (MPI #137.
      4) Substitutions: Section 01 6000 - Product Requirements.
8. Latex Primer for Interior Wood; MPI #39.
   a. Products:
      1) Benjamin Moore High Hiding All Purpose Primer 046 (MPI #39)
      2) Pittsburgh Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #39)
      3) Substitutions: Section 01 6000 - Product Requirements.

2.05 CONCRETE STAINS AND SEALER

A. Drawing Designation: CONCS.

B. 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.

C. Concrete Stains:
   1. I-TR-C: 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.
      b. Color: Clear.

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.

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. Concrete:
   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. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
H. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
I. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
J. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
   1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
K. Galvanized Surfaces:
L. 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.
M. 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.
N. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
O. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.
P. Previously Painted Existing Surfaces:
   1. Remove all loose paint, dust, dirt, mold, mildew, oil, grease, rust, loose mill scale, mortar, and any other surface contamination.
   2. Scrape all loose, blistered, peeling, scratched or otherwise imperfect paint down to bare substrate and sand adjacent tightly adhering paint to feather edge.

a. Tightly adhered existing paint may remain.
b. Spot prime all bare areas with appropriate primer before re-priming entire surface.

Q. Structural Glazed Facing Tile and Hard Tile Surfaces:
1. Remove all dust, dirt, mold, mildew, oil, grease, mortar, and any other surface contamination.
2. Mechanically abrade surface to achieve a surface profile as reccommended by the paint manufacturer.

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-3L, eggshell.

C. Wood: Finish surfaces exposed to view.
   1. Interior trim and frames: WI-OP-3L, 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: MgI-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-3A, flat.

END OF SECTION 09 9123

SECTION 10 0100 - MISCELLANEOUS SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Stationary Tote Storage

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.

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 TOTE STORAGE

A. Stationary Tote Storage; Wall mounted storage elements with rails for Certwood bins.
   1. Drawing Designation: Tote System A
   2. Products:
      a. VS America; Space Station Stationary: www.vsamerica.com.
      b. Substitutions: Not Permitted.
      c. Manufacturer's Representative: Christine DeBrot, 231.740.3935, c.debrot@vsamerica.com

3. Frame: Bent and welded rectangular steel tube on 4-adjustable feet and a steel top.
4. Rear Panel: None
5. Side Panels: None
6. Doors: None
7. Model No: 45417
8. Dimensions:
   a. Width: 28.35 inches
   b. Depth: 19.3 inches
   c. Height: 72.45 inches
9. Number of Columns: Two
10. Totes: Standard Width
    a. (6) Triple 9 inch Standard Bins
    b. (18) Single 3 inch Standard Bins
11. Metal Finish: Anthracite M063
12. Tote Finish: Clear 300.

B. Stationary Tote Storage; Wall mounted storage elements with rails for Certwood bins.
1. Drawing Designation: Tote System B
2. Products:
   a. VS America; Space Station Stationary: www.vsamerica.com.
   b. Substitutions: Not Permitted.
   c. Manufacturer's Representative: Christine DeBrot, 231.740.3935, c.debrot@vsamerica.com
3. Frame: Bent and welded rectangular steel tube on 4-adjustable feet and a steel top.
4. Rear Panel: None
5. Side Panels: None
6. Model No: 45426
7. Dimensions:
   a. Width: 24.85 inches
   b. Depth: 19.3 inches
   c. Height: 72.45 inches
8. Number of Columns: Two
9. Totes: Bookbin
   a. (16) Bookbin 6 inch
10. Metal Finish: Anthracite M063
11. Tote Finish: Clear 300.

2.02 ACCESSORIES

A. Mounting Hardware: Provide all related fasteners and hardware required for a complete installation at substrates indicated.

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.

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.

3.03 CLEANING

A. Clean specified products accordance with manufacturer's instructions

3.04 PROTECTION

A. Protect installed tote storage from subsequent construction operations.

END OF SECTION 10 0100

SECTION 10 1100 - VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sliding Markerboard System.
B. Tackable Wall Surface.

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard; 2022.
B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2025.
C. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.

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 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.

2.02 VISUAL DISPLAY UNITS

A. Porcelian Enamel Steel Markerboard Sliding Wall System:

1. Drawing Designation: MB1
2. Manufacturers:
   a. Claridge Products and Equipment, Inc; LCS Porcelian Sliding Wall System: www.claridgeproducts.com.
   b. Substitutions: See Section 01 600 - Product Requirements.
   c. Manufacturer's Representative: Jim Seibold, Jim@seiboldbaker.com, 419.356.2293.
3. Configuration:
   a. Two-Track:
      1) Classroom Teaching Wall - Six (6) sliding panels per system; each panel not less than one-half of unit length.
   b. Track to extend full length of system.
4. Sliding Markerboard Panels: Porcelain enamel on steel, laminated to core.
   a. Color: White
   b. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch.
   c. Core: Particleboard, 1/2 inch thick, laminated to face sheet.
   d. Backing: Aluminum foil, laminated to core.
   e. Overall Size: As indicated on drawings.
   f. Panel Width: 51 inches.
   g. Panel Height: 96 inches
   h. Frame: Extruded aluminum, with concealed fastners.
   i. Frame Finish: Anodized, natural.
   j. Bottom Supported: Aluminum track and nylon guide rollers at top, aluminum track and ball bearing nylon rollers at bottom.
      1) Track at floor to be recessed in floor below, cut slab approximatley 1/4 inch depth, verify top of track is flush with top of adjacent flooring, as indicated on A10 series drawings.
   k. Finger Pulls: One pair per sliding panel.

2.03 MATERIALS

A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
B. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
C. Fiber Board: ASTM C208, cellulosic fiber board.
D. Adhesives: Type used by manufacturer.

2.04 TRIM AND ACCESSORIES

A. Frame Profile: Extruded aluminum. Manufacturer's standard J-trim.
B. Magnetic Marker Holder:
   1. Claridge; Stadium Maker Caddy, Large Plastic Magnetic Holder with Divider, MGM-MC1-L; www.claridgeproducts.com.
   2. Color: White.
   3. Substitutions: See Section 01 6000 - Product Requirements.
C. Mounting Hardware: Concealed. Include brackets and all related fasteners and hardware required for a complete installation on substrates indicated.

2.05 TACKABLE WALL SURFACE

A. Tackable Wall Surface: Tackable sheet material, wall-applied, with perimeter metal edge trim.
   1. 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. Drawing Designation: TWS
      c. Product:
         1) Forbo Flooring Systems; Bulletin Board: www.forbo.com.
         2) Substitutions: Not permitted.

d. Color(s): Poppy Seed 2204

2. 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.
3. Adhesives: Provide manufacturer's recommended adhesive for substrates indicated.
4. 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. 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 10 1100

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.
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; 2023, with Editorial Revision.
B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
C. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2025.
D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
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; 2025.
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. 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. Folding Panel Partitions - Horizontal Opening:
   1. Basis of Design: Hufcor 633
   2. Substitutions: See Section 01 6000 - Product Requirements.
B. Self-supporting Truss System.

2.02 FOLDING PANEL PARTITIONS - HORIZONTAL OPENING

A. Folding Panel Partitions:
   1. Manually Operated: Side-opening; paired panels; side stacking; manually operated.
B. Panel Construction:
   1. Frame: 16 gauge, 0.0598 inch thick formed sheet steel frame top, bottom, jambs, and intermediates; welded construction, with acoustical insulation fill.
   2. Panel Substrate Facing: Steel sheet, manufacturer's standard thickness.
   3. Hinges: Panel manufacturer's standard butt type; minimum of 3 hinges per panel joint.
   4. Panel Properties:
      a. Thickness Without Finish: 3 inches.
      b. Width: Up to 48 inches (1219 mm).
      c. Weight: 8 lb/sq ft.
C. Panel Finishes:
   1. Facing: Markerboard.
   2. Exposed Metal Trim: Custom powder coated paint finish.
D. Panel Seals:
   1. Panel to Panel Seals: Grooved and gasketed astragals, with continuous flexible ribbed vinyl seal fitted to panel edge construction; color to match panel finish.
   2. Acoustic Seals: Flexible acoustic seals at jambs and ceilings, retractable floor seals.
E. Suspension System:
   1. Track: Formed steel or extruded aluminum; thickness and profile designed to support loads.
      a. Track shall provide support for adjacent ceiling materials.
      b. Connect track to structural support with adjustable steel hanger brackets and 3/8 inch diameter threaded rods.
         1) Hanger bracket thickness and profile designed to support track and associated loads.
      c. Include all associated hardware and accessories.

2. Carriers: Nylon wheels on trolley carrier at top of every panel, sized to carry imposed loads, with threaded pendant bolt for vertical adjustment.

F. Performance Requirements:
1. Acoustic Performance:
a. Sound Transmission Class (STC): 53 to 57 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: 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. Same construction as panels.
b. Frame: Adjustable metal frame; flush design.
c. 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.
d. Safety Features:
1) Pocket Door Interlock: Mechanism to prevent operation of panels unless storage pocket doors are fully open.
e. Factory finished to match partition panels.
3. Pass Door: Single door, 36 inch wide by 84 inch high opening; same design and construction as panel; fit door with perimeter acoustic gaskets, concealed closer, keyed lock, and tool operated floor seal. Frameless.
a. 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.

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. Markerboard - Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
   1. Color: White.
F. Tackboard - Natural Cork Sheet: Seamless, compressed, fine-grain cork sheet; bulletin board quality; sanded face for natural finish
G. 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.

3.05 CLOSEOUT ACTIVITIES

A. Demonstrate operation of partition and identify potential operational problems.

END OF SECTION 10 2239

SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

1.02 REFERENCE STANDARDS

A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2025.

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 PRODUCT TYPES

A. CG-1Corner Guards - Plastic, Flush 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: 2 inches.
   5. Corner: Radiused, 1/4 inch.
   6. Corner Angle: 90 degrees; and as otherwise indicated.

7. Color: As selected from manufacturer's standard colors.
8. Projection From Wall to Outside of Guard: 3/8 inch, maximum.
9. Length: One piece.
   a. Extend floor to ceiling; unless otherwise indicated.
10. Preformed end caps.
11. Products:
    a. Construction Specialties, Inc; Model SFS-20N: www.c-sgroup.com.
    b. Inpro Corp; Model 150F Flush Mount: www.inprocorp.com.
    c. Koroseal Interior Products, LLC; Model R400-Series: www.koroseal.com.
    d. Pawling Corporation; Model CGT-7: www.pawling.com.
    e. Substitutions: See Section 01 6000 - Product Requirements.

2.02 FABRICATION

A. Fabricate components with tight joints, corners and seams.

2.03 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. Stainless Steel Corner Guards:
   1. Adhere each wing of corner guard to substrate.
D. Corner Guards - Plastic, Surface Mounted:
   1. Mechanically fasten continuous metal retainers to substrate.
   2. Snap-on plastic finish cover.
E. Corner Guards - Plastic, Flush Mounted:
   1. Mechanically fasten continuous metal retainers to substrate; flanges shall overlap gypsum board.
   2. Refer to Section 09 2900 - {\t\#1000015} for finishing flanges with joint compound.
   3. Snap-on plastic finish cover.

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 10 2600

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.
B. Electric hair dryers.
C. Utility room accessories.

1.02 ABBREVIATIONS AND ACRONYMS

A. CFCI: Contractor to Furnish, Contractor to Install.
B. OFCI: Owner to Furnish, Contractor to Install.

1.03 REFERENCE STANDARDS

A. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2025a.
C. ASTM A666/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
D. ASTM B86 - Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings; 2023.
E. ASTM C1036 - Standard Specification for Flat Glass; 2021.
F. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.05 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. .

1.06 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 toilet, bath, and laundry accessories as required to prevent damage before installation.

1.08 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.

2.02 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/A666M, 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 - Bracket Type: Double roll, surface mounted bracket type, stainless steel, eccentric-shaped plastic spindle for 1/2 revolution delivery designed to prevent theft of tissue roll.
   1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-2740.
B. Paper Towel Dispenser - Folded Paper Type: Folded paper type, stainless steel, surface-mounted, with viewing slots on sides as refill indicator and tumbler lock.
   1. Owner Supplied, Cointractor Installed.
C. Waste Receptacle: Wall-mounted, stainless steel, removable container, continuously welded bottom pan and seamless exposed flanges.
   1. Owner Supplied, Contractor installed.
D. Soap Dispenser - Wall-Mounted: Liquid soap dispenser, wall-mounted, surface, with stainless steel cover and vertical stainless steel tank and working parts; push type soap valve, check valve, and window gauge refill indicator, tumbler lock.
   1. Owner Supplied, 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. 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. Robe Hook - Single: Stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.
1. Basis-of-Design Product: Bobrick Washroom Equipment, Inc.; B-76717.

2.06 ELECTRIC HAIR DRYERS

A. Electric Hair Dryers: Traditional fan-in-case type, with downward fixed nozzle.
1. Operation: Automatic, sensor-operated on and off.
2. Mounting: Semi-recessed.
a. Maximum Projection From Wall: 4 inches.
3. Cover: Stainless steel with brushed finish.
a. Tamper-resistant screw attachment of cover to mounting plate.
b. Screened or shielded air intake.
c. Screen or shield to prevent access to motor/heater.
4. Air Flow: 200 CFM, minimum.
5. Air Velocity: 7,000 linear feet per minute, maximum.
6. Total Wattage: 2300 W, maximum.
7. Runtime: 60 to 90 seconds, maximum.
8. Basis-of-Design Product: World Dryer Corp.; World Airstyle Model B.
a. Substitutions: Section 01 6000 - Product Requirements.

2.07 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.

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 10 2800

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; 2024.
B. NFPA 10 - Standard for Portable Fire Extinguishers; 2026.
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 10 4400

SECTION 10 5113 - METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal lockers.

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; 2025a.
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) Penco Products, Inc; Guardian Defiant II Lockers: www.pencoproducts.com.
         5) Lockers Manufacturing; Knock Down Plus: www.lockersmfg.com.

6) Substitutions: See Section 01 6000 - Product Requirements.

2. L-1
   a. Configuration: Single tier.
      1) Overall Width: 12 inches.
      2) Overall Depth: 12 inches.
      3) Overall Height: 60 inches.
      4) Height of Each Compartment: 60 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.
      4) Carpet Tile
         (a) Located at bottom of each locker, must fit with door closed.
         (b) Refer to specification 09 6813 Tile Carpeting for additional information.
   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, and boxed end panels.
   f. Color:
      1) Standard color(s) as selected by Architect.

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.
      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.

13. Coat Hooks: Stainless steel or zinc-plated steel.
14. Coat Rod: Stainless steel or zinc-plated steel.
15. Number Plates: Provide rectangular or oval shaped aluminum plates. Form numbers 1/2 inch high, in block font style; black color.

2.04 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.

2.05 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 10 5113

SECTION 12 2400 - WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manual roller shades.

1.02 REFERENCE STANDARDS

A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.

B. 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.

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.

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. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.

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. 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.

J. 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 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.

B. Handle and store shades in accordance with manufacturer's recommendations.

1.07 FIELD CONDITIONS

A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 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. Fabric: 10 years.
3. 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.

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: RSF1
   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: Black.
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. Fascia: Extruded aluminum, size as required to conceal shade mounting, 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 RSF1: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
a. Substitutions: Not permitted.
2. Products:
a. Mermet Corporation: E Screen: www.mermetusa.com.
b. Substitutions: Not permitted
3. Material: Vinyl coated fiberglass.
4. Performance Requirements:
a. UV Blockage: Approximately 97 percent.
b. Flammability: Pass NFPA 701 large and small tests.
c. Fungal Resistance: No growth when tested according to ASTM G21.
5. Openness Factor: 3 percent.
6. Roll Width: 122 inches, minimum.
7. Color: Pearl / Gray 007001.

2.04 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. 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 12 2400

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 - Standard for Materials and Finishes; 2020.
I. BHMA A156.9 - Cabinet Hardware; 2020.
J. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2024.
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.
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: 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: Particleboard with Thermofused Melamine (TFM). Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Drawer Construction Method: Glued and doweled; with captured bottoms. Drawer bottom minimum 0.25 inches.

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. PL2To match Wilsonart; Handspun Dove, 5034-38 : www.wilsonart.com.
      b. Substitutions: Not permitted.
   2. Thermally Fused Laminates:
      a. Color: White.
B. PVC Edgebanding Colors:
   1. Color(s): Handspun Dove W5034.

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 12 3216

SECTION 12 3600 - COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. 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/A666M - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2024.
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; 2025.
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. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
K. NSF 51 - Food Equipment Materials; 2023.
L. PS 1 - Structural Plywood; 2023.
M. SEFA 2 - Installations; 2010.
N. SEFA 3 - Laboratory Work Surfaces; 2020.
O. 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. 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) Durat; Durat Solid Surface: www.durat.fi/en
            2) Substitutions: Not permitted.
            3) Manufacturer's Representative: Susan Hall, 248.421.6000, susan@ecosurroundings.eco.
        b. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
        c. Color and Pattern: 730-00
        d. Drawing Designation: SS1
    3. Other Components Thickness: 1/2 inch, minimum.
    4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
    5. 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. Provide moisture resistant substrates at sink base, countertop, and splash within 18" of sink.

G. Provide marine grade substrates at high humid and/or moist environments.
H. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
I. Joint Sealant: Mildew-resistant silicone sealant, white.
J. 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.

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. Apply sealer products in accordance with manufacturer's written instructions.
C. 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 12 3600

SECTION 20 0500 - MECHANICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.

1.03 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
3. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
4. ABMA - American Boiler Manufacturers Association; www.abma.com.
5. AGA - American Gas Association; www.aga.org.
6. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.

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

41. USGBC - U.S. Green Building Council; www.usgbc.org.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.04 **PERFORMANCE REQUIREMENTS**

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.05 **QUALITY ASSURANCE**

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.

2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner’s Representatives causes interference.

G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.06 **CODES, PERMITS AND FEES**

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

D. Refer to Division 22 Section “Domestic Water Piping” for purchase and installation of potable water meters.

1.07 **DRAWINGS**

A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.08 **MATERIAL AND EQUIPMENT MANUFACTURERS**

A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.09 **INSPECTION OF SITE**

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 **ITEMS REQUIRING PRIOR APPROVAL**

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 **ACTION SUBMITTALS**

A. Submit for review in compliance with Division 01.

B. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.

C. Submittals shall be in groupings of similar or related items. Plumbing fixture submittals shall be in one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned “Rejected”. Submit product data with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.

D. Submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned “Rejected”.

E. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be included with the submittal for approval.

1.12 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings:

1. Prepare shop drawings to scale for the Architect/Engineer for review.
2. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.
3. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.
    a. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.
    b. Contractor is responsible for:
        1) Dimensions, which shall be confirmed and correlated at the job site.
        2) Fabrication processes and techniques of construction.
        3) Quantities.
        4) Coordination of Contractor’s work with all other trades.
        5) Satisfactory performance of Contractor’s work.
        6) Temporary aspects of the construction process.

B. Coordination Drawings:
1. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Instructional Manuals:
1. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.
2. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.
3. For Commissioned Projects: Operation and maintenance instructional manuals shall be submitted a minimum of four weeks prior to functional testing.
4. 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.
5. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

a. Routine maintenance procedures.

b. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.

c. Trouble-shooting procedures.

d. Contractor's telephone numbers for warranty repair service.

e. Submittals.

f. Recommended spare parts list.

g. Names and telephone numbers of major material suppliers and subcontractors.

h. System schematic drawings.

B. Record Drawings:

1. Submit record drawings in compliance with Division 01.

2. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.

3. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

C. Warranties:

1. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

2. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.

E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to

the Owner's satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **MECHANICAL DEMOLITION WORK**

A. Demolition of existing mechanical equipment and materials shall be done by the Contractor unless otherwise indicated. Include items such as, but not limited to, existing piping, pumps, ductwork, supports, and equipment where such items are not required for the proper operation of the modified system.

B. Include draining of piping systems where required for demolition, modification of, or connection to existing systems.

C. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this Work.

D. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse.

1. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived.

2. Remove items from the systems and turn over to the Owner in their condition prior to removal. The Owner will move and store these materials.

3. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

E. Work that has been cut or partially removed shall be protected against damage until covered by permanent construction.

F. Clean and flush the interior and exterior of existing relocated equipment and its related piping, valves, and accessories that are to be reused of mud, debris, pipe dope, oils, welding slag, loose mill scale, rust, and other extraneous material so that the existing equipment and accessories can be repainted and repaired as required for the proper operation and performance of the relocated equipment.

G. Where existing equipment is to be removed, cap piping under floor, behind face of wall, above ceiling, or at mains.

H. Cap ductwork and cap piping immediately adjacent to demolition as soon as demolition commences in order to allow existing systems to remain in operation.

1. Cap or plug piping with same or compatible piping material.

2. Cap or plug ducts with same or compatible ductwork material.

3.02 **REFRIGERANT HANDLING**

A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

1. ASHRAE Standard 15 and Related Revisions: Safety Code for Mechanical Refrigeration.

2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.

3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.

B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.03 **WORK IN EXISTING BUILDINGS**

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement, if necessary, of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.04 **TEMPORARY SERVICES**

A. Provide temporary service as described in Division 01.

B. The existing building will be occupied during construction. Maintain mechanical services and provide necessary temporary connections and their removal at no additional cost to the Owner.

3.05 **WORK INVOLVING OTHER TRADES**

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.06 **ACCEPTANCE PROCEDURE**

A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.

B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

E. Operation of the following systems shall be demonstrated:

1. Air Handling Systems.

2. Heating Systems.
3. Domestic Hot Water Heaters.
4. Domestic Hot Water Mixing Stations.
5. Temperature Controls.
6. Building Automation System.
7. Exhaust Systems.

F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

3.07 **PROJECT COMMISSIONING**

A. Refer to Division 01 “Project Commissioning” and the Commissioning Manual.

B. Purpose: Training, documentation and verification of the operation and functional performance of mechanical systems for compliance with the “design intent.”

END OF SECTION

SECTION 20 0510 - BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 22 Section “Domestic Water Piping” for flushing and cleaning of potable water piping.
3. Division 23 Section “Piping Systems Flushing and Chemical Cleaning” for flushing and cleaning of HVAC piping.

1.02 SUMMARY

A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheet metal systems and equipment. This section supplements all other Division 20, 21, 22, and 23 Mechanical Sections, and Division 01 Specification Sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, 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. Existing Piping: Use the following:

a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.

b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.

c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

3. Packaging: Premixed and factory packaged.

2.11 EPOXY BONDING COMPOUND

A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:

1. Euco 452 #450; Euclid Chemical Co.

2. Epobond; L & M Construction Chemicals.

3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

A. Commercial leak detector solution for pipe system testing.

B. Manufacturers:

1. American Gas and Chemicals Inc.; Leak Tec.

2. Cole-Parmer Inst. Co.; Leak Detector.

3. Guy Speaker Co. Inc.; Squirt 'n Bubbles.

2.13 PIPING CONCEALMENT SYSTEM

A. Manufacturers:

1. ARSCO Manufacturing Company.

2. DecoShield Systems, Inc.
3. JG Innovations Inc.

B. Description: Modular system of support brackets and covers made to protect piping.

C. Brackets: Glass-reinforced nylon.

D. Covers: 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); pha Series.
2. Heavy gage aluminum construction.
3. Removable top cover.
4. Fully insulated aluminum mounting base to isolate hood from galvanized curb.
5. Includes prefabricated roof curb with:
   a. Minimum 18 gage welded galvanized steel construction.
   b. Integral base plate.
   c. Factory installed insect and decay resistant wood nailer.

PART 3 EXECUTION

3.01 **PIPING SYSTEMS - COMMON REQUIREMENTS**

A. Refer to piping application schedules on the Drawings.

B. Install piping according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems, and in accordance with manufacturer’s instructions.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.

D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.

E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

H. Clean and lubricate elastomer joints prior to assembly.

I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

J. Install piping to conserve building space and not interfere with use of space.

K. Group piping whenever practical at common elevations.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.

M. Slope piping and arrange systems to drain at low points.

N. Slope horizontal piping containing non-condensable gases 1 inch per 100 feet, upward in the direction of the flow.

O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

P. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters, or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a minimum of 2 inches above sole plates and below top plates.

R. Do not penetrate building structural members unless specifically indicated on drawings.

S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.

T. Install valves with stems upright or horizontal, not inverted.

U. Provide clearance for installation of insulation and access to valves and fittings.

V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.

W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.

X. Install piping free of sags and bends.

Y. Install fittings for changes in direction and branch connections.

Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:

1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable. For up-feed risers, connect branch to top of main pipe.

2. Branch connected to top of main for steam and condensate, plumbing systems, compressible gasses, and vacuum.

AA. Install piping to allow application of insulation.

BB. Select system components with pressure rating equal to or greater than system operating pressure.

CC. After completion, fill, clean, and treat systems. Refer to Division 23 Sections “Hydronic Piping,” “Piping Systems Flushing and Chemical Cleaning,” and “HVAC Water Treatment.”

DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.

EE. Sleeves are not required for core-drilled holes in poured concrete walls.

FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.

GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces of walls.

a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.

b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.

c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.

d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.

e. For pipes penetrating floors with membrane water proofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.

4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.

5. Seal sleeves in plaster/gypsum-board partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.

6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

JJ. Existing Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Seal core drilled pipe penetrations using modular mechanical seals. Allow for 1-inch annular clear space between pipe and cored opening for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of cored hole. Assemble modular mechanical seals and install in annular space between pipe and cored opening. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

KK. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.
2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.

LL. Pipe Roof Penetration Enclosures:

1. Coordinate delivery of roof penetration enclosures to jobsite.
2. Locate and set curbs on roof.
3. Framing, flashing, and attachment to roof structure are specified under Division 07.
4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

MM. Verify final equipment locations for roughing-in.

NN. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 **PIPING JOINT CONSTRUCTION**

A. Join pipe and fittings according to the following requirements and Division 21, 22, and 23 Sections specifying piping systems.

B. Cut piping square.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.

G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.

J. Provide temperature sensing device thermal wells and similar piping specialty connections.

K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.

L. Locate instrument connections in accordance with manufacturer’s instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.

M. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

O. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.

1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.

2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket.

After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation. Contractor shall remove and replace any joints deemed improperly installed.

S. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

T. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.

U. 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.

V. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

W. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

X. 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.

Y. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

Z. 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 any air moving equipment, without all prefilters and final filters as specified.

B. Immediately prior to final building acceptance by the Owner, Contractor shall:

1. Thoroughly wash, recharge, and reinstall cleanable type air filters.
2. Replace all disposable type air filters with new units.

3.20 **CLEANING**

A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 23 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 22 Section “Domestic Water Piping.”

E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.

F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION

SECTION 20 0513 - MOTORS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 21, 22, and 23 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
4. Division 26 Section “Enclosed Switches and Circuit Breakers”.
5. Division 26 Section “Enclosed Controllers”.
6. Division 26 Section “Fuses”.

1.02 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. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

D. 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.

1.03 **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.

1.04 **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.

1.05 **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.

1.06 **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. 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 Rexnord Corporation/LEESON.

7. Regal Rexnord Corporation/Marathon Motors.

8. 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	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM 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	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM 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
7.5	88.5	87.5	85.5	86.5
10	90.2	89.5	88.5	87.5

	1200 RPM OPEN DRIP-PROOF MOTORS 6 POLE		3600 RPM OPEN DRIPPROOF MOTORS 2 POLE	
HP	NOMINAL EFF	MINIMUM EFF	NOMINAL EFF	MINIMUM EFF
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. 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:

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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Refrigerant Piping.”

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.

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. Minimum Pressure Rating: 150 psig, unless otherwise indicated.

4. 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. 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.

C. 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.

D. Packed Slip Expansion Joints: ASTM F 1007, carbon-steel, packing type designed for repacking under pressure and pressure rated for 250 psig at 400 deg F minimum. Include asbestos-free PTFE packing compound, limit stops, and drip connection if used for steam piping.

1. Manufacturers:

a. Adsco Manufacturing, LLC.

b. Advanced Thermal Systems, Inc.

c. Hyspan Precision Products, Inc.

d. Tyco Flow Control; Yarway.

2. Configuration: Single- and double-joint class with base, unless otherwise indicated.

3. End Connections: Flanged or weld ends to match piping system.

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 Connectors for Steam and Steam Condensate Service: Stainless steel hose and braid style with threaded end connections for pipe sized NPS 2 and smaller, and steel flange end connections for pipe sized NPS 2-1/2 and larger. Overall length sufficient to provide 1-1/2 inch offset.

C. 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. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 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 half scale.

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. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
4. 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.

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. Heating Hot 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.

C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).

F. Install ball valve and syphon fitting in piping for each pressure gage for steam.

G. Install test plugs in tees in piping.

H. Install flow indicators, in accessible positions for easy viewing, in piping systems.

I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

J. Install flowmeter elements in accessible positions in piping systems.

K. 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.

L. Install wafer-orifice flowmeter elements between pipe flanges.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings for attachment to portable indicators in accessible locations.

O. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

P. Assemble components and install thermal-energy meters.

Q. 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 20 Section "Mechanical Vibration Controls" for vibration isolation devices.
5. Division 20 Section "Pipe Flexible Connectors, Expansion Fittings and Loops" for pipe guides and anchors.
6. Division 21 Section "Fire-Suppression System" for pipe hangers for fire-protection piping.
7. Division 23 Section(s) "Metal Ducts" for duct hangers and support.

1.02 DEFINITIONS

A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry Inc.

B. MFMA: Metal Framing Manufacturers Association.

1.03 **PERFORMANCE REQUIREMENTS**

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.04 **ACTION SUBMITTALS**

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Thermal-hanger shield inserts.

1.05 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

1.06 **QUALITY ASSURANCE**

A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:

1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture, Selection, Application, and Installation.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 **HANGER ROD MATERIAL**

A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.

1. Rod continuously threaded.
2. Use of rod couplings is prohibited.

2.03 **STEEL PIPE HANGERS AND SUPPORTS**

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.

1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. Hilti USA.
5. nVent Electric plc; CADDY.

6. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.04 **TRAPEZE PIPE HANGERS**

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.05 **METAL FRAMING SYSTEMS**

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Anvil; Anvil-Strut; ASC Engineered Solutions.
2. B-Line by Eaton.
3. nVent Electrical plc; ERISTRUT Div.
4. Power-Strut; a part of Atkore International.
5. Unistrut; a part of Atkore International.
6. Hilti USA.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.06 **METAL INSULATION SHIELDS**

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 40, protective shields. Shields shall span an arc of 180 degrees.

C. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.07 **PIPE COVERING PROTECTION SADDLES**

A. Manufacturers:

1. Anvil; ASC Engineered Solutions.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. nVent Electric plc; CADDY.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-58, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.

1. Saddles shall match insulation thickness.
2. Saddle length: 12 inches.
3. Furnish with center rib for pipe sized NPS 12 and larger.

2.08 **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.

2.09 **FASTENER SYSTEMS**

A. Post-Installed Anchors:

1. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
   a. Manufacturers:
      1) B-Line by Eaton.
      2) DeWalt Engineered by Powers.
      3) Hilti, Inc.
      4) ITW Ramset/Red Head.
      5) MKT Fastening, LLC.
2. Internally Threaded Screw Anchors: Internally threaded, self-tapping screw anchor designed for performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, sand-lightweight concrete and concrete over steel deck.
   a. UL Listed or FMG approved for fire sprinkler piping.
   b. Available Sizes: For 1/4-inch, 3/8-inch, and 1/2-inch diameter rod sizes
   c. Manufacturers:
      1) B-Line by Eaton; Rapid Rod Hangers.
      2) DeWalt Engineered by Powers; Snake+.
3. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application. Exception: Do not use chemical fasteners to support hanger systems for fire protection piping.
   a. Manufacturers:
      1) DeWalt Engineered by Powers.
      2) Hilti, Inc.
      3) ITW Ramset/Red Head.
      4) MKT Fastening, LLC.
   b. 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.
   c. Stud: ASTM A 307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
   d. Washer and Nut: Zinc-coated steel.

B. Cast-in-Place Anchors:

1. General
   a. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.
   b. Manufacturers:
      1) B-Line by Eaton.

2) DeWalt Engineered by Powers.
3) Empire Industries, Inc.
4) Hilti, Inc.
5) ITW Ramset/Red Head.
6) MKT Fastening, LLC.
7) Richmond Screw Anchor Co.

2. Slotted Inserts: Continuous galvanized steel with temporary slot fillers and complete with nuts, studs, washers and the like, for 3/4 inch bolts.
   a. Manufacturers:
      1) B-Line by Eaton; B22-I Continuous Concrete Insert.
      2) Hilti, Inc.; CIS13812/PG.
      3) Hohman and Barnard, Inc.
      4) Richmond Screw Anchor Co.
      5) Unistrut; a part of Atkore International; P-3200 Continuous Insert.

2.10 **EQUIPMENT SUPPORTS**

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.11 **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. Equipment Supports: Painting is specified in Division 09 painting Sections.

C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 20 0547 - MECHANICAL VIBRATION CONTROLS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: Include load deflection curves for each vibration isolation device.

1.03 INFORMATIONAL SUBMITTALS

A. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:

1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

1.04 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.03 INFORMATIONAL SUBMITTALS

A. Samples: For color, letter style, and graphic representation required for each identification material and device.

B. Valve numbering scheme.

1.04 CLOSEOUT SUBMITTALS

A. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.05 **QUALITY ASSURANCE**

A. ASME Compliance: Comply with ASME (ANSI) A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.06 **COORDINATION**

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Seton.
2. Brady.
3. EMED.
4. Craftmark.
5. Brimar Industries, Inc.
6. Marking Services Inc. (MSI).
7. Kolbi Pipe Marker Co.

2.02 **EQUIPMENT IDENTIFICATION DEVICES**

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
    a. Manufacturer, product name, model number, and serial number.
    b. Capacity, operating and power characteristics, and essential data.
    c. Labels of tested compliances.
2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:
    a. Name and plan number.
    b. Equipment service.
    c. Design capacity.
    d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.03 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
3. Legends: Spelled out in full or commonly used and accepted abbreviations.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.

D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.

E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.

G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.04 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.05 **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 to match existing numbering scheme. 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: Pretensioned pipe markers. Use size to ensure a tight fit.

2. 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.

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. Identify ductwork with vinyl markers and flow direction arrows.

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.
   e. Steam: 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. General

PIPE LABELING

Pipe System Label	Drawing Abbrev.	Labels
Non-Potable Cold Water	NPCW	Black on Yellow
Domestic Hot Water	HW	Black on Yellow
High Pressure Domestic Hot Water	HPHW	Black on Yellow
High Pressure Domestic Hot Water Return	HPHWR	Black on Yellow
Domestic Hot Water Return	HWR	Black on Yellow
Soft Cold Water	SCW	White on Green
Soft Hot Water	SHW	White on Green
Soft Hot Water Return	SHWR	White on Green
Natural Gas	G	Black on Yellow
Fuel Oil Supply	FOS	Black on Yellow
Fuel Oil Return	FOR	Black on Yellow
Compressed Air (90psig)	A(90psig)	Black on Yellow
Compressed Air (25psig)	A	White on Green
Laboratory Vacuum	LVAC	Black on Yellow
Carbon Dioxide	CO_2	Black on Yellow
High Purity Water	DI	White on Green
Hot Water Htg. Supply	HWHS	Black on Yellow
Hot Water Htg. Return	HWHR	Black on Yellow
Terminal Unit Heating Sup.	THS	Black on Yellow
Terminal Unit Heating Ret.	THR	Black on Yellow
Animal Heating Supply	AHS	Black on Yellow
Animal Heating Return	AHR	Black on Yellow
Energy Recovery Loop Sup.	ERLS	Black on Yellow

Pipe System Label	Drawing Abbrev.	Labels
Energy Recovery Loop Ret.	ERLR	Black on Yellow
Chilled Water Supply	CHWS	White on Green
Chilled Water Return	CHWR	White on Green
Condenser Water Supply	CWS	White on Green
Condenser Water Return	CWR	White on Green
Process Cooling Water Sup.	PCWS	White on Green
Process Cooling Water Ret.	PCWR	White on Green
Refrigerant Liquid	RL	Black on Yellow
Refrigerant Suction	RS	Black on Yellow
Steam Condensate	LPC	Black on Yellow
Medium Pressure Steam Condensate	MPC	Black on Yellow
High Pressure Steam Condensate	HPC	Black on Yellow
Pumped Steam Condensate	PC	Black on Yellow
Medium Pressure Steam (60 psig)	MPS	Black on Yellow
High Pressure Steam,	HPS	Black on Yellow
Low Pressure Steam (5 psig)	LPS	Black on Yellow
Fire Protection	FP	White on Red
Medical Gases		
Service	Abbrev.	Labels
Air Conditioning Supply	Supply Air	White on Green
Air Conditioning Return	Return Air	White on Green
Exhaust Systems	Exhaust Air	Black on Yellow
Outside Air Intake	Outside Air	White on Green
Mixed Air	Mixed Air	White on Green

END OF SECTION

SECTION 20 0700 - MECHANICAL INSULATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. General

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.
E. Existing Plastic Water Piping Within Return Air Plenum Space:
   1. All Pipe Sizes: Fire-Rated Plenum Wrap: 1/2 inch thick.

1.05 **INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION**

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.06 **EQUIPMENT INSULATION SYSTEMS DESCRIPTION**

A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.07 **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.

1.08 **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.

1.09 **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.

B. Ductwork Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.10 **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.

1.11 **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.

1.12 **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.

D. 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.

E. Calcium Silicate:

1. Products: Subject to compliance with requirements, provide one of the products specified.

a. Industrial Insulation Group (The); Thermo-12 Gold.

2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.

2.03 **DUCTWORK INSULATION MATERIALS**

A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with 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.

C. 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 Sheet.
    b. Armacell LLC; AP Armaflex.
    c. IK Insulation Group; K-Flex USA LLC; Insul-Sheet.

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 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. 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.

2.12 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.

2.13 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.

2.14 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.

2.15 **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.

2.16 **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 CALCIUM SILICATE PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.

2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.

3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.

4. Finish flange insulation same as pipe insulation.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.

2. When preformed insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.

3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.09 **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.

3.10 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.

3.11 FIELD-APPLIED JACKET INSTALLATION

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where self-adhesive jackets are indicated, install according to manufacturer’s instructions and details on the drawings. Overlap seams arranged to shed water.

3.12 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."

3.13 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, 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 22 1116 - DOMESTIC WATER PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
3. Division 20 Section “Hangers and Supports.”
4. Division 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. 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.

C. 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, couplings, and water meters.

1.07 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Water Samples: Specified in Part 3 "Cleaning" Article.

1.08 **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.

1.09 **PROJECT CONDITIONS**

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without Owner's written permission.

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 **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."

C. Cast-Iron Gate Valves: MSS SP-70, with bolted bonnet, flanged end connections, and non-asbestos packing and gasket.

1. Class 125, OS&Y, Bronze-Mounted, Cast-Iron Gate Valves: ASTM A-126, Class B cast-iron body and bonnet with bronze trim, and solid-wedge disc; and having 200 psig CWP rating.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Crane Valve Group; Crane Valves.
      2) Hammond Valve.
      3) Milwaukee Valve Company; Model F-2885.
      4) NIBCO INC.; Model F-617-O.
      5) Watts Water Technologies.

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."

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. 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 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 20 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 22 Section "Domestic Water Piping" for water meters.
5. 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 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.

1.05 **QUALITY ASSURANCE**

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials", for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."
3. Comply with NSF 372, "Drinking Water System Components – Lead Content" for components with wetted surfaces in contact with potable water.

PART 2 PRODUCTS

2.01 **BACKFLOW PREVENTERS**

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.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. 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.

2.02 **BALANCING VALVES**

A. Calibrated Balancing Valves NPS 1/2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Armstrong International, Inc.
    b. Armstrong Pumps, Inc.
    c. Apollo Valves; by Conbraco Industries, Inc.
    d. Bell & Gossett; Xylem Inc.
    e. Flo Fab Inc.
    f. Flow Design Inc.
    g. Griswold Controls.
    h. NIBCO INC.
    i. IMI Indoor Climate; Tour & Andersson.
    j. Taco, Inc.
    k. Watts Water Technologies, Inc.; Watts Regulator Co.
2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
3. Body: Dezincification resistant brass, or bronze.
4. Minimum Flow Rate: 0.3 gpm.
5. Manufactur
6. 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.

2.03 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. ers: 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: Rough bronze.

2.04 **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.

2.05 **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.

2.06 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.

2.07 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.

2.08 **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 regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. 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.

G. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

H. 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."

I. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified. 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."

J. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

K. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.

L. Install non-freeze, nondraining-type post hydrants set in concrete or pavement.

M. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

N. Install roof hydrants in accordance with manufacturer’s instructions. Pipe drain hole to acceptable discharge point.

O. Install water hammer arresters in water piping according to PDI-WH 201.

P. Install air vents at high points of water piping.

Q. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

R. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

S. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.02 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping and specialties.

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. Double-check backflow-prevention assemblies.
5. Dual-check-valve backflow preventers.
6. Water pressure-reducing valves.
7. Calibrated balancing valves.

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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "Domestic Water Packaged Booster Pumps" for booster systems.
4. Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

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 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.

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.

1.08 **COORDINATION**

A. Coordinate size and location of concrete bases. 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 **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 SMALL CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS WITH INTEGRAL VARIABLE FREQUENCY CONTROL

A. Manufacturers:

1. Bell & Gossett; Xylem Inc.; ecocirc XL.

2. Grundfos Pumps Corporation; Magna Series.

3. Taco, Inc.; Veridian Series.

4. WILO-USA LLC; Stratos Z.

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: Bronze fitted.

a. Casing: Lead-free and corrosion resistant, 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: Electrically commutated electrical motor (ECM) with permanent magnet rotor.

a. Rotor Magnets: Time stable, non-toxic ceramic magnets (Sr-Fe).

b. Electrically Commuted Motor: Driven by frequency converter with integrated PFC filter.

C. Capacities and Characteristics: Refer to Schedule on Drawings.

2.04 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 120 deg F.

2.05 **FLEXIBLE CONNECTORS**

A. Refer to Division 20 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

2.06 **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. Install vertical in-line pumps on concrete bases. Install pumps with motor and pump shafts vertical.

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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements”.
2. Division 20 Section “Basic Mechanical Materials and Methods”.
3. Division 22 Section “Drainage Piping Specialties”.
4. Division 22 Section "Chemical-Waste Piping" for chemical-waste and vent piping systems.
5. Division 22 Section "Sewage Pumps."
6. 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 **ACTION SUBMITTALS**

A. Product Data: For pipe, tube, fittings, and couplings.

1.04 **CLOSEOUT SUBMITTALS**

A. Field quality-control inspection and test reports.

1.05 **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.

1.06 **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. 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.

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 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. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Flanges: ASME 16.1, Class 125, cast iron.

2.05 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

A. Hard Copper Tube: ASTM B 88, Types M, water tube, drawn temper.

1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.

2. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Types 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. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

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.

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. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.; DMD Div.

c. Ford Meter Box Company, Inc. (The); Pipe Products Div.

d. JCM Industries, Inc.

e. Smith-Blair, Inc.

f. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.

3. Gasket Material: Natural or synthetic rubber.

4. Metal Component Finish: Corrosion-resistant coating or material.

E. 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.

G. Install underground, ductile-iron, special pipe fittings according to AWWA C600.

H. Install underground, copper, force-main tubing according to Copper Development Association’s "Copper Tube Handbook."

I. 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."

J. 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."

K. 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.

L. 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.

M. 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.

N. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

O. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

P. Install underground PVC 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: Unshielded, 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 **HANGER AND SUPPORT INSTALLATION**

A. Pipe hangers and supports are specified in Division 20 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Install individual, straight, horizontal piping runs according to the following:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for 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.
8. NPS 10 and NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. 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.

J. Install supports for vertical copper tubing every 10 feet.

K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.06 **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.

3.07 **IDENTIFICATION**

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 20 Section "Mechanical Identification."

3.08 **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.

3.09 **CLEANING**

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 22 1319 - DRAINAGE PIPING SPECIALTIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section "Plumbing Fixtures" for hair interceptors.
4. Division 22 Section "Healthcare Plumbing Fixtures" for plaster sink interceptors.

1.02 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FRP: Fiberglass-reinforced plastic.

C. HDPE: High-density polyethylene plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. 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. 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. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary and storm piping specialty components.

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 **BACKWATER VALVES**

A. Horizontal, Cast-Iron Backwater Valves:

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. Mfr. Co.; Division of Smith Industries, Inc.; Model 7012.
    d. Tyler Pipe; Wade Div.
    e. Watts Drainage Products Inc.
    f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Enameled or epoxy-coated cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang closed.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

B. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Josam Company; Josam Div.
    b. Smith, Jay R. Mfr. Co.; Division of Smith Industries, Inc.
    c. Watts Drainage Products Inc.
    d. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.

4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

C. Horizontal, Plastic Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Canplas LLC.
   b. IPS Corporation.
   c. NDS Inc.
   d. Oatey.
   e. Plastic Oddities; a division of Diverse Corporate Technologies.
   f. Sioux Chief Manufacturing Company, Inc.; ProCheck.
   g. Zurn Plumbing Products Group; Light Commercial Operation.
2. Size: Same as connected piping.
3. Body: PVC
4. Cover: Same material as body with threaded access to check valve.
5. Check Valve: Removable swing check.
6. End Connections: Socket type.

D. Access Hand Holes:

1. Description: Comply with SCTE 77.
   a. Color: Gray.
   b. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
   c. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
   d. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   e. Cover Legend: Molded lettering, as indicated for each service.
   f. Piping Entrance Provisions: Precast in enclosure wall.
   g. Yard Boxes: 12 inches wide by 24 inches long.
2. Polymer Concrete Yard Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Armorcast Products Company.
      2) Carson Industries LLC.
      3) CDR Systems Corporation.
      4) NewBasis.
      5) QUAZITE; Hubbell Lenior City, Inc.

2.02 **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.

2.03 **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-A.
    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 diameter.
13. Top Loading Classification: Light Duty.
14. Inlet Fitting: Gray iron, with spigot outlet.

B. Cast-Iron Floor Drains (Mechanical Rooms, Electrical Rooms, and Penthouses) 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. 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: Square.
12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area.
13. Top Loading Classification: Heavy Duty.
14. Outlet Fitting: Gray iron, with spigot outlet.

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.

B. Stack Air-Admittance Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Durgo, Inc.
    b. Oatey.
    c. Studor, Inc.
2. Standard: ASSE 1050 for vent stacks.
3. Housing: Plastic.
4. Operation: Mechanical sealing diaphragm.
5. Size: Same as connected stack vent or vent stack.

C. Wall Box:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. Durgo, Inc.
    b. Oatey.
    c. RectorSeal.
    d. Studor, Inc.

2. Description: White plastic housing with white plastic grille, made for recessed installation. Include bottom pipe connection and space to contain one air-admittance valve.
3. Size: About 9 inches wide by 8 inches high by 4 inches deep.

2.05 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 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 RD-2:

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.

2.07 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 with increaser fitting of size indicated.

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. Downspout Boots:

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout.
3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
4. Size: Same as or larger than connected downspout.

I. 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.

J. Downspout Covers DC-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Fig. No. 1775.
   b. Zurn Plumbing Products Group; Specification Drainage Operation; Z199-DC.

2. Description: Round fabricated stainless steel frame with mounting holes, and with fabricated secured perforated stainless steel hinged strainer.

3. Size: Same as connected conductor.

2.08 **FLASHING MATERIALS**

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.

2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.

2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.01 **INSTALLATION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

1. Installation of Access Hand Holes:

a. Install boxes level and plumb and with orientation and depth coordinated with connecting piping to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of piping, and seal joint between box and extension as recommended by the manufacturer.

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. 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.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. 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.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Assemble stainless-steel channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

I. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

J. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

K. Install fixture air-admittance valves on fixture drain piping.

L. Install stack air-admittance valves at top of stack vent and vent stack piping.

M. Install air-admittance-valve wall boxes recessed in wall.

N. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

O. 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.

P. Assemble open drain fittings and install with top of hub 2 inches above floor.

Q. Install deep-seal traps on floor drains and other waste outlets, if indicated.

R. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.

S. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

T. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

U. Install vent caps on each vent pipe passing through roof.

V. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

W. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

X. Install manufactured, gray-iron downspout boots at grade with top 6 inches above grade. Secure to building wall.

Y. Install cast-iron soil pipe downspout boots at grade with top of hub 6 inches above grade.

Z. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

AA. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.

BB. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

1. Above-Floor Installation: Set unit with bottom resting on floor, unless otherwise indicated.
2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.

CC. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing. Coordinate oil-interceptor storage tank and gravity drain with Division 33 Section "Fuel Oil Distribution."

DD. 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.

EE. Install wood-blocking reinforcement for wall-mounting-type specialties.

FF. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

GG. 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.

HH. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.

1. Comply with requirements in Division 07 Section "Penetration Firestopping."

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 equipment to allow service and maintenance.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Solids interceptors.
2. Oil interceptors.
3. 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."

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 22 1413 - STORM DRAINAGE PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 22 Section “Drainage Piping Specialties.”
4. Division 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 SYSTEMS DESCRIPTIONS

A. Storm drainage piping system materials are scheduled on the Drawing.

1.04 ACTION SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

1.05 **CLOSEOUT SUBMITTALS**

A. Field quality-control inspection and test reports.

1.06 **QUALITY ASSURANCE**

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).

C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with “NSF-dwv” for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping 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. 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.

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 **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. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end, unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Flanges: ASME 16.1, Class 125, cast iron.

2.05 **COPPER TUBE AND FITTINGS**

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast-copper or ASME B16.29, wrought-copper, solder-joint fittings.

B. Hard Copper Tube: ASTM B 88, 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. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

3. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

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, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

2.07 **SPECIAL 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. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:

a. Cascade Waterworks Mfg. Co.

b. Dresser, Inc.; DMD Div.

c. EBAA Iron Sales, Inc.

d. Ford Meter Box Company, Inc. (The); Pipe Products Div.

e. JCM Industries, Inc.

f. Romac Industries, Inc.

g. Smith-Blair, Inc.

h. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.

3. Gasket Material: Natural or synthetic rubber.

4. Metal Component Finish: Corrosion-resistant coating or material.

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.

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."

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."

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. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

O. Install PVC storm drainage piping according to ASTM D 2665.

P. Install underground PVC storm 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. 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 **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. Individual, Straight, Horizontal Piping Runs: According to the following:
    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 20 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install 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: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. 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.

J. Install supports for vertical copper tubing every 10 feet.

K. 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 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.

D. Connect force-main piping to the following:

1. Storm Sewer: To exterior force main or storm manhole.
2. Sump Pumps: To sump pump discharge.

3.06 **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.

3.07 **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 3300 - ELECTRIC DOMESTIC WATER HEATERS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 ACTION SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.03 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 wiring. Differentiate between manufacturer-installed and field-installed wiring.

B. Product Certificates: For each type of electric water heater, signed by product manufacturer.

C. Source quality-control test reports.

1.04 CLOSEOUT SUBMITTALS

A. Field quality-control test reports.

B. Operation and Maintenance Data: For electric water heaters to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of electric water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of electric water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. 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.

D. ASME Compliance: Where indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

E. 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.

2. ASHRAE 90.2, “Energy Efficient Design of New Low-Rise Residential Buildings,” for household water heaters.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for all components that will be in contact with potable water.

1.06 **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, LIGHT-DUTY ELECTRIC WATER HEATERS**

A. Point of Use Storage Electric Water Heaters: Comply with UL 174.

1. Manufacturers:

a. Bock Water Heaters, Inc.; nDurance Series.

b. Bradford White Corporation.

c. Lochinvar Corporation.

d. PVI Industries, LLC.; A Watts Brand.

e. Smith, A. O. Water Products Company.

2. Storage-Tank Construction: Steel.

a. Tappings: ASME B1.20.1 pipe thread.

b. Pressure Rating: 150 psig.

c. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending lining material into tappings.

3. Factory-Installed Storage-Tank Appurtenances:

a. Anode Rod: Replaceable magnesium.

b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.

c. Drain Valve: ASSE 1005.

d. Insulation: Comply with ASHRAE/IESNA 90.1 or ASHRAE 90.2.

e. Jacket: Steel with enameled finish.

1) Short: Cylindrical shape.

f. Heat Trap Fittings: Inlet type in cold-water inlet and outlet type in hot-water outlet.

g. Heating Elements: Two; electric, screw-in immersion type with 12 kW or less total, and wired for nonsimultaneous operation, unless otherwise indicated.

h. Temperature Control: Adjustable thermostat for each element.

i. Safety Control: High-temperature-limit cutoff device or system.

j. Relief Valve: ASME rated and stamped and complying with ASME PTC 25.3 for 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 relief valve with sensing element that extends into storage tank.

4. 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:

a. 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. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

B. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated steel bracket for wall mounting and capable of supporting water heater and water.

C. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

D. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that are capable of isolating each water heater and of providing balanced flow through each water heater.

E. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

F. Water Regulators: ASSE 1003, water-pressure reducing valve. Set at 25-psig- maximum outlet pressure, unless otherwise indicated.

G. Shock Absorbers: ASSE 1010 or PDI WH 201, Size A water hammer arrester.

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 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.

D. Install combination temperature and 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.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 20 Section "Valves" for hose-end drain valves.

F. Install thermometer on outlet piping of water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.

G. Install thermometers on inlet and outlet piping of household, collector-to-tank, solar-electric water heaters. Refer to Division 20 Section "Meters and Gages" for thermometers.

H. Install pressure gage(s) on outlet of commercial electric water- heater piping. Refer to Division 20 Section "Meters and Gages" for pressure gages.

I. 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, 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.

J. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

K. Fill water heaters with water.

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. 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. 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. 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 water heaters that do not pass tests and inspections. Replace with water heaters meeting Contract requirements 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 commercial electric water heaters.

END OF SECTION

SECTION 22 4200 - PLUMBING FIXTURES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 20 Section “Mechanical General Requirements.”
3. Division 20 Section “Basic Mechanical Materials and Methods.”
4. Division 22 Section "Drinking Fountains and Water Coolers."
5. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
6. Division 22 Section “Drainage Piping Specialties” for floor drains, and specialty fixtures not included in this Section.
7. 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. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.03 **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.; Afwall Wall Hung Elongated Toilet.
    b. Ferguson Enterprises, Inc.; ProFlo.
    c. Kohler Co.; Kingston K-4325-0.
    d. Sloan Valve Company.
    e. Zurn Plumbing Products Group; EcoVantage.
2. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation.
    a. Style: Flushometer valve.
        1) Bowl Type: Elongated with siphon-jet design.
        2) Supply Spud Location: Top.
        3) Design Consumption: 1.28 gal./flush or 1.6 gal./flush.
        4) Color: White.
    b. Flushometer: FV-2-1.
    c. Toilet Seat: TS-1.
    d. Fixture Support: Water-closet support combination carrier.

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 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.

2.04 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.

i. Fixture Support: Lavatory with concealed arms.

2.05 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 1340.109.

b. Chicago Faucets; Model 333-765.

c. Delta Faucet Company; 87T Series.

d. Geberit Manufacturing, Inc.

e. Kohler Co.

f. Moen Commercial.

g. Speakman Company; Model S-5122.

h. T & S Brass and Bronze Works, Inc.

i. Zurn Plumbing Products Group; Z86100-XL.

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. Deck Plate: Not required.

e. Mounting: Deck, concealed.

f. Valve Handle(s): Push button, requiring less than 5 pounds of operating force.

g. Inlet(s): NPS 1/2.

h. Spout Outlet: Vandal resistant aerator.

i. Operation: Self-closing, metering, with replaceable valve cartridge.

2.06 **COUNTER-MOUNTING SINKS**

A. Sinks, SK-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Elkay Manufacturing Co.

b. Franke Consumer Products, Inc., Commercial Div.

c. Just Manufacturing Company.

d. Moen Commercial.

2. Description: Single-bowl, counter-mounting, lay-in stainless-steel sink.

a. Overall Dimensions: 17 inches left to right by 19 inches front to back.

b. Metal Thickness: 22 gage, with sound dampened underside.

c. Bowl:

1) Dimensions: 14 inches by 14 inches by 6 inches deep.

2) Drain: 3-1/2-inch grid with offset waste.

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: ot required.

i. Hot-Water Dispenser: Not required.

2.07 **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-2.

d. Drain: Grid with NPS 3 outlet.

2.08 **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. 631-R.
    c. Delta Faucet Company; Model 28C4934-R2.
    d. Elkay Manufacturing Co.; LK940GNO8T4H.
    e. Kohler Co.; K7320-4.
    f. Moen Commercial.
    g. Speakman Company; SC-5749.
    h. T & S Brass and Bronze Works, Inc.
    i. Zurn Plumbing Products Group; Z842B4.
2. Description: Commercial/Industrial sink faucet. Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
    a. Body Material: Commercial, solid brass.
    b. Finish: Polished chrome plate.
    c. Mixing Valve: Two handle.
    d. Centers: 8 inches.
    e. Mounting: Back/wall.
    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 swing gooseneck.
    j. Spout Outlet: Aerator.
    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 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.

2.09 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.

2.10 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.

B. Protective Shielding Piping Enclosures (PSG-2):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Sloan Valve Co.

b. TRUEBRO, Inc.

c. Zurn Plumbing Products Group; Z6900-VG

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.11 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. Water-Closet Supports:

1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include:

a. Single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement.

b. Faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture.

c. Cast iron nipple and coupling kit.

d. Additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.

2. Accessible-Fixture Support: Include rectangular steel uprights.

D. 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.

E. 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.

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 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."

V. 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. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Adjust flow at laboratory faucets having serrated nozzles to prevent splashing.

D. Replace washers and seals, or cartridges of leaking and dripping faucets and stops.

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 4700 - DRINKING FOUNTAINS, WATER COOLERS, AND CUSPIDORS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”

1.02 DEFINITIONS

A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.

D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. TDS: Total dissolved solids.

H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.03 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.

C. Regulatory Requirements: Comply with requirements in the U.S. Architectural & Transportation Barriers Compliance Board's "Uniform Federal Accessibility Standards (UFAS), 1985-494-187" about fixtures for people with disabilities.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.

F. AHRI Standard: Comply with AHRI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with AHRI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

G. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 PRODUCTS

A. Water Coolers (EWC-1):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkay Manufacturing Co.; LZSTL8WSSP.
   b. Halsey Taylor.
   c. Haws Corporation.
   d. Murdock Manufacturing; A Member of Morris Group International.
   e. Oasis Corporation.
   f. Sunroc Corp.
2. Description: Accessible, AHRI 1010, Type PB, pressure with bubbler, Style W, wall-mounting water cooler for adult/child-mounting height with bottle filling station.
   a. Cabinet: Bilevel, stainless steel, with hinged cover for quick filter changes.
   b. Bubbler: One, flexible or elastomeric overmolded, with adjustable stream regulator, located on each cabinet deck.
   c. Control: Push bar.
   d. Supply: NPS 3/8 with isolation valve.
   e. Filter: One or more water filters complying with Filter First Act, NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
   f. Drain(s): Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.1.
   g. Cooling System: Electric, with hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.

1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.

2) Electrical Characteristics: 1/5 hp; 120-V ac; single phase; 60 Hz.

h. Bottle Filling Station: Recessed design constructed of 18 gage Type 300 series stainless steel and ABS plastic. Include:

1) Electronic sensor for no-touch activation.

2) Automatic 20-second shut-off timer.

3) 1.1 gpm flow rate

4) Anti-microbial protected plastic components.

5) Filter status indicating light.

i. Support: Refer to "Fixture Supports" Article.

2.02 **FIXTURE SUPPORTS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.; A Member of Morris Group International.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **APPLICATIONS**

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.03 **INSTALLATION**

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 20 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.04 **CONNECTIONS**

A. Piping installation requirements are specified in other Division 20 and 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.05 **FIELD QUALITY CONTROL**

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.

2. Report test results in writing.

3.06 **ADJUSTING**

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.07 **CLEANING**

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 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 AIR HANDLING SYSTEM BALANCING PROVISIONS

A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 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).

2.12 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 20 Section "Motors."

2.13 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.

2.14 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 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.

2.16 **ROOFTOP EQUIPMENT ENCLOSURES**

A. Mounts directly to mechanical equipment and requires no roof penetration.

B. Sliding panels provide access to equipment compartments for service and maintenance.

C. Rated to withstand lateral forces developed due to wind speeds of 225 mph.

D. Baked on polyester powder coat finish meeting ASTM B-117 standard for 500 hour salt spray.

2.17 **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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical Identification" for valve tags and charts.
2. Division 22 Section “General-Duty Valves for Plumbing” for plumbing valves.
3. 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. 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.

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 systems where grooved-end connections are permitted: Valve ends may use grooved-end connections. Do not use for steam or steam condensate piping.
8. For systems where pressure-sealed connections are permitted: Valve ends may use pressure-sealed connections.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

G. Valve Actuators:
1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

H. Extended Valve Stems: On insulated valves.

I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.
1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, 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, full-depth ASME B1.20.1 threaded or solder 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.

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, full-depth ASME B1.20.1 threaded or solder 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 77C-A Series.

b. Crane Co.; Crane Valves.

c. Hammond Valve.

d. Kitz Corporation; Kitz Valves.

e. Milwaukee Valve Company.

f. NIBCO INC.; Models S-585-70-66 or T-585-70-66.

g. Watts Water Technologies, Inc.; Series B6080G2/B6081G2.

D. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim and Pressure-Seal Ends: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing; 225 psig at 250 Degrees F maximum pressure/temperature rating and 250-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. Hammond Valve.

c. Kitz Corporation; Kitz Valves.

d. Milwaukee Valve Company.

e. NIBCO INC.; Model PC-585-70-66.

f. Watts Water Technologies, Inc.

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 and larger.

3. Handwheel: For valves other than quarter-turn types.

4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

H. Extended Valve Stems: On insulated valves.

I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.

N. 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.

O. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

P. 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.

Q. Extended Valve Stems: On insulated valves.

R. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.

S. Valve Grooved Ends: AWWA C606.

T. 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.

U. Threaded: With threads according to ASME B1.20.1.

V. Valve Bypass and Drain Connections: MSS SP-45.

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. Lug-Style (Single-Flange) Size NPS 14 and Larger, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, and phenolic-backed EPDM seat (liner) attached to the body.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series 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-1000-5.

i. Tyco Flow Control; Grinnell Flow Control.

j. Watts Water Technologies.

D. 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.

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 check valves for proper direction of flow and as follows:

1. 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Common Work Results for HVAC.”

1.02 SUMMARY

A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:

1. Air Systems:
    a. Constant-volume air systems.
    b. Dual-duct systems.
    c. Variable-air-volume systems.
    d. Multizone systems.

e. Induction-unit systems.

2. Hydronic Piping Systems:

a. Constant-flow systems.

b. Variable-flow systems.

c. Primary-secondary systems.

3. HVAC equipment quantitative-performance settings.

4. Exhaust hood airflow balancing.

B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.03 **DEFINITIONS**

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. AHJ: Authority having jurisdiction.

C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

F. NC: Noise criteria.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. RC: Room criteria.

I. Report Forms: Test data sheets for recording test data in logical order.

J. Smoke-Control System: An engineered system that uses fans to produce airflow and pressure differences across barriers to limit smoke movement.

K. Smoke-Control Zone: A space within a building that is enclosed by smoke barriers and is a part of a zoned smoke-control system.

L. Stair Pressurization System: A type of smoke-control system that is intended to positively pressurize stair towers with outdoor air by using fans to keep smoke from contaminating the stair towers during an alarm condition.

M. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

N. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

O. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

P. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

Q. TAB: Testing, adjusting, and balancing.

R. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

S. Test: A procedure to determine quantitative performance of systems or equipment.

T. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 **INFORMATIONAL SUBMITTALS**

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit electronic 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 electronic copies of the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit electronic 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 electronic 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.

g. Third Coast Test and Balance

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. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.08 **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. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 **GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.

G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

H. Verify that motor starters are equipped with properly sized thermal protection.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check condensate drains for proper connections and functioning.

L. Check for proper sealing of air-handling unit components.

M. Check for proper sealing of air duct system.

3.05 **PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

b. Measure static pressure directly at the fan outlet.

c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.

a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

5. When existing air handling systems require rebalancing, select required sheave sizes and advise Mechanical Contractor to change drive sheaves accordingly. Refer to Division 23 Section “Common Work Results for HVAC” for additional requirements.

6. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.

a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.06 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.

3.07 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.

3.08 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.

3.09 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

3.10 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.

3.11 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.

3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.

1. Measure and record the operating speed, airflow, and static pressure of each fan.
2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
3. Check the condition of filters.
4. Check the condition of coils.
5. Check the operation of the drain pan and condensate drain trap.
6. Check bearings and other lubricated parts for proper lubrication.
7. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.

B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished.

1. New filters are installed.
2. Coils are clean and fins combed.
3. Drain pans are clean.
4. Fans are clean.
5. Bearings and other parts are properly lubricated.
6. Deficiencies noted in the preconstruction report are corrected.

C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.

1. Compare the indicated airflow of the renovated work to the measured fan airflows and determine the new fan, speed, filter, and coil face velocity.
2. If calculations increase or decrease the airflow and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated airflow and water flow rates. If 5 percent or less, equipment adjustments are not required.
3. Air balance each air outlet.

3.13 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Air handling equipment and outlets: Plus or minus 5 percent.
    a. Where terminal units serve 6 or more outlets within a common room, individual outlets may vary up to plus or minus 10 percent of design flow rates if overall room supply is within plus or minus 5 percent.
2. Heating-Water Flow Rate: 0 to minus 10 percent.
3. Cooling-Water Flow Rate: 0 to plus 5 percent.

3.14 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.

3.15 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. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Room or riser served.
d. Coil make and size.
e. Flowmeter type.
2. Test Data (Indicated and Actual Values):
a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

N. Packaged Chiller Reports:
1. Unit Data:
a. Unit identification.
b. Make and model number.
c. Manufacturer's serial number.
d. Refrigerant type and capacity in gal.
e. Starter type and size.
f. Starter thermal protection size.
g. Compressor make and model number.
h. Compressor manufacturer's serial number.
2. Water-Cooled Condenser 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.
3. Air-Cooled Condenser Test Data (Indicated and Actual Values):
a. Entering- and leaving-air temperature in deg F.
4. Evaporator Test Reports (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.

5. Compressor Test Data (Indicated and Actual Values):
    a. Voltage at each connection.
    b. Amperage for each phase.
    c. Kilowatt input.
    d. Crankcase heater kilowatt.
    e. Chilled-water control set point in deg F.
    f. Condenser-water control set point in deg F.
6. Refrigerant Test Data (Indicated and Actual Values):
    a. Oil level.
    b. Refrigerant level.

O. 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.

P. Cooling Tower or Condenser Test Reports: For cooling towers or condensers, include the following:

1. Unit Data:

a. Unit identification.

b. Make and type.

c. Model and serial numbers.

d. Nominal cooling capacity in tons.

e. Water-treatment chemical feeder and chemical.

f. Number and type of fans.

g. Fan motor make, frame size, rpm, and horsepower.

h. Fan motor voltage at each connection.

i. Sheave make, size in inches, and bore.

j. Sheave dimensions, center-to-center, and amount of adjustments in inches.

k. Number of belts, make, and size.

l. Pump make and model number.

m. Pump manufacturer's serial number.

n. Pump motor make and frame size.

o. Pump motor horsepower and rpm.

Q. 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.

R. 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.

S. Vibration Measurement Reports:

1. Date and time of test.
2. Vibration meter manufacturer, model number, and serial number.
3. Equipment designation, location, equipment, speed, motor speed, and motor horsepower.
4. Diagram of equipment showing the vibration measurement locations.
5. Measurement readings for each measurement location.
6. Calculate isolator efficiency using measurements taken.
7. Description of predominant vibration source.

T. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each tested location on a separate NC or RC chart. Record the following on the forms:

1. Date and time of test. Record each tested location on its own NC curve.
2. Sound meter manufacturer, model number, and serial number.
3. Space location within the building including floor level and room number.
4. Diagram or color photograph of the space showing the measurement location.
5. Time weighting of measurements, either fast or slow.
6. Description of the measured sound: steady, transient, or tonal.
7. Description of predominant sound source.

U. Indoor-Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

V. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.16 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.
2. Randomly check the following for each system:

a. Measure airflow of at least 10 percent of air outlets.

b. Measure water flow of at least 5 percent of terminals.

c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.

d. Measure sound levels at two locations.

e. Measure space pressure of at least 10 percent of locations.

f. Verify that balancing devices are marked with final balance position.

g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.

3. Owner 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.

3.17 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Testing, Adjusting, and Balancing.”
4. Division 26 Section “Electrical General Requirements.”
5. Division 26 Section “Control-voltage Electrical Power Cables.”
6. Division 26 Section “Hangers and Supports for Electrical Systems.”

7. Division 26 Section “Raceways and Boxes.”

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. Gauges, 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 or lbs./hr).
    e. Design pressure drop (ft. head) or (psi), where applicable.
    f. Calculated valve Cv, where applicable.
    g. Selected valve Cv, where applicable.
    h. Resultant pressure drop (ft. head) or (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 (ft. head) of (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. WG).

i. Shut-off rating/differential pressure rating (in. wg).

j. Leakage rating (CFM/sq. ft. at 4 in. wg).

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.

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 the electronic files for all as-built shop drawings in pdf format.

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 a 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 a minimum of one four hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions 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. Johnson Controls – Facility Explorer with FX Controllers / by:
    a. BASS Controls (Sterling Heights, MI).
    b. Conti Corp Controls Group. (Sterling Heights, MI).
    c. ControlNet (Swartz Creek, Kalamazoo & Grand Rapids, MI).
    d. Control Solutions Inc. (Alpena, Rochester Hills & Wyoming, MI).
    e. Johnson Controls, Inc. (Auburn Hills, MI) – NOT Metasys Products.
    f. K&S Ventures, Inc. (Rochester Hills, MI).
    g. Knight Watch (Kalamazoo, Grand Rapids, Lansing & Troy, MI).
    h. Metro Controls, Inc. (Clinton Twp, MI).
    i. Michigan Environmental Controls, Inc. (New Hudson, MI).
    j. Pulse Building Services (Grand Rapids, MI).
    k. SysTemp Corporation. (Rochester Hills, MI).
    l. W.J. O'Neil Controls Group. (Livonia, MI).

2.02 BAS BUILDING NETWORK SUPERVISORY CONTROLLER (EXISTING)

A. The Building Network Supervisory Controller is existing and shall be utilized to provide the communication interface between the Owner's Ethernet and the field control devices.

B. Provide updated and upgraded software and hardwire to support the additional controller addresses in this project.

2.03 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.

B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.

C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer's terminal, portable operator's unit or the remote Operator Workstation when applicable for project.

D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.

2.04 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.

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. 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.

2.05 DDC INPUT/OUTPUT SENSORS

A. 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. Johnson Controls.

   c. Senva.

   d. Veris Industries.

B. 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 network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.

B. 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.

C. Data communications media shall be twisted pair wires.

D. 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.

E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

F. 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.

G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.07 **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.

2.08 **CONTROL VALVES AND VALVE OPERATORS**

A. Pressure Independent Control Valves (2-way):

1. Up to 2 inches: Characterized ball valve or Globe valve style with integral pressure compensating cartridge which maintains a constant pressure drop across valve seat while providing equal percentage flow control. Ball valve construction shall include bronze or brass-nickel plated body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats. Globe valve construction shall include bronze or AMETAL (a dezincification alloy of TA), stainless steel or brass stem and EPDM type seats.
2. Accuracy: Control valves shall accurately control flow from 0 to 100% of the full rated flow. Flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations when the pressure drop across the valve is within the range of 5 psid to 35 psid.
3. Manufacturers:
    a. Belimo.

B. 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.

2.09 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.

2.10 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.

2.11 **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.

2.12 **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".

2.13 **THERMOSTATS – ELECTRONIC & ELECTRIC**

A. 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 V, ac or 120 V, ac duty as required

B. 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.

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 **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.

3.03 **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 graphics for each network device and/or DDC controller.

3.04 **OWNER INSTRUCTION AND TRAINING**

A. Provide a minimum of eight (8) 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 computer training & tutorial material on USB Flash Drives describing operator's BAS graphical interface capabilities and functions.

E. Provide literature pertaining to the operation and maintenance of the DDC system components provided.

3.05 **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.

3.06 **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.

END OF SECTION

SECTION 23 2113 - HYDRONIC PIPING

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PART 1 gENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 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.
14. Division 33 Section “Underground Hydronic Distribution Piping” for preinsulated piping systems.

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:

1.04 **SYSTEMS DESCRIPTIONS**

A. Hydronic piping system materials are scheduled on the Drawings.

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.

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. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Socket Fittings: ASME B16.22.

E. Wrought-Copper Unions: ASME B16.22.

F. 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.

G. 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.

H. 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.
6. Fittings: ASTM A234 ANSI B16.9, steel butt weld to match pipe wall thickness, Class 300.
7. Flanges: Class 300 forged steel welding neck to match pipe wall thickness and valve flanges, ANSI B16.5. Orifice plate flanges shall be raised face welding neck type with ring joint gaskets and flange taps. Coordinate orifice plate flanges with orifice plate flow elements.

B. Schedule 80 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 80, seamless steel pipe. Include ends matching joining method.
2. Screwed Couplings: Extra heavy tapered threaded black carbon steel.
3. Screwed Unions: 300 pound SWP female screwed malleable iron with ground joint and brass to iron seat.
4. Screwed Fittings: 300 pound SWP banded malleable iron screwed, ASTM A 197 and ANSI B16.3.

C. 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 **JOINING MATERIALS**

A. Refer to Division 20 Section “Basic Mechanical Materials and Methods.”

2.04 **VALVES**

A. General Service Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC."

2.05 **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 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.

12. Minimum allowable differential pressure reading at pressure gauge connections at rated design flow rate for each application: 5 inches W.G.
13. Maximum allowable permanent pressure loss at rated design flow rate for each application: 3 feet W.G.

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 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.
12. Minimum allowable differential pressure reading at pressure gauge connections at rated design flow rate for each application: 5 inches W.G.
13. Maximum allowable permanent pressure loss at rated design flow rate for each application: 3 feet W.G.

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.

2.06 **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.

2.07 **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.

2.08 **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.
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.

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 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 in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.

F. 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 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 20 Section "Meters and Gages."

3.06 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. 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.
5. 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 3113 - METAL DUCTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section "Mechanical General Requirements."
2. Division 23 Section "Nonmetal Ducts" for fabric ducts, fibrous-glass ducts, thermoset FRP ducts, thermoplastic ducts, PVC ducts, and concrete ducts.
3. Division 23 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
4. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.02 SUMMARY

A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

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 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

1.08 **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."

1.09 **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 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.

1. Manufacturers:

a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.

C. Water-Based Joint and Seam Sealant:

1. Manufacturers:

a. Design Polymerics; DP1010 Water Based Duct Sealant.

b. Hardcast; Flex-Grip 550 and Versa-Grip 181.

c. Polymer Adhesives; No. 11.

d. United McGill.

2. Application Method: Brush on.

3. Solids Content: Minimum 63 percent.

4. Shore A Hardness: Minimum 20.

5. Water resistant.

6. Mold and mildew resistant.

7. VOC: Maximum 75 g/L (less water).

8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.

9. Service: Indoor or outdoor.

10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Manufacturers:

a. Hardcast; Sure-Grip 404.

b. United McGill.

2. Application Method: Brush on.

3. Base: Synthetic rubber resin.

4. Solvent: Toluene and heptane.

5. Solids Content: Minimum 60 percent.

6. Shore A Hardness: Minimum 60.

7. Water resistant.

8. Mold and mildew resistant.

9. VOC: Maximum 395 g/L.

10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.

11. Service: Indoor or outdoor.

12. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.

2. Type: S.

3. Grade: NS.

4. Class: 25.

5. Use: O.

F. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

G. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.04 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. 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."

3. 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.

2.05 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.

2.06 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.

2.07 **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.

J. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:

1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.

2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction, riveted and bonded.
4. Other Fittings: Riveted and bonded joints.
5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

2.08 **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.

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 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.

3.05 **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. Install concrete inserts before placing concrete.

E. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

F. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

G. Install roof mounted duct supports in accordance with manufacturer’s instructions. Provide additional membrane layer or walkpads under support bases as required.

H. Use load rated cable suspension system for round duct in exposed locations.

3.06 **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.

3.07 **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.

3.08 **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.

3.09 **START UP**

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 23 3119 - HVAC CASINGS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”

1.02 SUMMARY

A. Section Includes:

1. Factory or shop-fabricated, field-assembled, single-wall casings for HVAC equipment.

1.03 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. In this Section, these values are the result of the formula Btu x in./h x sq. ft. x deg F at temperature differences specified. Values are expressed as Btu.

1. Example: Apparent Thermal Conductivity (k-Value): 0.26.

1.04 PERFORMANCE REQUIREMENTS

A. Static-Pressure Classes:

1. Upstream from Fan(s): 2-inch wg.
2. Downstream from Fan(s): 2-inch wg.

B. Acoustical Performance:

1. NRC: 1.09 according to ASTM C 423.
2. STC: 40 according to ASTM E 90.

C. Structural Performance:

1. Casings shall be fabricated to withstand 133 percent of the indicated static pressure without structural failure. Wall and roof deflection at the indicated static pressure shall not exceed 1/8 inch per foot of width.
    a. Fabricate outdoor casings to withstand wind load of 15 lbf/sq. ft. and snow load of 30 lbf/sq. ft.

1.05 **ACTION SUBMITTALS**

A. Product Data: For factory-fabricated casings, sealant materials, and acoustic liner materials.

1.06 **INFORMATIONAL SUBMITTALS**

A. Product Certificates: For factory-fabricated casings, signed by product manufacturer.
1. Show sound-absorption coefficients in each octave band lower than those scheduled when tested according to ASTM C 423.
2. Show airborne sound transmission losses lower than those scheduled when tested according to ASTM E 90.

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 sizes and locations of steel supports. Supports are specified in Division 05 Section "Metal Fabrications."

C. 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 **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. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Exterior Surface Galvanized Coating Designation: G90.
2. Interior Surface Galvanized Coating Designation:
    a. Sections Not Exposed to Moisture: G90.
    b. Sections Housing and Downstream from Cooling Coil and Humidifiers: G90.

B. Stainless Steel: ASTM A 480/A 480M, Type 304, and having a No. 2D finish.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet steel casings.

D. Miscellaneous Materials and Products: Types and sizes required to comply with HVAC casing system requirements, including proper connection of ducts and equipment.

2.03 **SEALANT MATERIALS**

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Manufacturers:
    a. Design Polymerics; DP1010 Water Based Duct Sealant.
    b. Hardcast; Flex-Grip 550 and Versa-Grip 181.
    c. Polymer Adhesives; No. 11.
    d. United McGill.
2. Application Method: Brush on.
3. Solids Content: Minimum 65 percent.
4. Shore A Hardness: Minimum 20.
5. Water resistant.
6. Mold and mildew resistant.
7. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel or stainless steel.

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. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
10. Service: Indoor or outdoor.
11. Substrate: Compatible with galvanized sheet steel or stainless steel.

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. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

2.04 **GENERAL CASING FABRICATION REQUIREMENTS**

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 9, "Equipment and Casings," for acceptable materials, material thicknesses, and casing construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

1. Fabricate casings with more than 3-inch wg negative static pressure according to SMACNA's "Rectangular Industrial Duct Construction Standards."

2. Casings with more than 2-inch wg positive static pressure may be fabricated according to SMACNA's "Rectangular Industrial Duct Construction Standards."

B. Factory- or Shop-Applied Antimicrobial Coating:

1. Apply to the interior sheet metal surfaces of casing in contact with the airstream. Apply untreated clear coating to the exterior surface.

2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Coating containing the antimicrobial compound shall have a hardness of 2H minimum when tested according to ASTM D 3363.

4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 according to UL 723; certified by an NRTL.

5. Applied Coating Color: Standard.

C. Sealing Requirement: SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Seal Class A. Seal all seams, joints, connections, and abutments to building.

D. Penetrations: Seal all penetrations airtight. Cover with escutcheons and gaskets, or fill with suitable compound so there is no exposed insulation. Comply with requirements for escutcheons specified in Division 20 Section "Basic Mechanical Materials and Methods." Provide shaft seals where fan shafts penetrate casing.

E. Access Doors: Fabricate access doors according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 9-15, "Casing Access Doors - 2-inch wg (500 Pa)," and Figure 9-16, "Casing Access Doors - 3-10-inch wg "; and according to pressure class of the plenum or casing section in which access doors are to be installed.

1. Size: 20 by 54 inches.

2. Vision Panel: Double-glazed, wire-reinforced safety glass with an airspace between panes and sealed with interior and exterior rubber seals.

3. Hinges: Piano or butt hinges and latches, number and size according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

4. Latches: Minimum of two wedge-lever-type latches, operable from inside and outside.

5. Neoprene gaskets around entire perimeters of door frames.

6. Doors shall open against air pressure.

F. Condensate Drain Pans: Formed sections of Type 304, stainless-steel sheet complying with requirements in ASHRAE 62.1. Provide drain pans at cooling coils, humidifiers, and at energy recovery heat exchangers. Pans shall be located under entire component including connections, and extend a minimum of 12 inches past cooling coil/heat exchanger, and a minimum of 24 inches past humidifier.

1. Double-wall construction shall have space between walls filled with foam insulation and sealed moisture tight.

2. Intermediate drain pan or drain trough shall collect condensate from top coil for units with stacked coils or stacked eliminators.
3. Insulation: Polystyrene or polyurethane.
4. Slopes shall be in a minimum of two planes to collect condensate when units are operating at maximum catalogued face velocity.
5. Each drain pan connection shall have a trap.

2.05 **FACTORY-FABRICATED (ACOUSTICAL PLENUM) CASINGS**

A. Description: Double-wall, insulated, pressurized equipment casing.
1. Manufacturers:
a. IAC Acoustics; a Division of Sound Seal Inc.
b. Price Industries.
c. Ruskin Sound Control.
d. VAW Systems Ltd.
e. Vibro-Acoustics; A Swegon Group Company.

B. Panel Fabrication: Solid, galvanized sheet steel exterior shell and solid, galvanized sheet steel interior shell; with 4-inch space between shells, as indicated.
1. Fabricate with a minimum number of joints.
2. Weld exterior and interior shells to perimeter; to interior, longitudinal, galvanized-steel channels; and to box-end internal closures. Paint welds.
3. Exterior Shell Thickness: 0.040 inch minimum.
4. Fabricate perimeter and interior, longitudinal channel members with galvanized-steel shapes.
5. Fill each panel assembly with noncombustible, acoustic quality, shot-free fiberglass insulation with long, resilient fibers bonded with a thermosetting resin.
a. Density shall be as required to insure conformance with laboratory test data.
b. Fiberglass shall be packed with a minimum of 10 percent compression during casing assembly.
c. Media shall be inert, mildew resistant, and vermin proof, and comply with NFPA 90A; and resilient such that it will not crumble or break, and conform to irregular surfaces.
d. Media shall not cause or accelerate corrosion of aluminum or steel.
e. Media shall be encapsulated in Mylar to prevent shedding, erosion and impregnation of the fiberglass.
f. Mineral wool shall not be permitted as a substitute for fiberglass.
6. Fabricate panels with tongue-and-groove, continuous self-locking joints effective inside and outside each panel.

C. Trim Items: Fabricate from a minimum of 0.052-inch galvanized sheet steel, furnished in standard lengths for field cutting.

D. Access Doors: Fabricate personnel access doors at least 24 by 60 inches and other access doors in sizes indicated.
1. Fabricate doors of same thickness as panels, with a minimum 0.040-inch solid, interior and exterior, galvanized sheet steel shell.

2. Install a minimum of two ball-bearing hinges and two wedge-lever-type latches, operable from inside and outside. Install doors to open against air pressure differential. Install neoprene gaskets around entire perimeters of door frames.

3. Fabricate windows in doors consisting of double-glazed, wire-reinforced safety glass with an air space between panes and sealed with interior and exterior rubber seals.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine **concrete** bases roof curbs and steel supports for compliance with requirements for conditions affecting installation and performance of HVAC casings.

B. Examine casing insulation materials and liners before installation. Reject casings that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install casings according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with recommended spacing of sheet metal screws and with requirements for casing sealing and trim positioning.

B. Support casings on floor or foundation system. Secure and seal to base.

C. Equipment Mounting: Install HVAC casings on concrete base. Comply with requirements for concrete base specified in Division 03.

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 concrete base.

2. For supported casings, 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 embedded.

4. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Apply sealant to joints, connections, and mountings.

E. Field-cut openings for pipe and conduit penetrations; insulate and seal according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

F. Support components rigidly with ties, braces, brackets, and anchors of types that will maintain housing shape and prevent buckling.

G. Align casings accurately at connections, with 1/8-inch misalignment tolerance and with smooth interior surfaces.

H. Maintain duct seal class integrity throughout casings.

3.03 FIELD QUALITY CONTROL

A. 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. Determine leakage from entire system or section of system by relating leakage to surface area of test section. Comply with requirements for leakage classification of ducts connected to casings.

3. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.04 **CLEANING**

A. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

1. Intermediate level.

END OF SECTION

SECTION 23 3300 - DUCT ACCESSORIES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 23 Section “Testing, Adjusting, and Balancing” for duct test holes.
3. Division 23 Section “Temperature Controls” for motorized control dampers.
4. Division 28 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.02 DEFINITIONS

A. NVLAP: National Voluntary Laboratory Accreditation Program.

B. Low Pressure: Up to 2 inch WG and velocities less than 2,000 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 2,000 fpm and less than 3,000 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 3,000 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 **BACKDRAFT DAMPERS**

A. Manufacturers:

1. American Warming and Ventilating; Mestek, Inc.
2. Greenheck Fan Corporation.
3. Ruskin Company.

B. Description: Multiple-blade, parallel action counterbalanced, with blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Performance: Based on tests in accordance with AMCA Standard 500:

1. Pressure drop not to exceed 0.15 inch wg at face velocity of 2500 fpm.
2. Leakage not to exceed 9.2 cfm per square foot at 1 inch wg differential and temperature of 70 deg F.

D. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

E. Blades: 0.025-inch- thick, roll-formed aluminum or 0.050-inch- thick aluminum sheet.

F. Blade Seals: Manufacturer’s standard seal material.

G. Blade Axles: Nonferrous or galvanized steel.

H. Tie Bars and Brackets: Aluminum or galvanized steel.

2.04 **LOW PRESSURE MANUAL VOLUME DAMPERS**

A. Manufacturers:

1. American Warming and Ventilating; 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. Pottorff.
8. Ruskin Company.
9. Vent Products Co., Inc.
10. 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.

2.05 LOW LEAKAGE MANUAL VOLUME DAMPERS

A. Low-Leakage, Steel, Manual Volume Dampers:

1. Manufacturers:

a. American Warming and Ventilating; Mestek, Inc.

b. Greenheck Fan Corporation.

c. Louvers and Dampers, Inc.; Mestek, Inc.

d. Nailor Industries Inc.

e. Pottorff.

f. Ruskin Company.

g. Vent Products Co., Inc.

2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

3. Suitable for horizontal or vertical applications.

4. Frames:

a. Hat shaped.

b. Galvanized-steel channels, 0.064 inch thick.

c. Mitered and welded corners.

d. Flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.

b. Opposed-blade design.

c. Stiffen damper blades for stability.

d. Galvanized, roll-formed steel, 0.064 inch thick.

6. Blade Axles: Galvanized steel.

7. Bearings:

a. Oil-impregnated bronze.

b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Neoprene.

9. Jamb Seals: Cambered stainless steel.

10. Tie Bars and Brackets: Galvanized steel.

11. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

B. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Manufacturers:

a. American Warming and Ventilating; Mestek, Inc.

b. Greenheck Fan Corporation.

c. Louvers and Dampers, Inc.; Mestek, Inc.

d. Nailor Industries Inc.

e. Ruskin Company.

f. Vent Products Co., Inc.

2. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

3. Suitable for horizontal or vertical applications.

4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

5. Blades:

a. Multiple or single blade.

b. Opposed-blade design.

c. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

d. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

6. Blade Axles: Galvanized steel.

7. Bearings:
    a. Oil-impregnated bronze.
    b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Blade Seals: Felt.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

C. Jackshaft:
1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware:
1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

E. 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 stainless 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. Pottorff.

6. Ruskin Company.

B. Dynamic fire dampers with curtain style blades and labeled according to UL 555

1. Maximum static pressure equal to the design pressure class of the duct system in which installed.

2. Maximum velocity 2,000 fpm for duct system design pressure class 2 inches w.g. and lower, and 3,000 fpm for duct system design pressure class between 2 inches w.g. and 6 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.

2. 3 hours for 4 hour rated walls.

D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Fusible Links: Replaceable, 212 deg F rated.

2.08 **FIRE DAMPERS (MULTIPLE BLADE TYPE)**

A. Manufacturers:

1. Greenheck Fan Corporation.

2. NCA; a brand of Metal Industries Inc.

3. Nailor Industries Inc.

4. Pottorff.

5. Ruskin Company.

B. Dynamic fire dampers with multiple blades and labeled according to UL 555.

1. Maximum static pressure equal to the design pressure class of the duct system in which installed.

2. Maximum velocity 2,000 fpm for duct system design pressure class 2 inches w.g. and lower, and 3,000 fpm for duct system design pressure class between 2 inches w.g. and 6 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.

2. 3 hours for 4 hour rated walls.

D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer's UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.

H. Axles: 1/2 inch plated steel hex.

I. Bearings: Stainless steel, or oil-impregnated bronze sleeve type, pressed into frame.

J. Linkage: Concealed in frame.

K. Fusible Links: Replaceable, 212 deg F rated.

2.09 **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. Pottorff.
6. 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. Maximum static pressure equal to the design pressure class of the duct system in which installed.

F. Maximum velocity 2,000 fpm for duct system design pressure class 2 inches w.g. and lower, and 3,000 fpm for duct system design pressure class between 2 inches w.g and 6 inches w.g.

G. Damper Actuators: Electric modulating or two-position action as required.

1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
2. Size for torque required for damper seal at load conditions.
3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (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.

H. 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).

I. 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.

2.10 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. Pottorff.
6. 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. Maximum static pressure equal to the design pressure class of the duct system in which installed.

D. Maximum velocity 2,000 fpm for duct system design pressure class 2 inches w.g. and lower, and 3,000 fpm for duct system design pressure class between 2 inches w.g and 6 inches w.g.

E. Fire Rating:
1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

F. Frame and Blades: 0.064-inch- thick, galvanized sheet steel.

G. Mounting Sleeve: Factory-installed, galvanized sheet steel.
1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.

H. Rated pressure and velocity to exceed design airflow conditions.

I. Damper Actuators: Electric modulating or two-position action as required.
1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
2. Size for torque required for damper seal at load conditions.
3. Overload Protection: Microprocessor or an electronic based motor controller providing burnout protection if stalled before full rotation is reached. The actuator shall be electronically cut off at full open to eliminate noise generation with the holding noise level to be inaudible.
4. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.

5. Power Requirements (Two-Position Spring Return): 24 or 120 V ac (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.

J. 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).

K. 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.

2.11 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.

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.

1. Erosion Barrier: Fiberglass cloth.

a. Return fan inlet and outlet silencer fill do not require an erosion barrier.

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.

2.12 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Pottorff.

2. Ventfabrics, Inc.

3. Young Regulator Co.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 3/4 inches deep.

F. Wall-Box Cover-Plate Material: Steel.

2.13 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.

F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz./sq. yd.
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd.
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

2.14 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.

2.15 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.16 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. On downstream side of air duct coils.
3. Upstream from duct filters.
4. At outdoor-air intakes and mixed-air plenums.
5. At drain pans.
6. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
7. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
8. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
9. 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Motors.”
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.

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 **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 and GB.
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.

2.02 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 18 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 18 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.

2.03 **MOTORS**

A. Comply with requirements in Division 20 Section "Motors."

2.04 **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 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
PART 2 PRODUCTS 1
2.01 AIR DIFFUSION DEVICES 1
2.02 SOURCE QUALITY CONTROL 2
PART 3 EXECUTION 2
3.01 EXAMINATION 2
3.02 INSTALLATION 2
3.03 ADJUSTING 2

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.

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 8224 - VERTICAL UNIT VENTILATORS

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 DEFINITIONS 1
1.04 ACTION SUBMITTALS 1
1.05 INFORMATIONAL SUBMITTALS 2
1.06 CLOSEOUT SUBMITTALS 2
1.07 QUALITY ASSURANCE 2
1.08 EXTRA MATERIALS 2
PART 2 PRODUCTS 2
2.01 UNIT VENTILATOR (HIGH EFFICIENCY) 2
2.02 BASIC UNIT CONTROLS 4
2.03 CAPACITIES AND CHARACTERISTICS 4
PART 3 EXECUTION 4
3.01 EXAMINATION 4
3.02 INSTALLATION 5
3.03 CONNECTIONS 5
3.04 FIELD QUALITY CONTROL 5
3.05 ADJUSTING 5
3.06 DEMONSTRATION 5

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-Source Unitary Heat Pumps" for ground-loop, water-source heat-pump-type vertical unit ventilators.

1.02 SUMMARY

A. This Section includes vertical style unit ventilators and accessories with the following heating and cooling features:

1. Hydronic heating coil.
2. Hydronic reheat coil.
3. Direct-expansion refrigerant cooling coil.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. DDC: Direct digital controller.

C. HGBP: Hot-gas bypass.

1.04 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories for each unit type and configuration.

1.05 **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. Details of anchorages and attachments to structure and to supported equipment.
3. Wiring Diagrams: Power, signal, and control wiring.

B. Samples for Initial Selection: For units with factory-applied color finishes.

C. Samples for Verification: For each type of unit ventilator indicated.

1.06 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. Operation and Maintenance Data: For unit ventilators to include in operation and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

C. Warranty: Special warranty specified in this Section.

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.

B. Comply with NFPA 70.

C. Comply with minimum COP/efficiency levels according to ASHRAE/IESNA 90.1.

D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

E. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

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. Unit Ventilator Filters: Furnish spare filter for each filter installed.

PART 2 PRODUCTS

2.01 **UNIT VENTILATOR (HIGH EFFICIENCY)**

A. Basis-of-Design Product: Subject to compliance with requirements, provide Airedale; High Efficiency Classmate or a comparable product by one of the following:

1. Modine Manufacturing Company; Airedale.
2. System Air Company.
3. Temspec Inc.

B. Unit Casing: Constructed of galvanized sheet steel, braced and reinforced for rigidity, covered with baked dry powder epoxy resin paint in manufacturer’s standard color as selected by Architect.

1. Cabinet front containing low level return air grille integral to door front and sound attenuating inlet plenum.

2. Removable panels or hinged door with spring loaded pins for access to cooling coil, supply and evaporator fan/motor assemblies, electronic controls, filters, and dampers.
3. Furnish matching outside air back plenum where indicated for field mounting to rear of unit to allow louver installation above existing window sill heights.
4. Furnish matching blank-off panels where required to conceal back of unit. Coordinate with architectural casework.
5. As a separate assembly, provide matching discharge plenum with hot water heating coil assembly for field mounting to top of unit. If manufacturer's standard design does not require a separate assembly housing the heating coil, furnish matching duct shroud to conceal supply duct from unit discharge to above finished ceiling. Coordinate with Architectural ceiling elevations.
6. Unit shall be fitted with power disconnect switch located on control panel, sized for full load amperage. Switch lockable in off position.

C. Insulation: Minimum 1/2-inch thick, coated glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.
1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

D. Modulating Damper: Spring return type, designed to mix outside air with return air.
1. Capable of permitting 100 percent outside air into the conditioned space, or recycling return air and allowing minimum outside air into the conditioned space.
2. Fully modulating allowing any mixture of outside air and return air with minimum damper position setting to continuously maintain outside air ventilation requirements dependent on control via the unit's DDC controls.
3. Blade seals shall overlap for minimum leakage.

E. Louver Blades: Aluminum, storm-proof, mounted at 45 degree angle in heavy gage extruded aluminum frames.
1. Blade profile and louver size designed to prevent water penetration during full economizer operation.
2. 1//2 inch mesh bird screen shall be attached to louver frame.

F. Fans and Fan Motor:
1. Indoor fan assembly: Consisting of two blowers and one common-shafted electronically commutated motor (ECM).
   a. ECM having a wide range of programmable speed and torque characteristics.
   b. ECM fully programmable to compensate for wide variety of static pressures as well as lack of maintenance.
2. Outdoor fan assembly: Consisting of two backward curved plug fans with centrifugal blower wheels.

G. Cooling:
1. First stage: Fully modulating economizer.
2. Second stage: Unit mounted direct expansion coil.

H. Drain Pans: Insulated galvanized steel with plastic liner .Drain pan shall be removable. Include factory-installed float switch to detect high condensate water level and disable fan operation.

I. Filters: Accessible from front of unit and positioned to filter mixed air prior to conditioning. Microbial treated, and with minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

J. Refrigeration System: Fully hermetic scroll type compressor, internally equalized expansion valve, filter/dryer, factory installed high and low refrigerant pressure switches and service valves, suitable for HCFC R-410a.

1. Compressor protected against excessive motor temperatures and current by means of internal overload protector.

2. Evaporator and condenser coils constructed of aluminum fins mechanically bonded to copper tubes.

a. Condenser coil: High-efficiency cross-rifle type.

3. Cooling Only Units: Contain factory fitted expansion device(s), filter dryer, high- and low-pressure switches, manual reset high-pressure cutout, and automatic reset low-pressure cutout.

4. Accessories: Sound-deadening compressor acoustic wrap.

K. Heating Coil: Factory piped and complete with isolation valves, balance valve, strainer, and manual air vent.

L. Furnish unit having factory wired and tested 3-speed motor switch. Unit shall be set to provide design airflow at specified static pressure on medium speed.

M. Manufacturer shall factory install DDC based controls as furnished by Temperature Controls Contractor. Refer to Temperature Control Drawings for scope of work.

N. Electrical:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection.

2. Wiring shall be numbered and color-coded to match wiring diagram.

3. Minimum SCCR according to UL 508 shall be as indicated on the Drawings.

4. Each motor shall have overcurrent protection.

5. Factory installed power monitor shall detect phase loss and phase reversal to shut down the unit when a fault is detected.

2.02 BASIC UNIT CONTROLS

A. Control devices are specified in Division 23 Section "HVAC Instrumentation and Controls," and operational sequences are indicated on the Drawings.

B. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.03 CAPACITIES AND CHARACTERISTICS

A. Refer to Schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive unit ventilators 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 unit ventilator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Install unit ventilators to comply with NFPA 90A.

B. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above finished floor.

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. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to unit ventilator factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

B. Connect supply and return ducts to unit ventilators with flexible duct connectors specified in Division 23 Section "Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Division 26 Section "Grounding and Bonding."

D. 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. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Record temperatures entering and leaving energy recovery wheel when outdoor-air temperature is a minimum of 15 deg F higher, or 20 deg F lower, than room temperature.

C. Remove and replace malfunctioning units and retest as specified above.

3.05 **ADJUSTING**

A. Adjust initial temperature and humidity set points.

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 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 unit ventilators.

END OF SECTION

SECTION 23 8240 - CENTRIFUGAL FAN CABINET UNIT HEATERS (HOT WATER)

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 ACTION SUBMITTALS 1
1.03 INFORMATIONAL SUBMITTALS 1
1.04 CLOSEOUT SUBMITTALS 2
1.05 QUALITY ASSURANCE 2
1.06 EXTRA MATERIALS 2
PART 2 PRODUCTS 2
2.01 MANUFACTURED UNITS 2
2.02 UNIT CONTROLS 3
PART 3 EXECUTION 3
3.01 EXAMINATION 3
3.02 INSTALLATION 3
3.03 CONNECTIONS 4
3.04 FIELD QUALITY CONTROL 4
3.05 DEMONSTRATION 4

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 piping valves and specialties.
4. Location and arrangement of integral controls.
5. Wiring Diagrams: Power, signal, and control wiring.
6. Suspended ceiling components.
7. Structural members to which cabinet unit heaters will be attached.
8. Method of attaching hangers to building structure.
9. Size and location of initial access modules for acoustical tile.
10. Items penetrating finished ceiling, including the following:
    a. Lighting fixtures.

b. Air outlets and inlets.

c. Speakers.

d. Sprinklers.

e. Access panels.

11. Perimeter moldings for exposed or partially exposed cabinets.

1.04 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

B. 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. 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. Carrier Corporation; United Technologies Corporation.

2. Daikin Applied; a member of Daikin Industries, Ltd.

3. Hydro-Air Components Inc.; Zehnder Rittling.

4. Modine Manufacturing Company.

5. Sterling Radiator; a Mestek Company.

6. Trane; a Trane Technologies Brand.

7. Vulcan Radiator; a Mestek Company.

B. Description: A factory-assembled and -tested unit complying with AHRI 440.

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. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

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 piping and 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 and 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. 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. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Duct Accessories."

D. Comply with safety requirements in UL 1995.

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. 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. 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 23 8241 - PROPELLER FAN UNIT HEATERS – STEAM, HOT WATER, ELECTRIC

PART 1 GENERAL 1
1.01 RELATED DOCUMENTS 1
1.02 SUMMARY 1
1.03 ACTION SUBMITTALS 1
1.04 INFORMATIONAL SUBMITTALS 1
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1.06 QUALITY ASSURANCE 2
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2.01 MANUFACTURERS 2
2.02 UNIT HEATERS 3
2.03 CASING 3
2.04 COILS 3
2.05 ELECTRIC-RESISTANCE HEATING ELEMENTS 3
2.06 FAN 3
2.07 FAN MOTORS 3
2.08 CAPACITIES AND CHARACTERISTICS 3
PART 3 EXECUTION 3
3.01 EXAMINATION 3
3.02 INSTALLATION 4
3.03 CONNECTIONS 4
3.04 FIELD QUALITY CONTROL 4
3.05 DEMONSTRATION 4

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 hot-water or 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.
5. Suspended ceiling components.

6. Structural members to which unit heaters will be attached.
7. 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 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steam Unit Heaters:
    a. Daikin Applied; a member of Daikin Industries, Ltd.
    b. Dunham-Bush
    c. Modine Manufacturing Com.
    d. Sterling Radiator, a Mestek Company.
    e. Trane Inc.; a Trane Technologies Brand.
2. Hot-Water Unit Heaters:
    a. Daikin Applied; a member of Daikin Industries, Ltd.
    b. Dunham-Bush, Inc.
    c. Hydro-Air Components; Zehnder Rittling.
    d. Modine Manufacturing Company.
    e. Sterling Radiator, a Mestek Company.
    f. Trane Inc.; a Trane Technologies Brand.
    g. Vulcan Radiator, a Mestek Company.
3. 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 **COILS**

A. Test and rate propeller unit-heater coils according to ASHRAE 33.

B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.05 **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.

2.06 **FAN**

A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.07 **FAN MOTORS**

A. Comply with requirements in Division 20 Section "Motors."

B. Motor Type: Permanently lubricated, multispee

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. 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. Comply with safety requirements in UL 1995.

D. 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."

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. 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 26 0010 - ELECTRICAL GENERAL REQUIREMENTS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification sections, apply to work of this section.

1.02 SUMMARY

A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.03 REFERENCES

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. ANSI - American National Standards Institute; www.ansi.org.
2. ASTM - ASTM International; www.astm.org.
3. CSI - Construction Specifications Institute (The); www.csiresources.org.
4. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
5. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
6. NEC - National Electrical Code
7. NECA - National Electrical Contractors Association; www.necanet.org.
   a. NECA 1-2000, “Practices for Good Workmanship in Electrical Contracting (ANSI).”
8. NEMA - National Electrical Manufacturers Association; www.nema.org.
9. NETA - InterNational Electrical Testing Association; www.netaworld.org.
10. UL - Underwriters Laboratories Inc.; www.ul.com.

1.04 **QUALITY ASSURANCE**

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test, and leave ready for operation the electrical systems as specified in the Division 26 Sections and as indicated on Drawings.
   1. Contract Documents are complementary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
   2. The Contractor understands that the work herein described shall be complete in every detail.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State, and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.
   1. Notify the Architect/Engineer if revisions to the Drawings or Specifications are required to conform to applicable ordinances, codes, or regulations. Identify the cost associated with these revisions in the bid.

C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county, and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Avoid interference with the work of other trades. Remove and relocate any work which in the opinion of the Owner’s Representatives causes interference.

1.05 **CODES, PERMITS AND FEES**

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals, and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules, and regulations.

B. Comply with rules of local utility companies. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets, and meters which will be required and include the cost of all such items and all utilities costs in proposal.

C. All work shall be executed in accordance with the rules and regulations outlined in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction that exceed code requirements, the Drawings and/or Specifications shall govern.

1.06 **DRAWINGS**

A. The Drawings show the location and general arrangement of equipment, electrical systems, and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes, and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, apart from minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades, and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.07 **MATERIAL AND EQUIPMENT MANUFACTURERS**

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new, be standard products of manufacturers regularly engaged in the production of electrical equipment and be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering, or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third-party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.08 **INSPECTION OF SITE**

A. Visit the site, examine, and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.09 **ITEMS REQUIRING PRIOR APPROVAL**

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information, and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 **SHOP DRAWINGS/SUBMITTALS**

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. If deviations (not substitutions) from the Contract Documents are deemed necessary by the Contractor, the details of such deviations, the reason for the deviation, and the resulting changes shall be included with the submittal for approval.

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 (light fixtures).

1.11 **COORDINATION DRAWINGS**

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 **OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS**

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Manual shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.

C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:

1. Routine maintenance procedures.

2. Trouble-shooting procedures.

3. Contractor's telephone numbers for warranty repair service.

4. Submittals.
5. Recommended spare parts list.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 **RECORD DRAWINGS**

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work. Modifications to original drawings shall be marked with a contrasting color so the marks are readily apparent.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer, and Owner at their request during construction.

1.14 **INSTRUCTION OF OWNER PERSONNEL**

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.

D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 **WARRANTY**

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 26 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship, or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 **USE OF EQUIPMENT**

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 **COORDINATION**

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. To ensure that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions; and to maintain the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION**

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange, and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.02 **DEMOLITION WORK**

A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items related to the existing systems that are being removed such as, but not limited to, electrical equipment, cabinets, devices, lighting fixtures, conduit, fittings, boxes, wiring, and supports. No abandoned components of the electrical systems indicated to be removed shall remain.

1. Where electrically powered equipment is included in the demolition scope of other trades, disconnect electrical wiring connections and remove circuit wiring complete.

B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

C. Unless specifically noted otherwise, removed materials shall not be reused in the work.

1. Materials indicated to be salvaged shall be carefully removed, stored, and protected from damage.
2. Salvaged materials intended to be re-used shall be thoroughly cleaned, refurbished if necessary, and determined to be fully functional prior to placing back into service.
3. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items that the Owner has waived ownership shall

become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

D. Where equipment or fixtures are removed, outlet boxes that remain recessed in walls shall be properly blanked off, and conduits capped. After alterations are complete, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical systems remaining in service shall not be changed unless specifically indicated as part of the project scope.

E. Reroute signal wires, lighting, and power wiring as required to maintain services that are to remain and/or unaffected by the renovations. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or the panels.

F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.

G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where specifically indicated on the drawings or approved by the Architect/Engineer.

H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, re-lamped, and reconditioned suitable for satisfactory operation and appearance.

3.03 **INSTALLATION OF EQUIPMENT**

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:

1. Allow for wiring devices, control devices, and fire alarm devices to be relocated within a 10’ radius to accommodate final coordination with furnishings and other finish elements. Devices relocated prior to installation shall be done without additional cost to the project.

3.04 **WORK IN EXISTING BUILDINGS**

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's Representative.

D. Prior to starting work in any area, obtain approval for doing so from a qualified representative of the Owner who is designated and authorized by the Owner to perform testing and abatement of all hazardous materials including but not limited to, asbestos. The Contractor shall not perform any inspection, testing, containment, removal, or other work that is related in any way whatsoever to hazardous materials under the Contract.

3.05 **TEMPORARY SERVICES**

A. Provide and remove upon completion of the project, following the general conditions and as described in Division 01, a complete temporary electrical and telephone service during construction.

3.06 **DISPOSAL**

A. Fluorescent Lamps

1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).
2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location before transportation.
3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.
4. Upon completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state, and federal guidelines.

B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.
2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel drums with labels that meet the Department of Transportation Regulations.
3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.
4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state, and federal guidelines.

3.07 **CHASES AND RECESSES**

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.08 **CUTTING, PATCHING AND DAMAGE TO OTHER WORK**

A. Refer to General Conditions for requirements.

B. All cutting, patching, and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.09 **EXCAVATION AND BACKFILLING**

A. Provide all excavation, trenching, tunneling, dewatering, and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. 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.

D. Backfill all excavations inside building, under drives, and parking areas with well-tamped granular material. 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.

E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen excavated material in such a way as to prevent settling.

3.10 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.

3.11 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.

3.12 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.

3.13 EXTRA WORK

A. For additional electrical work which may be proposed or requested, furnish an itemized cost breakdown of material and labor required to complete the work. Proceed only after receiving a written authorization.

B. Before providing an itemized break-down for additional electrical work, submit unit prices for the following items: 1/2", 3/4", 1", 1-1/2" EMT conduit; #12, #10, #8, #6, #2 building wire; duplex receptacles, GFCI receptacles, data box and raceway, V4000 wiremold, and fittings fire alarm audible/visual notification appliance and visual notification appliance, clocks and speakers, and other common electrical work which may be anticipated for any future revisions. These unit costs, once agreed to, shall be applied to additions and deducts for all project change orders.

3.14 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.

3.15 PROJECT COMMISSIONING

A. Refer to Division 01 “Project Commissioning” and the Commissioning Manual.

B. Purpose: Training, documentation and verification of the operation and functional performance of electrical systems for compliance with the “design intent.”

END OF SECTION

SECTION 26 0519 - CONDUCTORS AND CABLES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes:

1. Building wires and cables rated 600V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Sections include the following:

1. Division 26 Section “Control-Voltage Electrical Power Cables” for multi-conductor cables for electrical control and communications systems operating at 70V and less.

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. Mineral Insulated Cable, Type MI
3. 2- Hour Fire Rated Mc Power Cable
4. 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.

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.
2. Aluminum, complying with ASTM B 800 and ASTM B 801 for conductors #1 AWG and larger.

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.

I. Jacket: PVC applied over armor.

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 and multi-circuit with color-coded conductors.

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.

G. Outer Jacket (if required): Black low smoke zero halogen polyolefin.

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: Steel or 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.

D. Isolated Power System Circuits: Use Type XLP in raceway.

3.03 **INSTALLATION OF CONDUCTORS AND CABLES**

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

G. 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. AC/MC cable shall not be used for home runs to receptacle or distribution panels.

L. Where AC/MC cable is permitted by the specifications, AC/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 0523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes control-voltage electrical power cables for the following systems:

1. Temperature controls
2. Building automation
3. Lighting control
4. Low voltage lighting power limited circuits
5. Shade control systems
6. Class 1 and Class 2 power limited circuits supplying LED lighting on the secondary of low voltage drivers or power supplies.
7. Any control voltage, signal cable or power limited circuit required.

B. Section Includes the following:

1. Category 5e balanced twisted pair cable.

2. Category 6 balanced twisted pair cable.
3. Category 6a balanced twisted pair cable.
4. Balanced twisted pair cable hardware.
5. Twin-axial data highway cable.
6. RS-232 cable.
7. RS-485 cable.
8. Control cable.
9. Control-circuit conductors.

C. Related Requirements:

1. Section 26 0010 "Electrical General Requirements".
2. Section 26 0529 “Hangers and Supports for Electrical Systems”.
3. Section 26 0533 “Raceways and Boxes”.
4. Section 28 3100 “Fire Alarm” for cable specific to fire alarm systems signaling line circuits and notification appliance circuits.

1.03 **ACTION SUBMITTALS**

A. Product Data:

1. Category 5e balanced twisted pair cable.
2. Category 6 balanced twisted pair cable.
3. Category 6a balanced twisted pair cable.
4. Balanced twisted pair cable hardware.
5. Twin-axial data highway cable.
6. RS-232 cable.
7. RS-485 cable.
8. Control cable.
9. Control-circuit conductors.

1.04 **INFORMATIONAL SUBMITTALS**

A. Source quality-control reports.

B. Field quality-control reports.

PART 2 PRODUCTS

2.01 **PERFORMANCE REQUIREMENTS**

A. Cable specifications shall meet the minimum requirements of the equipment or control system manufacturer for which the cables are intended to support, or as specified in other sections.

1. Coordinate with submittals for each special system, where applicable.
2. Where cable specifications for specific systems differ from these specifications, use the cable with performance characteristics required by the manufacturer, with the appropriate environmental rating and color coding as indicated.

3. All execution articles in this section shall apply to all control voltage cable systems in addition to control system manufacturer requirements. Where these specifications differ or conflict with the system manufacturer instructions or recommendations, the more restrictive requirements shall apply.

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. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.

1. Flame Travel Distance: 60 inch or less.

2. Peak Optical Smoke Density: 0.5 or less.

3. Average Optical Smoke Density: 0.15 or less.

D. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.

E. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.02 CATEGORY 5E BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 5e cable at frequencies up to 100 MHz.

B. Standard: Comply with ICEA S-90-661, NEMA WC 63.1, and TIA-568-C.2 for Category 5e cables.

C. Conductors: 100 ohm, No. 24 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP)

E. Cable Rating: Plenum.

F. Jacket: Color coded thermoplastic.

1. Color shall be determined by system served by cabling.

2.03 CATEGORY 6 BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, certified to meet transmission characteristics of Category 6 cable at frequencies up to 250 MHz.

B. Standard: Comply with NEMA WC 66/ICEA S-116-732 and TIA-568-C.2 for Category 6 cables.

C. Conductors: 100 ohm, No. 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum.

F. Jacket: Color coded thermoplastic.

1. Color shall be determined by system served by cabling.

2.04 CATEGORY 6A BALANCED TWISTED PAIR CABLE

A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500 MHz.

B. Standard: Comply with TIA-568-C.2 for Category 6a cables.

C. Conductors: 100 ohm, No. 23 AWG solid copper.

D. Shielding/Screening: Unshielded twisted pairs (UTP).

E. Cable Rating: Plenum.

F. Jacket: Color coded thermoplastic.

1. Color shall be determined by system served by cabling.

2.05 **BALANCED TWISTED PAIR CABLE HARDWARE**

A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.

B. General Requirements for Balanced Twisted Pair Cable Hardware:

1. Comply with the performance requirements of balanced twisted pair cable required for the system.

2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.

3. Cables must be terminated with connecting hardware of same category or higher.

C. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.

D. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:

a. Universal T568A and T568B wiring labels.

b. Labeling areas adjacent to conductors.

c. 24 or 48 ports.

2. Construction: 16-gauge steel and mountable on 19 inch equipment racks.

3. Number of Jacks per Field: One for each four-pair cable indicated plus spares and blank positions adequate to suit specified expansion criteria.

E. Patch Cords: Factory-made, four-pair cables in lengths required for specific application; terminated with an eight-position modular plug at each end.

1. Patch cords must have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords must have latch guards to protect against snagging.

F. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.

2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.

3. Marked to indicate transmission performance.

G. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100 ohm unshielded or shielded balanced twisted pair cable.

2. Designed to snap-in to a patch panel or faceplate.
3. Standards:
    a. Category 5e, unshielded balanced twisted pair cable must comply with IEC 60603-7-2.
    b. Category 6, unshielded balanced twisted pair cable must comply with IEC 60603-7-4.
    c. Category 6a, unshielded balanced twisted pair cable must comply with IEC 60603-7-41.
4. Marked to indicate transmission performance.

H. Faceplate:
1. Four port, minimum, vertical single-gang faceplates designed to mount to single-gang wall boxes.
2. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 2726 "Wiring Devices".
3. Metal Faceplate: Stainless steel, complying with requirements in Section 26 2726 "Wiring Devices".
4. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
    a. Flush mounting jacks, positioning the cord at a 45-degree angle.

I. Legend:
1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.06 TWIN-AXIAL DATA HIGHWAY CABLE

A. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 20 AWG, 22AWG or 24 AWG, stranded (7x28), (7x30), (7x32) tinned-copper conductors and number of pairs as required for the application and/or required by the system manufacturer's recommendations.
2. Plastic insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with 24 AWG, stranded (7x32) tinned-copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.07 RS-232 CABLE

A. Plenum-Type, TIA 232-F:
1. Three or Nine, No. 22 AWG, stranded (7x30) tinned copper conductors. Conductor quantity as required for application.
2. PE insulation.
3. Aluminum foil-polyester tape shield with 100 percent shield coverage.

4. Fluorinated ethylene propylene jacket.
5. Conductors are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.08 **RS-485 CABLE**

A. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, two pairs, No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.

2.09 **CONTROL CABLE**

A. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG stranded tinned-copper conductors. Number of pairs and gauge as required by the application.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.10 **CONTROL-CIRCUIT CONDUCTORS**

A. Class 1 Control Circuits:

1. Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
2. Type TC, complying with UL 1277 in raceway.
3. Type MC, complying with UL 1569.

B. Class 2 Control Circuits:

1. Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
2. Power-limited cable, concealed in building finishes.
3. Power-limited tray cable, in cable tray.

C. Class 3 Remote-Control and Signal Circuits:

1. Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.
2. Power-limited cable, concealed in building finishes.
3. Power-limited tray cable, in cable tray
4. Type TW or Type TF, complying with UL 83, in raceway.

D. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.11 **SOURCE QUALITY CONTROL**

A. Factory test twisted pair cables according to TIA-568-C.2.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Test category 5E, 6 and 6A cables on receipt at Project site.

1. Test each pair of twisted pair cable for open and short circuits.

3.02 **INSTALLATION OF RACEWAYS AND BOXES**

A. Comply with requirements in Section 26 0533 "Raceways and Boxes" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.

1. Outlet boxes for cables must be no smaller than 4 inch square by 2-1/8 inch deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.

2. Flexible metal conduit must not be used.

B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.

C. Install manufactured conduit sweeps and long-radius elbows if possible.

D. Raceway Installation in Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.

2. Install cable trays to route cables if conduits cannot be located in these positions.

3. Secure conduits to backboard if entering the room from overhead.

4. Extend conduits 3 inch above finished floor.

5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.03 **INSTALLATION OF CONDUCTORS AND CABLES**

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA-568-C Series of standards.

2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."

3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, control panels, cross-connect and patch panels.

4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points unless specifically allowed and indicated in the system manufacturers installation instructions.

5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.

6. Secure and support cables at intervals not exceeding 30 inch and not more than 6 inch from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire must be copper, and grounding methods must comply with IEEE C2.
16. Where ceilings consist of exposed construction, 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.
17. Install all cable in conduit in mechanical rooms, loading docks and similar service spaces.
18. Drops to surface mounted devices shall be installed in conduit in service spaces or surface raceway in finished spaces.
19. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
20. No exposed cable shall be visible below the ceiling.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces and other equipment rooms with terminating hardware and interconnection equipment.
2. Suspend cable that is not in a raceway a minimum of 8 inch above ceilings by cable supports not more than 30 inch apart.
3. Unless specifically permitted otherwise for open ceiling applications in finished areas, cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

E. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only when space under floor is used for the transport of environmental air.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inch of cable in a coil not less than 12 inch in diameter.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inch.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inch.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inch.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inch.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inch.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inch.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
   a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
   b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inch.
   c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inch.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inch.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inch.

3.04 REMOVAL OF CONDUCTORS AND CABLES

A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.05 CONTROL-CIRCUIT CONDUCTORS

A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.
2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.06 FIRESTOPPING

A. Comply with requirements in Section 07 8413 "Penetration Firestopping."

B. Comply with TIA-569-D, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.07 **GROUNDING**

A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.

B. For control-voltage wiring and cabling, comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems."

C. Observe installation instructions for grounding according to system manufacturer's installation instructions, where applicable.

3.08 **IDENTIFICATION**

A. Comply with requirements for identification specified in Division 26 Section "Electrical Identification."

B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.

C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

D. Color Coding: Provide control voltage cables with jacket color to indicate system served: Coordinate with owner's published standards or owner's network and security consultants.

1. Use the following color-coding scheme, or submit project specific scheme for approval:

a. Temperature controls: Blue with unique striping for each sub-system

b. Building automation backbone: Blue

c. Lighting control: Green

d. Low voltage lighting power limited circuits: Black with grey stripe

e. Shade control systems: Black with red stripe

f. Class 1 and Class 2 power limited circuits supplying LED lighting on the secondary of low voltage drivers or power supplies. Black with green stripe

g. Miscellaneous power limited cables not otherwise specified: Black.

h. Reserved for Fire Alarm: Red

i. Reserved for Enterprise Network/Telecommunications Cable: White

j. Reserved for Video Surveillance: Purple

k. Reserved for Access Control: Orange

3.09 **FIELD QUALITY CONTROL**

A. Tests and Inspections:

1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

    a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide or transfer the data from the instrument to the computer, save as text files, print, and submit.

C. End-to-end cabling will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section “Conductors and Cables”.

1.03 REFERENCES

A. ASTM B 3: Specification for Soft or Annealed Copper Wire.

B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

C. ASTM B 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 1100 – 1992: Recommended Practice for Powering and Grounding Sensitive Electronic Equipment.

H. IEEE C2: National Electrical Safety Code.

I. NETA MTS – 2001: Maintenance Testing Specifications.

J. NFPA 70: National Electrical Code.

K. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

L. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

M. UL 467: Grounding and Bonding Equipment.

N. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

O. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.04 **ACTION SUBMITTALS**

A. Product Data: For the following:

1. Ground rods.

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.

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.

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. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

G. 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.

H. 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.

I. 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.

J. 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. 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.

F. 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.

G. 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 in accordance with NFPA 70:

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. 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.

G. 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.

H. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

I. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.

J. Separately Derived AC Power Systems: Ground separately-derived ac power system neutrals including distribution transformers and uninterruptible power supplies to grounding electrodes per NFPA 70.

K. 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.

L. 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.

M. Bond together metal building elements not attached to grounded structure; bond to ground.

N. 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. 3/0 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.

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 tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.

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.

3.07 **GRADING AND PLANTING**

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.03 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.05 **QUALITY ASSURANCE**

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.06 **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."

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. 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.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

2.02 **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 (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with:
    a. Two-bolt conduit clamps
    b. Single-bolt conduit clamps
    c. Single-bolt conduit clamps using spring friction action for retention in support channel.

D. Support single runs of MC cable using spring-steel clamps from suspended ceiling hangers, hanger wire or building structure at intervals not to exceed three feet. Do not support MC cable from ceiling grid.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. 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.
6. To Light Steel: Sheet metal screws.

7. 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 floor decks, roof decks, pipes, ducts, mechanical equipment, or conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch (25 mm) 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: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections, Section "High-Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 0533 - RACEWAYS AND BOXES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

B. Related Sections include the following:

1. Division 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. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit, IMC.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel or Aluminum.

G. LFMC: Flexible steel conduit with PVC jacket.

H. 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. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
2. Fittings for EMT: Steel, compression type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.

2.02 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American International.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
5. Certainteed Corp.; Pipe and Plastics Group.
6. Condux International.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
11. Lamson and Sessions: Carlon Electrical Products.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
14. Scepter.
15. Spiralduct, Inc./AFC Cable Systems, Inc.
16. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

F. HDPE: UL 651, ASTM D 3350, ASTM D 1248 Schedule 40.

G. RTRC: Comply with UL 2515A and NEMA TC 14.

2.03 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.

2.04 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Airey-Thompson Sentinel Lighting: Wiremold Company (The).

b. Thomas & Betts Corporation.

c. Walker Systems, Inc.; Wiremold Company (The).

d. Wiremold Company (The); Electrical Sales Division.

e. Mono-Systems, Inc.

B. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.05 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

G. 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.

H. 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.

2.06 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."

2.07 **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.

2.08 **GROUT**

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

PART 3 EXECUTION

3.01 **RACEWAY APPLICATION**

A. Provide raceways in interior and exterior locations in accordance with the “Raceway Application Matrix” included on the drawings.

B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.

C. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

D. Minimum Raceway Size: 3/4-inch trade size.

E. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. EMT: Use compression steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

F. Do not install aluminum conduits in contact with concrete.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.02 **INSTALLATION**

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inchesaway 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 inchesof 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 inchesof enclosures to which attached.

K. Raceways Embedded in Slabs:

1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.

2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.

3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.

4. Space raceways laterally to prevent voids in concrete.

5. Run conduit larger than 1-inch trade size 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 and EMT 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 Ftemperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg Ftemperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg Ftemperature change.
    d. Attics: 135 deg Ftemperature 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 semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

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.

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.

LL. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.

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 inchesof 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 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.

3.05 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.

3.06 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."

3.07 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.

3.08 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 0553 - ELECTRICAL IDENTIFICATION

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. 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 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background. Minimum letter height shall be 3/8 inch.

B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.06 **MISCELLANEOUS IDENTIFICATION PRODUCTS**

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.

1. Minimum Width: 3/16 inch.
2. Tensile Strength: 50 lb, minimum.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black, except where used for color-coding.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.07 **WIRING DEVICE IDENTIFICATION**

A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.

PART 3 EXECUTION

3.01 **APPLICATION**

A. Accessible Raceways and 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. Fire Alarm System: Red.
2. Security System: Blue and yellow.
3. Telecommunication System: Green and yellow.
4. 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. Electrical substations.

f. Emergency system boxes and enclosures.

g. Motor-control centers.

h. Disconnect switches.

i. Enclosed circuit breakers.

j. Motor starters.

k. Variable Frequency Controllers

l. Push-button stations.

m. Power transfer equipment.

n. Contactors.

o. Remote-controlled switches, dimmer modules, and control devices.

p. Battery inverter units.

q. Battery racks.

r. Power-generating units.

s. Voice and data cable terminal equipment.

t. Master clock and program equipment.

u. Intercommunication and call system master and staff stations.

v. Television/audio components, racks, and controls.

w. Fire-alarm control panel and annunciators.

x. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.

y. Monitoring and control equipment.

z. Uninterruptible power supply equipment.

aa. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

bb. 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 nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Grounded Conductor (Neutral): White.
3. Colors for 480/277-V Circuits:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Ground Conductor (Neutral): Grey.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. 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 red colored band on each fire alarm conduit and junction box.

S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION

SECTION 26 0573 - OVERCURRENT DEVICE COORDINATION STUDY/ARC FLASH HAZARD ANALYSIS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.02 SCOPE

A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E -Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D prepared by the electrical equipment manufacturer.

C. The scope of the studies shall include all new distribution equipment supplied by the equipment manufacturer under this contract as well as all directly affected existing distribution equipment at the customer facility

1.03 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis
4. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings
5. IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
6. IEEE 1584 -Guide for Performing Arc-Flash Hazard Calculations

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
4. ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. The National Fire Protection Association (NFPA)

1. NFPA 70 -National Electrical Code, latest edition
2. NFPA 70E – Standard for Electrical Safety in the Workplace, latest edition.

1.04 **ACTION SUBMITTALS**

A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.05 **INFORMATIONAL SUBMITTALS**

A. The results of the short-circuit, protective device coordination, and arc flash hazard analysis studies shall be summarized in a final report. Report shall be provided on electronic media. All literature shall be combined in one document and shall be properly bookmarked with all applicable sections.

B. The report shall include the following sections:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One-line diagram.

C. Arc flash labels shall be provided in full size representation in PDF format and submitted with the study.

D. The report shall be signed and sealed by the Professional Engineer supervising the study.

1.06 **QUALIFICATIONS**

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies and registered in the state where the project is located.

D. The equipment manufacturer shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 **COMPUTER SOFTWARE PROGRAMS**

A. Computer Software Programs: Subject to compliance with requirements, provide products by one of the following:

1. EDSA Micro Corporation.
2. SKM Systems Analysis, Inc.
3. ESA Inc.
4. CGI CYME.
5. Operation Technology, Inc.

PART 2 PRODUCTS

2.01 **STUDIES**

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E -Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D prepared by the equipment manufacturer.

2.02 **DATA COLLECTION**

A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data to satisfy the study requirements.

2.03 **SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY**

A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.

B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated

4. Source impedance data, including electric utility system and motor fault contribution characteristics
5. Tabulations of calculated quantities
6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
1. Electric utility's supply termination point
2. Incoming switchgear
3. Unit substation primary and secondary terminals
4. Low voltage switchgear
5. Motor control centers
6. Standby generators and automatic transfer switches
7. Branch circuit panelboards
8. Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:
1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
3. Notify design engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.04 **PROTECTIVE DEVICE COORDINATION STUDY**

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:
1. Electric utility's overcurrent protective device
2. Medium voltage equipment overcurrent relays
3. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
6. Conductor damage curves
7. Ground fault protective devices, as applicable

8. Pertinent motor starting characteristics and motor damage points, where applicable
9. Pertinent generator short-circuit decrement curve and generator damage point
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

G. For emergency and standby distribution paths, provide selective coordination tables to demonstrate tested upstream/downstream breaker pairs selectively coordinate across the full range of over currents, from overload to the maximum available fault current, and for the full range of overcurrent protective device opening times associate with those fault currents.

2.05 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2018, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations

F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06 **REPORT SECTIONS**

A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
3. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X”d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
4. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage
   b. Calculated fault current magnitude and angle
   c. Fault point X/R ratio
   d. Equivalent impedance
2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage
   b. Calculated symmetrical fault current magnitude and angle
   c. Fault point X/R ratio
   d. Calculated asymmetrical fault currents
      1) Based on fault point X/R ratio
      2) Based on calculated symmetrical value multiplied by 1.6
      3) Based on calculated symmetrical value multiplied by 2.7
   e. Equivalent impedance
3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
   a. Voltage

b. Calculated symmetrical fault current magnitude and angle
c. Fault point X/R ratio
d. No AC Decrement (NACD) Ratio
e. Equivalent impedance
f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:
1. Phase and Ground Relays:
a. Current transformer ratio
b. Current setting
c. Time setting
d. Instantaneous setting
e. Recommendations on improved relaying systems, if applicable.
2. Circuit Breakers:
a. Adjustable pickups and time delays (long time, short time, ground)
b. Adjustable time-current characteristic
c. Adjustable instantaneous pickup
d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations
1. Arcing fault magnitude
2. Protective device clearing time
3. Duration of arc
4. Arc flash boundary
5. Working distance
6. Incident energy
7. Hazard Risk Category
8. Recommendations for arc flash energy reduction

PART 3 EXECUTION

3.01 **FIELD ADJUSTMENT**

A. The contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

C. Notify design engineer in writing of any required major equipment modifications.

3.02 **ARC FLASH WARNING LABELS**

A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label for equipment where arc incident energy is calculated shall include the following, at a minimum:

1. Location designation
2. Nominal system voltage
3. Arc flash boundary
4. Incident energy
5. Working distance
6. Engineering report number, revision number and issue date.

D. The label for equipment where arc incident energy is not calculated shall include the following, at a minimum:

1. Location designation
2. Nominal system voltage
3. Arc flash boundary from NFPA 70E 2018 Table 130.7(C) 15(a)
4. Arc flash PPE category from NFPA 70E 2018 Table 130.7(C) 15(a)
5. Engineering report number, revision number and issue date.

E. Labels shall be machine printed, with no field markings.

F. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 480 and 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.
4. For each switchgear, one flash label shall be provided.
5. For medium voltage switches one arc flash label shall be provided

G. Labels shall be field installed by the contractor.

END OF SECTION

SECTION 26 0923 - LIGHTING CONTROL DEVICES

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following lighting control devices:

1. Time controllers.
2. Outdoor and indoor photoelectric control.
3. Occupancy sensors.
4. Wall digital time switches.
5. Low voltage key switch.
6. Stand-alone room controller systems.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements”.
2. Division 26 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.03 REFERENCES

A. IEEE C62.41: Guide for Surge Voltages in Low-Voltage AC Power Circuits.

B. IEEE C136.10: Standard for Roadway Lighting Equipment Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.

C. NEMA ICS 2: Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC Part 8: Disconnect Devices for Use in Industrial Control Equipment.

D. NFPA 70: National Electrical Code.

E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

F. UL 486B: Wire Connectors for Use with Aluminum Conductors.

G. UL 773: Plug-in, Locking Photocontrols for Use with Area Lighting.

H. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.

I. UL 917: Clock Operated Switches.

J. UL 1449: Surge Protective Devices.

K. UL 1598: Luminaires.

L. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.04 **DEFINITIONS**

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.

D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.

E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.

1.05 **SUBMITTALS**

A. Product Data: For each type of product indicated including physical data and electrical performance.

B. Shop Drawings: Show installation details for occupancy, light-level sensors, and room controller systems.

1. Lighting plan showing location, orientation, and coverage area of each sensor.

2. Lighting plan showing location of each room controller, sensor, wall station, and other system components.

3. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:

1. Description of operation and servicing procedures.

2. List of major components.

3. Recommended spare parts.

4. Programming instructions and system operation procedures.

1.06 **QUALITY ASSURANCE**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.07 **COORDINATION**

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate interface of lighting control devices with temperature controls specified in Division 23.

1.08 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver products to the site under provisions of Division 26 Section “Electrical General Requirements”.

B. Store and protect products under provisions of Division 26 Section “Electrical General Requirements”.

PART 2 PRODUCTS

2.01 **GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS**

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.02 **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.
10. Provide all control units and relays required to interface with occupancy sensors as required.

C. Indoor Photoelectric Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.
    a. Control units shall be provided as required to power indoor photoelectric sensor, control lighting loads and provide a minimum of one auxiliary contact.
    b. Sensor control units shall mount external to 4” sq junction box in the ceiling space. Wiring between control unit and photoelectric switch shall be plenum rated.
    c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.
    d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.
    e. It is acceptable to provide controls and auxiliary contacts as required integral to the sensor, provided all required contacts are provided.
    f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.04 **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. Wattstopper PW-100.
   b. Hubbell Building Automation SOM 101.
   c. Greengate OSW-P-MV or ONW-P-MV.
   d. Sensorswitch WSD.
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.
3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
   a. Manufacturers:
      1) Wattstopper PW-200.
      2) Hubbell Building Automation SOM-102.
      3) Greengate OSW-P-DMV or ONW-P-DMV.
      4) Sensorswitch WSD-2P.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
   a. Wattstopper DT 300
   b. Hubbell Building Automation “OMNI-DT” Series.
   c. Greengate OAC-DT.
   d. Sensorswitch CM-PDT-R.
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. Wattstopper DT-200

b. Hubbell Building Automation “LO-DT” Series.

c. Greengate OAWC-DT-120.

d. Sensorswitch WV-PDT-R/WV-BR.

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. Wattstopper “WT” Series.

b. Hubbell Building Automation “OMNI-US” Series.

c. Greengate OAC-U.

d. Sensorswitch CM MPT-10.

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. Wattstopper CI-200.

b. Hubbell Building Automation OMNI-IR.

c. Greengate OAC-P.

d. 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 LOW VOLTAGE KEY SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Lighting Solutions
2. Acuity
3. Lutron
4. Hubbell
5. Crestron Controls

B. Low Voltage Digital Key Switch:
1. Low voltage momentary key switch; available in white, ivory, grey and black; compatible with wall plates with decorator opening. Key stations shall include the following features:
a. RJ-45 ports for connection to the power relay pack.

b. Low voltage digital key switch shall be delivered with pre-defined functions including, on, off. No additional configuration shall required to provide a fully functional system. Systems that require configuration out of the box shall not be acceptable.

2. Provide compatible power relay pack.

2.06 **ROOM CONTROLLER SYSTEM**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Lighting Solutions
2. Acuity
3. Lutron
4. Hubbell
5. Crestron Controls

B. General

1. System shall be fully functional out-of-the-box to the connected devices in the space without commissioning or the use of any tools. System shall not require a dedicated PC or a dedicated cloud connection.
2. Factory virtual support shall be available at no cost to the owner. Factory assistance shall consist of solving programming or application questions concerning the control equipment.
3. Coordinate sensor locations, coverages and required quantities with manufacturer's recommendations. Provide all sensors and components as required to achieve complete coverage and functionality of the space indicated.
4. Provide system with functionality to override the "ON" function in the event of sensor, controller, or component failure.
5. System shall have an isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options.
6. System components shall connect together using CAT 5e cables with RJ45 connectors, which provide both data and power to room devices, to form the local network. Features of the Room Controller local network include:
   a. Default functionality of occupancy sensors, wallstations, daylight sensors, receptacle controls, BMS status output and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
   b. Replacement of any device in the network with a standard off the shelf unit without requiring commissioning, configuration or setup.
7. Room 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).

C. Room Controller:

1. Room 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. NEMA 1 metallic enclosure that includes normal power line voltage section, emergency power line voltage section, and low voltage section Including knockouts for direct conduit connection.
3. Voltage rating of 120/277 VAC, 60 Hz.
4. Minimum of six low voltage connections using standard CAT 5e cables and RJ45 connectors for local network connections of wallstations, sensors, lighting controls, and receptacle controls.
5. On/Off/Dimming Room Controllers shall include three relay, switching zone configuration or three relay, three 0-10V dimming zone configuration as indicated on drawings.
6. Provide UL 924 listed emergency lighting relay where indicated on drawings.

D. Daylight Sensor:

1. An internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
2. Three light level ranges: Low (3-300 Lux), High (30-3000 Lux), And Direct Sun (300-30000 Lux).
3. Capability of controlling up to three daylight zones.
4. Infrared (IR) transceiver for daylight sensor range and daylight zone gain adjustments via handheld remote programmer.
5. RJ45 Port for Connection to Room Controller Local Network.
6. Adjustable sensor with mounting bracket to accommodate multiple mounting methods and building materials. The daylight sensor may be mounted on a ceiling tile, skylights, wall, lighting fixture, or backbox.
7. Device automatically establishes dimming set-points upon power up without any programming. Optional calibration using the wireless IR handheld programmer.

E. Occupancy Sensor:

1. Shall incorporate non-volatile power failure memory. Should power be interrupted and subsequently restore, settings and parameters saved in protected memory shall not be lost.
2. Designed and tested to withstand discharges of 154,000 volts per IEC 801-2 without impairment of performance.
3. Products tested to NEMA WD7-2011 Occupancy Motion Sensors Standards.
4. Sensor shall have time delays from 10 to 30 minute and shall automatically adjust time delay and sensitivity settings.
5. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation. LED’s shall indicate PIR detection and Ultrasonic detection.
6. All sensors shall have readily accessible, user adjustable setting for time delay and sensitivity. Setting shall be located on the sensor and shall be recessed to limit tampering.
7. All sensors shall be Class 2 devices and shall be provided with all necessary mounting hardware and instructions.
8. Two RJ45 Ports for Connection to Room Controller Local Network.

9. Device calibration and features:
    a. Sensitivity - 0-100% in 10% increments.
    b. Time delay - 1-30, self-adjusts to 10 min based on room occupancy.
    c. Test mode - Fifteen second time delay.
    d. Detection technology - PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    e. Walk-through mode.
    f. Ultrasonic and Dual Technology Sensors utilize two independent sensor detection circuits simultaneously to ensure optimum performance, regardless of location or proximity to walls and structures.
    g. Ultrasonic and Dual Technology Sensors utilize Variable Drive Circuitry (VDC) in cases of over saturation from misapplication, which automatically adjusts the volumetric output without reducing detection capability. Systems that reduce detection coverage area shall not be acceptable.
    h. Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency, continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
    i. All load parameters including Automatic On/Manual On, blink warning and daylight enable/disable when daylight sensors are pre-defined with the Room Controller local network.
10. Manual override of controlled loads.

F. Digital Wallstations:
1. Low voltage momentary pushbutton switches in 2, 3, 4, 5 and 6 button configuration; available in white, ivory, grey and black; compatible with wall plates with decorator opening. Wallstations shall include the following features:
    a. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
    b. Intuitive button labeling to match application and load controls.
    c. Pre-defined digital button configurations. Each wallstation to be shipped with pre-defined digital button configurations which are automatically sensed by the connected Room Controller and mapped to specific load controls for immediate out of the box functionality.
2. Two RJ-45 ports for connection to the Room Controller local network.
3. Room Controller digital wallstations shall be delivered with pre-defined functions including, on, off raise, lower, manual and scene control. No additional configuration shall required to provide a fully functional system. Systems that require configuration or load binding and do not deliver maximum energy savings out of the box shall not be acceptable.
4. Wallstations scene control shall be adjustable through a simple interface or handheld control for flexibility of lighting scenes. This personal remote shall allow individual zone control, scene control and scene setting capabilities.
5. Optional custom labeling shall be provided as indicated on the drawings.

G. Handheld Remote Controls:
1. Battery-operated handheld for system and sensor configuration. Remote controls shall include the following features:

a. Two-way infrared (IR) transceiver for line of sight up to 30 feet.

b. Three intuitive daylight sensor range pushbuttons.

c. LED confirms button press.

d. Inactivity timeout to save battery life.

H. Emergency Lighting:

1. Where indicated, provide Room Controller with emergency relay. Upon loss of normal power the UL 924 output will force the emergency lighting On and to full brightness (if dimming) until normal power is restored. Features Include:

a. 120/277VAC, 50/60 Hz, 3 amp driver rating.

b. Push the "All Off' button on any wallstation four times, will turn off normal lighting and force UL 924 emergency output On and full bright.

c. Auxiliary input for remote Alert Mode (All On, and full bright).

PART 3 EXECUTION

3.01 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.

3.02 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.

3.03 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.

3.04 ROOM CONTROLLER INSTALLATION, SERVICE AND COMMISSIONING

A. The control system shall be installed and fully wired as shown on the drawings, shop drawings, and manufacturer’s instructions by the installing contractor. The contractor shall complete all electrical connections to all control circuits.

B. Upon completion of the installation, the system shall be started up and programmed by the manufacturer's factory authorized representative who will verify a complete fully functional system.

C. Adjust sensors and test that complete minor motion coverage is obtained. Provide written confirmation of testing to owner, architect and engineer.

D. Provide written or computer-generated documentation on the system start-up and programming of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.).
3. Load parameters (e.g. blink warning, etc.).

E. The electrical contractor shall provide both the manufacturer and the electrical engineer with twenty one working days written notice of the system startup and programming date.

F. System Commissioning:

1. Facilitate the functional testing and verification of the lighting control system by an independent, third party commissioning agent. In compliance with ASHRAE 90.1-2013.
2. Perform commissioning in the presence of the Owner’s representative.
3. Submit functional test plan checklist signed by the commissioning agent.

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 0999 - ELECTRICAL TESTING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”
2. Division 26 Section “Conductors and Cables.”
3. Division 26 Section “Grounding and Bonding.”
4. Division 26 Section “Central Battery Inverters.”
5. Division 26 Section “Enclosed Switches.”
6. Division 26 Section “Enclosed Controllers.”
7. Division 26 Section “Panelboards.”
8. Division 26 Section “Dry Type Transformers (600V and Less).”
9. Division 26 Section “Fuses.”
10. Division 26 Section “Functional Performance Testing for Power and Lighting.”

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 Contractor shall submit proof of the above qualifications with bid proposal.

F. The terms test agency, test contractor, testing laboratory, test organization, or contractor test company, shall be construed to mean the testing firm.

G. Acceptable Testing Firms:

1. Potomac Testing; Phone (248) 689-8980.
2. Utilities Instrumentation Services; Phone (734) 424-1200.
3. High Voltage Maintenance Corporation; Phone (248) 305-5596.
4. Powertech Services, Inc.; Phone (810) 720-2280.
5. Power Plus Engineering, Inc.; Phone (800) 765-3120.
6. Premier Power Maintenance, Inc.; (517) 230-6629

1.05 **PERFORMANCE REQUIREMENTS**

A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.

B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.

C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.

D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.

E. The testing firm shall maintain a written record of all tests and shall assemble and certify a final test report.

F. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
    a. Occupational Safety and Health Act.
    b. Accident Prevention Manual for Industrial Operations, National Safety Council.
    c. Applicable state and local safety operating procedures.
    d. NETA Safety/Accident Prevention Program.
    e. Owner's safety practices.
    f. National Fire Protection Association - NFPA 70E.
    g. American National Standards for Personnel Protection.
2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.
3. The testing firm shall have a designated safety representative on the project to supervise operations with respect to safety.

1.06 **TEST INSTRUMENT CALIBRATION**

A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.
2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.
3. Instruments shall be calibrated in accordance with the following frequency schedule:
    a. Field instruments: Analog - 6 months maximum Digital - 12 months maximum
    b. Laboratory instruments: 12 months
    c. Leased specialty equipment: 12 months (Where accuracy is guaranteed by Lessor)
4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

B. Field Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
    a. Maintained in good visual and mechanical condition.

b. Maintained in safe, operating condition.

C. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.

2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.

3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.

4. Accuracy of metering in test equipment shall be appropriate for the test being performed.

5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.

1.07 **TEST REPORTS**

A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:

1. A list of visual and mechanical inspections required by Division 26 Specification Sections in a checklist or similar format.

2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.

3. Summary and interpretation of test results detailing problems located and recommended corrective measures.

4. Record of infrared scan and photos showing potential problem locations.

5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.01 **THERMOGRAPHIC SURVEY**

A. Visual and Mechanical Inspection

1. Remove all necessary covers prior to scanning.

2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned

1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.

C. Provide report indicating the following:

1. Problem area (location of "hot spot").

2. Temperature rise between "hot spot" and normal or reference area.

3. Cause of heat rise.

4. Phase unbalance, if present.
5. Areas scanned.

D. Test Parameters

1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

E. Test Results

1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
    a. Temperature gradients of 37°F to 44.6°F indicate possible deficiency and warrant investigation.
    b. Temperature gradients of 44.6°F to 59°F indicate deficiency; repair as time permits.
    c. Temperature gradients of 61°F and above indicate major deficiency; repair immediately.

END OF SECTION

SECTION 26 2200 - DRY-TYPE TRANSFORMERS (600 V AND LESS)

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 750 kVA:

1. Distribution transformers.
2. Isolation transformers.
3. 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: Copper or 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 SHEILDED ISOLATION TRANSFORMERS

A. Description: Factory-assembled and –tested, air cooled, dry-type, shielded isolation transformer rated for 60 Hz operation. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. General: Comply with the requirements specified for Distribution Transformers.

C. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:
    a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
    b. Common-Mode Noise Attenuation: Minus 120 dBA minimum at 0.5 to 1.5 kHz; minus 65 dBA minimum at 1.5 to 100 kHz.
    c. Normal-Mode Noise Attenuation: Minus 52 dBA minimum at 1.5 to 10 kHz.

2.05 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.

2.06 **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. Adjust buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report that records output voltages and tap settings.

END OF SECTION

SECTION 26 2416 - PANELBOARDS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. 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.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner's representative no fewer than seven days in advance of proposed interruption of electrical service.

2. Do not proceed with interruption of electrical service without written permission from Owner's representative.

1.09 **COORDINATION**

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

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. Rated for environmental conditions at installed location.

a. Outdoor Locations: NEMA 250, Type 3R.

b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

c. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2. 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.

3. Finishes:

a. Panels and Trim: galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

b. Back Boxes: same finish as panels and trim.

4. Directory Card: With transparent protective cover, mounted in metal frame, inside panelboard door.

B. Phase and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.

3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box as called out on panel schedules.

C. Conductor Connectors: Suitable for use with conductor material.

1. Main and Neutral Lugs: Mechanical type.

2. Ground Lugs and Bus Configured Terminators: Compression type.

D. 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 copper 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).

6. AFCI Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.

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. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."

5. Shunt Trip: 120-V trip coil energized from separate circuit.

6. Do not use tandem circuit breakers.

7. Provide lock on devices for circuit breakers when called out on panel schedules with “LOD” designation.

8. 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

9. Provide GFCI circuit breaker when called out on panel schedules with “GFCI” designation.
10. Provide Arc-Fault Circuit Interrupters where indicated on panel schedule with “AFCI” designation.
11. Provide shunt trip breakers when called out on panel schedules with “STB” designation.
12. Provide smart controllable circuit breakers when called out on panel schedules with “SMT” designation.
13. 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. Provide permanent provisions for padlocking all overcurrent devices in Distribution Panelboards. Provisions shall remain in place whether or not lock is installed.

B. 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles
2. Ground-fault circuit interrupter receptacles
3. Controlled 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 not controlled receptacle: Ivory, unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Normal Power System controlled receptacle: Gray, unless otherwise indicated or required by NFPA 70 or device listing.

3. Wiring Devices Connected to Emergency Power System: Red.

4. Wiring Devices Connected to Optional Standby Power System: Red.

5. Wall Switches: Ivory, unless otherwise indicated.

2.02 STANDARD GRADE RECEPTACLES

A. Duplex Receptacle, NEMA 5-20R:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. 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: 5362TR

b. Eaton/Arrow Hart Wiring Devices: AHTR5362

c. Leviton: 5362-SG

d. Legrand, Pass & Seymour: TR5362

C. 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 **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.

2.04 **CONTROLLED RECEPTACLES**

A. General:

1. Comply with NEC Article 406.3(E). Provide permanent markings of controlled symbol and the word “controlled”.

B. Controlled 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: HBL5362__TR
   b. Eaton/Arrow Hart Wiring Devices: Equal to Hubbell
   c. Leviton: Equal to Hubbell

d. Legrand, Pass & Seymour: Equal to Hubbell

C. Controlled 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 products by one of the following:

a. Hubbell Wiring Device-Kellems: GFRTR20C2

b. Eaton/Arrow Hart Wiring Devices: Equal to Hubbell

c. Leviton: Equal to Hubbell

d. Legrand, Pass & Seymour: Equal to Hubbell

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 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking type plug and receptacle body connector, NEMA WD 6, device configurations as indicated on drawings, heavy-duty grade.

B. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.

C. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.07 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.

2.08 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**:** 45 feet of 3 no. 12 SJO cord with strain relief.

D. Wiring device: Portable outlet box with liquidtight cord connector and one NEMA 5-20R duplex GFCI receptacle (controlled where indicated on the drawings), outlet box and flip-top cover attached to end of cable reel.

E. Electrical Connection: Provide 48 inch pigtail with NEMA 5-20P plug.

2.09 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 pilot light where indicated. Switch shall be illuminated when the switch is on.

G. Provide key type where indicated. Furnish four keys to Owner.

H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.

1. Switch: 20 A, 120/277-V ac.
2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.10 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. Smooth, high-impact thermoplastic, color to match wring device.
3. Material for Unfinished Spaces:
    a. Smooth, high-impact thermoplastic, color to match wiring device.
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

5. Material for Damp Locations: Gasketed Cast aluminum with hinged cover and listed and labeled as Weatherproof.
   a. Manufacturers:
      1) Red Dot Model CCGV, ABB Installation Products
      2) Eaton/Arrow Hart WLRD1
      3) Legrand, Pass & Seymour
      4) Intermatic: WP3110MXD

2.11 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.

2.12 POKE-THROUGH ASSEMBLIES

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 Poke-Through Assembly Schedule on Plan.
C. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
   1. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly; minimum 2-hour rating.
   2. Comply with UL514A scrub water exclusion requirement.
D. Compartments: Provide barrier separating power from telecommunications cabling.
E. 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 receptacles, 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 cover plates on receptacles in damp locations.

H. Install weatherproof While-In-Use cover plates on receptacles in wet locations.

I. Install tamper-resistant type receptacles in all locations as required by the NEC (406.12) and as indicated on plan.

J. Use oversized plates for outlets installed in masonry walls.

K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

L. Remove wall plates and protect devices and assemblies during painting.

M. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

N. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.02 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 26 Section "Electrical Identification" with black-filled lettering on face of wall plate, and durable wire markers or tags inside outlet boxes.

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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches, panelboards, switchboards, and controllers.

1.03 ACTION 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.

1.04 CLOSEOUT SUBMITTALS

A. 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.

1.05 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.

1.06 **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.

1.07 **COORDINATION**

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

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. 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 Bussmann, 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 T, fast acting.
2. Feeders: Class RK1, time delay.
3. Motor Branch Circuits: Class RK5, time delay.
4. Other Branch Circuits: Class RK1, time delay.

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.

3.03 **IDENTIFICATION**

A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section “Fuses”.
2. Division 26 Section “Hangers and Supports for Electrical Systems”.

1.02 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Non-fusible switches.
3. Molded-case circuit breakers.
4. Molded-case switches.
5. Enclosures.

1.03 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault circuit-interrupter for equipment protection.

D. GFLS: Ground-fault circuit-interrupter for life safety.

E. HD: Heavy duty.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.04 **REFERENCES**

A. NECA 1: Practices for Good Workmanship in Electrical Contracting.

B. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA 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.

J. UL 50: Enclosures for Electrical Equipment, Non-Environmental Considerations.

K. UL 50E: Enclosures for Electrical Equipment, Environmental Considerations

L. UL 98: Enclosed and Dead-Front Switches

M. UL 489: Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures

N. UL 1053: Standard For Ground-Fault Sensing and Relaying Equipment.

O. UL 1077: Supplementary Protectors for Use in Electrical Equipment

P. UL 508: Industrial Control Equipment

1.05 **ACTION SUBMITTALS**

A. Product Data:

1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

2. Enclosure types and details for types other than UL 50E, Type 1.

3. Current and voltage ratings.

4. Short-circuit current rating.

5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.

6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.06 **INFORMATIONAL SUBMITTALS**

A. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.07 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "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 **MAINTENANCE MATERIAL SUBMITTALS**

A. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

B. Fuse Pullers: Two for each size and type.

PART 2 PRODUCTS

2.01 **GENERAL REQUIREMENTS**

A. Source Limitations: Obtain products from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2.02 **FUSIBLE SWITCHES**

A. Manufacturers:

1. Eaton.
2. ABB.
3. Siemens Industries, Inc.
4. Square D by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Service-Rated Switches: Labeled for use as service equipment.

5. Hook stick Handle: Allows use of hook stick to operate handle.
6. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120 V(ac).
    a. Provide auxiliary contacts for fusible switches serving Elevators.
7. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.03 **NONFUSIBLE SWITCHES**

A. Manufacturers:
1. Eaton.
2. ABB.
3. Siemens Industries, Inc.
4. Square D by Schneider Electric.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Three Pole, Double Throw, 600 V(ac), 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating – 120VAC.
    a. Provide auxiliary contacts for motor disconnects served by variable frequency controllers.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.04 **MOLDED-CASE CIRCUIT BREAKERS**

A. Manufacturers:
1. Eaton.
2. ABB.
3. Siemens Industries, Inc.
4. Square D by Schneider Electric.

B. Circuit breakers must be constructed using glass-reinforced insulating material. Current carrying components must be completely isolated from handle and accessory mounting area.

C. Circuit breakers must have toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. Circuit-breaker handle must be over center, be trip free, and reside in tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon must be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with push-to-trip button, located on face of circuit breaker to mechanically operate circuit-breaker tripping mechanism for maintenance and testing purposes.

D. Maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings must be clearly marked on face of circuit breaker.

E. MCCBs must be equipped with device for locking in isolated position.

F. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.

G. Standard: Comply with UL 489 with required interrupting capacity for available fault currents.

H. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits.

1. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

I. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

J. Electronic Trip Circuit Breakers: Field-replaceable rating plug, RMS sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

K. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

L. GFLS Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6 mA trip).

M. GFEP Circuit Breakers: With Class B ground-fault protection (30 mA trip).

N. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Application Listing: Appropriate for application.
3. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
4. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key must be removable only when circuit breaker is in off position.

2.05 MOLDED-CASE SWITCHES

A. Manufacturers:

1. Eaton.
2. ABB.
3. Siemens Industries, Inc.
4. Square D by Schneider Electric.

B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

D. Features and Accessories:

1. Standard frame sizes and number of poles.

2. Lugs:
   a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
   b. Lugs must be suitable for 90 deg C rated wire, sized in accordance with 75 deg C temperature rating in NFPA 70.
3. Key Interlock Kit: Externally mounted to prohibit switch operation; key must be removable only when switch is in off position.

2.06 **ENCLOSURES**

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish:
1. Gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1)
2. Gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (UL 50E Types 3R, 12)
3. A brush finish on Type 304 stainless steel (UL 50E Type 4-4X stainless steel)

C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts.

D. Operating Mechanism:
1. Directly operable through front cover of enclosure (UL 50E Type 1).
2. Directly operable through dead front trim of enclosure (UL 50E Type 3R).
3. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.

2.07 **TOGGLE DISCONNECT SWITCH**

A. Manufacturers:
1. Double Pole:
   a. Hubbell 1372.
   b. Leviton 3032-2W.
   c. Pass & Seymour 7812.
   d. Bryant 30102.
2. Three Pole:
   a. Hubbell 1379.
   b. Leviton MS303-DSW.
   c. Pass & Seymour 7813.
   d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volts, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SELECTION OF ENCLOSURES

A. Indoor, Dry and Clean Locations: UL 50E, Type 1.

B. Outdoor Locations: UL 50E, Type 3R.

C. Kitchen and Wash-Down Areas: UL 50E, Type 4X, stainless steel.

D. Other Wet or Damp, Indoor Locations: UL 50E, Type 4.

E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.

3.03 INSTALLATION

A. Comply with manufacturer’s published instructions.

B. Special Techniques:

1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

3. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

4. Install fuses in fusible devices.

C. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

D. Anchor floor-mounted switches to concrete base.

E. Install NEMA KS 1 enclosed switch for motor loads ½ HP and larger and equipment loads greater than 30A.

F. Install toggle disconnect switch, surface mounted, for motor loads less than ½ HP and equipment loads 30A. and less.

G. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

H. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

I. Support enclosures independent of connecting conduit or raceway system.

J. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.04 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Electrical Identification.”

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.
3. Provide adhesive label on inside door of each switch indicating UL fuse class and size for replacement.

3.05 **FIELD QUALITY CONTROL**

A. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch and relay type and labeling verification.
   3. Verify rating of installed fuses.

B. Perform field quality control tests in accordance with Division 26 section “Electrical Testing”:

C. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
      g. Inspect bolted electrical connections for high resistance using one of the following methods:
         1) Use low-resistance ohmmeter.
            a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
            a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
      h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
      i. Verify correct phase barrier installation.
      j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
   2. Electrical Tests:
      a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
      b. Measure contact resistance across each switchblade fuse holder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."

D. Tests and Inspections for Molded-Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that unit is clean.

e. Operate circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the following methods:

1) Use low-resistance ohmmeter.

a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.

a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

h. Perform adjustments for final protective device settings in accordance with coordination study.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 M Ω.

e. Determine the following by primary current injection:

1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.

f. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.

g. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.

h. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Test and adjust controls, remote monitoring, and safeties.

E. Nonconforming Work:

1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

2. Remove and replace defective units and retest.

F. Collect, assemble, and submit test and inspection reports.

1. Test procedures used.

2. Include identification of each enclosed switch and circuit breaker tested and describe test results.

3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.06 **ADJUSTING**

A. Adjust moving parts and operable components to function smoothly and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges in accordance with study report specified in Division 26 Section “Overcurrent Device Coordination Study/Arc Flash Hazard Analysis”.

3.07 PROTECTION

A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.08 MAINTENANCE

A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.

1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

3.09 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.

3.10 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

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:

1. Across-the-line, manual and magnetic controllers.
2. Reduced-voltage controllers.

B. Related Sections include the following:

1. Division 26 Section "Electrical Power Monitoring and Control" for interfacing communication and metering requirements.
2. 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.
3. 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 **PROJECT CONDITIONS**

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Owner’s representative no fewer than seven days in advance of proposed interruption of electrical service.
2. Indicate method of providing temporary utilities.
3. Do not proceed with interruption of electrical service without written permission from Owner’s representative.

1.11 **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 size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. 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.

1.12 **EXTRA MATERIALS**

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. 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. Eaton .

3. Siemens

4. Square D by Schneider Electric

2.02 **ACROSS-THE-LINE ENCLOSED CONTROLLERS**

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, non-reversing, across the line, unless otherwise indicated.

1. Control Circuit: 120 V; obtained from integral control power transformer with sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

3. Adjustable Overload Relay: Dip switch selectable for motor running overload protection with NEMA ICS 2, Class 20 tripping characteristic, and selected to protect motor against voltage and current unbalance and single phasing. Provide relay with Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.

C. 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. Current-Sensing, Phase-Failure Relays for Bypass Controllers: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

I. 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: gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1). gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12). Brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel)

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. Conduit installation requirements are specified in other Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. 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. 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, except optional tests, stated in NETA ATS, "Motor Control - Motor Starters and Motor Control - Adjustable Speed Drive Systems." 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.

3.09 **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 "Closeout Procedures."

END OF SECTION

SECTION 26 3323 - CENTRAL BATTERY INVERTERS

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”

1.02 SUMMARY

A. This Section includes fast-transfer central battery inverters with the following features:

1. Output distribution section.
2. Internal maintenance bypass/isolation switch.
3. Remote monitoring provisions.

B. Related Sections:

1. Division 26 “Hangers and Supports for Electrical Systems” for concrete bases.

1.03 **DEFINITIONS**

A. LCD: Liquid-crystal display.

B. LED: Light-emitting diode.

C. UPS: Uninterruptible power supply.

1.04 **ACTION SUBMITTALS**

A. Product Data: For the following:

1. Electrical ratings, including the following:
   a. Capacity to provide power during failure of normal ac.
   b. Inverter voltage regulation and total harmonic distortion of output current.
   c. Rectifier data.
   d. Transfer time of transfer switch.
   e. Data for specified optional features.
2. Transfer switch.
3. Inverter.
4. Battery charger.
5. Batteries.
6. Battery monitoring.
7. Manufacturer’s anchorage and base recommendations.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.

1. Wiring Diagrams: Detail internal and interconnecting wiring; and power, signal, and control wiring.
2. Elevation and details of control and indication displays.
3. Output distribution section.

1.05 **INFORMATIONAL SUBMITTALS**

A. Source quality-control test reports.

B. Field quality-control test reports.

1.06 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For central battery inverter equipment to include in emergency, operation, and maintenance manuals specified in Division 1.

B. Warranties: Special warranties specified in this Section.

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.

B. Central Battery Inverter System: UL 924 listed.

C. Comply with NFPA 70 and NFPA 101.

1.08 **DELIVERY, STORAGE, AND HANDLING**

A. Deliver equipment in fully enclosed vehicles.

B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for nonoperating equipment.

1.09 **WARRANTY**

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace batteries that fail in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.

B. Warranty Period: Include the following warranty periods, from date of Substantial Completion.

1. Standard, Valve-Regulated, Recombinant, Lead-Calcium Batteries:

a. Full Warranty: One year.

b. Pro Rata: Nine years.

1.10 **COORDINATION**

A. Coordinate size and location of concrete 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.”

1.11 **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. Deliver extra materials to Owner.

1. Fuses: One for every 10 of each type and rating, but no fewer than 3 of each.

2. Cabinet Ventilation Filters: One complete set.

PART 2 PRODUCTS

2.01 **MANUFACTURERS**

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Myers Power Products, Inc. (Basis of design)

2. Chloride Systems.

3. Controlled Power Company.

4. Cooper Industries, Inc.; Sure-Lites Division.

5. Dual-Lite.

6. Lithonia Lighting; Emergency Lighting Systems.

7. Thomas & Betts Corporation; Emergi-Lite Corporation Division.

2.02 **INVERTER PERFORMANCE REQUIREMENTS**

A. Ratings: Provide rated KVA output, input voltage and output voltage as indicated on the drawings.

B. Fast-Transfer Central Battery Inverters: Automatically sense loss of normal ac supply and use a solid-state switch to transfer loads. Transfer in 0.004 second or less from normal supply to battery-inverter supply.

1. Operation: Unit supplies power to output circuits from a single, external, normal supply source. Unit automatically transfers load from normal source to internal battery/inverter source. Retransfer to normal is automatic when normal power is restored.

C. Maximum Acoustical Noise: 50 dB, "A" weighting, emanating from any component under any condition of normal operation, measured 39 inches from nearest surface of component enclosure.

2.03 **SERVICE CONDITIONS**

A. Environmental Conditions: Inverter system shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Ambient Temperature for Electronic Components: 32 to 98 deg F.
2. Relative Humidity: 0 to 95 percent, noncondensing.
3. Altitude: Sea level to 4000 feet.

2.04 **INVERTERS**

A. Description: Solid-state type, with the following operational features:

1. Automatically regulate output voltage to within plus or minus 5 percent.
2. Automatically regulate output frequency to within plus or minus 1 Hz, from no load to full load at unit power factor over the operating range of battery voltage.
3. Output Voltage Waveform of Unit: Sine wave with maximum 10 percent THD throughout battery operating-voltage range, from no load to full load.
    a. THD may not exceed 5 percent when serving a resistive load of 100 percent of unit rating.
4. Output power rating: Rated in kVA at unity power factor, and shall be able to supply the rated kW from .5 lagging to .5 leading.
5. Output Protection: Current-limiting and short-circuit protection.
6. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.

2.05 **BATTERY CHARGER**

A. Description: Solid-state, automatically maintaining batteries in fully charged condition when normal power is available. With LED indicators for "float" and "high-charge" modes.

2.06 **BATTERIES**

A. Description: Standard, valve-regulated, recombinant, lead-calcium batteries.

2.07 **ENCLOSURES**

A. NEMA 250, Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.

B. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment.

2.08 **CONTROL AND INDICATION**

A. Description: Group displays, indications, and basic system controls on common control panel on front of central battery inverter enclosure.

B. Minimum displays, indicating devices, and controls shall include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms shall include an audible signal and a visual display.

C. Indications: Labeled LED or Plain-language messages on a digital LCD or LED.

1. Quantitative Indications:
    a. Input voltage, each phase, line to line.
    b. Input current, each phase, line to line.
    c. System output voltage, each phase, line to line.
    d. System output current, each phase.
    e. System output frequency.
    f. DC bus voltage.
    g. Battery current and direction (charge/discharge).
    h. Elapsed time-discharging battery.
2. Basic Status Condition Indications:
    a. Normal operation.
    b. Load-on bypass.
    c. Load-on battery.
    d. Inverter off.
    e. Alarm condition exists.
3. Alarm Indications:
    a. Battery system alarm.
    b. Control power failure.
    c. Fan failure.
    d. Overload.
    e. Battery-charging control faulty.
    f. Input overvoltage or undervoltage.
    g. Approaching end of battery operation.
    h. Battery undervoltage shutdown.
    i. Inverter fuse blown.
    j. Inverter transformer overtemperature.
    k. Inverter overtemperature.
    l. Static bypass transfer switch overtemperature.
    m. Inverter power supply fault.
    n. Inverter output overvoltage or undervoltage.
    o. System overload shutdown.
    p. Inverter output contactor open.
    q. Inverter current limit.
4. Controls:
    a. Inverter on-off.
    b. Start.
    c. Battery test.
    d. Alarm silence/reset.

e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

1. Inverter on battery.
2. Inverter on-line.
3. Inverter load-on bypass.
4. Inverter in alarm condition.
5. Inverter off (maintenance bypass closed).

E. Include the following minimum array:

1. Ready, normal-power on light.
2. Charge light.
3. Inverter supply load light.
4. Battery voltmeter.
5. AC output voltmeter with an accuracy within 2 percent of full scale.
6. Load ammeter.
7. Test switch to simulate ac failure.

F. Enclosure: Steel, with hinged lockable doors, suitable for wall or floor mounting. Manufacturer's standard corrosion-resistant finish.

2.09 OPTIONAL FEATURES

A. Multiple Output Voltages: Supply unit branch circuits at different voltage levels if required. Transform voltages internally as required to produce indicated output voltages.

B. Maintenance Bypass/Isolation Switch: Switch is interlocked so it cannot be operated unless static bypass transfer switch is in bypass mode. Switch provides manual selection among the following three conditions without interrupting supply to the load during switching:

1. Full Isolation: Load is supplied, bypassing central battery inverter system. Normal ac input circuit, static bypass transfer switch, and central battery inverter load terminals are completely disconnected from external circuits.
2. Maintenance Bypass: Load is supplied, bypassing central battery inverter system. Central battery inverter ac supply terminals are energized to permit operational checking, but system load terminals are isolated from the load.
3. Normal: Normal central battery inverter ac supply terminals are energized and the load is supplied through either static bypass transfer switch and central battery inverter rectifier-charger and inverter, or battery and inverter.

2.10 OUTPUT DISTRIBUTION SECTION

A. Panelboard: Comply with Division 26 Section "Panelboards," except provide assembly integral to equipment cabinet.

2.11 SYSTEM MONITORING AND ALARMS

A. Provisions for Remote Computer Monitoring: Communication module in unit control panel provides capability for remote monitoring of status, parameters, and alarms specified in Part 2 "Control and Indication" Article. Remote computer and connecting signal wiring will be provided by Owner. Include the following features:

1. Connectors and network interface units or modems for data transmission via RS-232 link.

B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

1. Annunciation of Alarms: At inverter system control panel.

2.12 **SOURCE QUALITY CONTROL**

A. Factory test complete inverter system, including battery, before shipment. Include the following:

1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
2. Full-load test.
3. Transient-load response test.
4. Overload test.
5. Power failure test.

B. Observation of Test: Give 14 days' advance notice of tests and provide access for Owner's representative to observe tests at Owner's option.

C. Report test results. Include the following data:

1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
3. List of instruments and equipment used in factory tests.

PART 3 EXECUTION

3.01 **EXAMINATION**

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 **INSTALLATION**

A. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.03 **CONNECTION**

A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams, unless otherwise indicated.

B. Ground equipment according to Division 26 Section "Grounding and Bonding."

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 **IDENTIFICATION**

A. Identify equipment and components according to Division 26 Section “Electrical Identification.”

3.05 **FIELD QUALITY CONTROL**

A. After central battery inverters are installed and electrical circuitry has been energized, test for compliance with requirements.

B. Testing: Perform the following field quality control tests in accordance with Division 26 section “Electrical Testing” and according to manufacturer's written instructions and as listed below, to demonstrate condition and performance of each component of central battery inverter system:

1. Inspect interiors of enclosures for integrity of mechanical and electrical connections, component type and labeling verification, and ratings of installed components.
2. Test manual and automatic operational features and system protective and alarm functions.
3. Test communication of status and alarms to remote monitoring equipment.
4. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.18 and 7.22.2. Certify compliance with test parameters.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including electrical connections. Report results in writing.

D. Remove malfunctioning units, replace with new units, and retest as specified above.

E. Report results in writing.

3.06 **STARTUP SERVICE**

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that central battery inverter is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 26 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

3.07 **ADJUSTING AND CLEANING**

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Install new filters in each equipment cabinet within 14 days from date of Substantial Completion.

3.08 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery inverters. Refer to Division 1 Section "Closeout Procedures/Demonstration and Training."

END OF SECTION

SECTION 26 5119 - LED INTERIOR LIGHTING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Division 26 "Lighting Control Devices."

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lamp: LED and substrate as a replaceable assembly.

F. LED: Light-emitting diode.

G. Lumen: Measured output of lamp and luminaire, or both.

H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 **ACTION SUBMITTALS**

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.

1.05 **INFORMATIONAL SUBMITTALS.**

A. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Sample warranty.

1.06 **CLOSEOUT SUBMITTALS**

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.07 **MAINTENANCE MATERIAL SUBMITTALS**

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 5% attic stock of each type and rating installed. Furnish at least one of each type.

2. LED Drivers 5% attic stock of each type and rating installed. Furnish at least one of each type.

3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.

1.08 **QUALITY ASSURANCE**

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with:

1. NFPA 70 - National Electrical Code.
2. NECA/IESNA 500-1998 – Recommended Practice for Installing Indoor Commercial Lighting Systems.
3. NECA/IESNA 502-1999 – Recommended Practice for Installing Industrial Lighting Systems.
4. Code of Federal Regulations (47 CFR 37342).
5. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.

F. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.09 **DELIVERY, STORAGE, AND HANDLING**

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 **COORDINATION**

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.11 **WARRANTY**

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) or manufacturer’s standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 **LUMINAIRES (LIGHTING FIXTURES)**

A. Provide Luminaires as indicated on drawings.

2.02 **LUMINAIRE REQUIREMENTS**

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

D. Unless otherwise specified in Luminaire product data, provide products with a CCT of 50000 K.

E. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.

F. Driver

1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.

2. Nominal Input Voltage: All drivers shall be rated for use on either 120V or 277V systems.

2.03 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 LIGHTING UNITS

A. General: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.

2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.

2.05 EMERGENCY AUTOMATIC LOAD CONTROL RELAY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bodine BLCD Series.

2. Nine-24, Inc.: ELCR Series.

3. LVS, EPC Series

4. IOTA, ETS-20 Series

5. Functional Devices, Inc., ESR Series

6. ETC, ALCR Series

7. Wattstopper, ELCU series

B. Description:

1. The Automatic Load Control Relay (ALCR) shall provide required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area of the building.

2. The ALCR shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device.

3. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.

4. Self-contained with integral ½" nipple mount with snap in locking feature for mounting into a standard junction box knock out.
5. Normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
6. Universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
7. Integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
8. Dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
9. Separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
10. Normal power input leads shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
11. Automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
12. Utilize zero crossing circuitry to protect relay contacts from inrush current.
13. Plenum rated housing equipped with compression flying leads.
14. The unit shall be UL listed to the UL924 standard and labeled for connection to both normal and emergency lighting power sources.

C. Provide device with proper rating for total load and load type being transferred

D. Provide for devices suitable for line voltage and low voltage dimming control where required such that device bypasses dimming control signal to luminaire to provide full output upon loss of normal power.

E. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings for dimming characteristics.

2.06 BRANCH CIRCUIT EMERGENCY LIGHTING TRANSFER SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. LVS EPC-D-F-ATS Series
2. Bodine.

B. Description: Localized load transfer switch to allow emergency fixture to be powered and controlled by the normal lighting circuit, sense presence of normal power ahead of control circuit and switch luminaire (both line and neutral) over to emergency source upon loss of normal source.

C. Universal dimming capability to allow the lighting to be controlled and dimmed by the normal lighting circuit during normal times. In the event of a loss of the normal branch circuit, and transfer the designated emergency fixtures form normal dimming control to the emergency

power source and bring them to full brightness, regardless of the current state of the dimming system.

D. Device shall be mounted remotely for each control circuit as application requires.

E. Listed and labeled by an NRTL to the UL1008 for emergency operation and listed for field installation.

F. Integral test switch and indicating lamps to indicate status.

G. Provide device with proper rating for total load and load type being transferred

H. Coordinate with luminaire product data, lighting control schedules and details and diagrams included on the drawings.

2.07 **MATERIALS**

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

2. Glass: Annealed crystal glass unless otherwise indicated.

3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage, and coating.

c. CCT and CRI for all luminaires.

2.08 **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.

2.09 **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 and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

J. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

K. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
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 four-point 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 wire support for wiring at one point and tubing, rod or 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.
3. Adjust the aim of luminaires in the presence of the Architect.

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 9413 - FUNCTIONAL PERFORMANCE TESTING FOR POWER AND LIGHTING CONTROLS

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PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for Functional Performance Testing (FPT) of building systems and equipment to verify compliance with sequences of operation.

B. FPT applies to power and lighting systems covered by ASHRAE 90.1 version currently adopted by Michigan Energy Code, whether or not project commissioning is specified.

C. When commissioning is specified, FPT requirements in this Section are in addition to commissioning requirements in Division 01 Section "*Commissioning General Requirements"* and discipline-specific commissioning sections.

1.02 RELATED SECTIONS

A. 01 9113 – Commissioning General Requirements.

B. 26 0800 – Commissioning of Electrical.

C. Division 26 – Electrical.

D. Division 27- Communications

E. Division 28- Electronic Safety and Security

1.03 REFERENCES

A. ASHRAE 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings, version as currently adopted by Michigan Energy Code

B. International Energy Conservation Code (IECC), version as currently adopted by Michigan Energy Code.

1.04 DEFINITIONS

A. Commissioning Provider (CxP), also known as Commissioning Authority (CxA): an entity identified by the Owner who leads, plans, schedules, and coordinates the commissioning team to implement building *commissioning.*

B. Commissioning: a quality-focused process for enhancing the delivery of a project for verifying and documenting that the building and its systems, controls, and building envelope are planned,

designed, installed, tested, and include plans for operation and maintenance to meet specified requirements.

C. Deficiency: A system or equipment condition that fails to perform as required.

D. Functional Performance Testing (FPT): a systematic process to verify that controls and other elements of the building project are capable of and configured to operate or perform as required. Dynamic functions and operations of equipment and systems shall be demonstrated using manual (direct observation) or monitoring methods. The systems are run through all the control system's sequences of operation and components are verified to respond as the sequence states.

E. Sequence of Operation (SOO): Control logic and response conditions specified in Contract Documents for mechanical, electrical, and control systems.

F. Verification and Testing Provider (V&T provider): an entity who completes the activities needed to implement the building Verification and Functional Performance Testing (FPT) activities. V&T Providers shall not be individuals who performed the design or installation.

1.05 **SUBMITTALS**

A. Preconstruction Submittals

1. Proposed testing plan, including systems, methods, responsibilities, and schedule.

2. Sample test forms and checklists for Engineer review.

B. Functional Performance Testing Reports:

1. Project commissioning documents shall comply with ASHRE/IES Standard 202 or other generally accepted engineering standards acceptable to the building official

2. Contractor shall prepare a written report for each functional performance test performed. Reports shall be compiled into a single electronic package for submission at project closeout. Each report shall include, at minimum:

a. System Identification – Name and description of the system or equipment tested, including tag or ID number.

b. Test Information – Date of test, location, weather/operating conditions as applicable.

c. Participants – Names, titles, and firms of personnel performing and witnessing the test.

d. Reference Criteria – Sequence of operation, code requirement, or specification section being verified.

e. Test Procedure – Step-by-step description of how the test was conducted, including setpoints, inputs applied, and expected responses.

f. Results – Measured or observed data, presented in tabular or checklist format where practical.

g. Pass/Fail Outcome – Clear indication of whether each step met requirements.

h. Deficiencies – Description of failed steps, issues encountered, or incomplete functions.

i. Corrective Actions – Description of adjustments, repairs, or programming changes made, with date of resolution.

j. Retest Results – Documentation of retest where deficiencies were corrected.

C. Final Compilation: Submit all functional performance testing reports as follows:

1. Single indexed PDF file (searchable text).

2. Electronic file shall be organized by discipline and system, with table of contents.

3. Reports shall be provided prior to request for Substantial Completion.

1.06 **QUALITY ASSURANCE**

A. Installing contractors shall provide a qualified technician experienced with verification or FPT to perform the verification and testing (V&T) of the designated systems. V&T providers shall not be individuals who performed design or installation of the systems or assemblies being verified or tested.

B. The Engineer and/or Owner's Representative may request to witness FPT activities.

C. V&T providers shall review the construction documents to verify that the relevant sensor locations, devices, and control sequences are properly specified; performance and testing criteria are included; and equipment to be tested is accessible for testing and maintenance.

D. Functional testing shall not begin until system installation, start-up, and balancing are complete and approved.

1.07 **COORDINATION**

A. Coordinate FPT schedule with Engineer and Owner to allow witnessing (if requested).

B. Provide a minimum of 14 days' notice prior to each test.

C. If applicable, commissioning is specified in the following sections:

1. 01 9113 – Commissioning General Requirements

2. 26 0800 – Commissioning of Electrical

D. Management: The V&T Provider shall coordinate the V&T activities through the Construction Manager and reports to the owner, A/E, CM, and (if applicable) Commissioning Provider. All members shall work together to fulfill their contracted responsibilities and meet the objectives of the Contract Documents.

E. Scheduling: The V&T Provider with work with the CM to schedule the V&T activities within sufficient notice, and the CM will integrate all V&T activities into the overall project schedule. As construction progresses, more detailed schedules are developed. All parties will address scheduling problems and make necessary notifications in a timely manner in order to expedite the V&T process.

F. Manufacturers' Field Services: V&T Provider shall identify instances where manufacturers' field representatives are required, and the CM will coordinate their services.

PART 2 PRODUCTS

2.01 **INSTRUMENTATION**

A. Instrumentation shall be provided by the Contractor; provide all specialized tools, test equipment, and instruments required to execute verification and testing.

PART 3 EXECUTION

3.01 **PREPARATION**

A. Verify systems are complete and started prior to testing.

B. Verify that control systems are programmed, graphic interfaces are operational, and trending/logging functions are enabled.

3.02 **GENERAL TESTING REQUIREMENTS**

A. Where control sequences are referenced in this specification, refer to sequences of operation listed on contract documents.

B. Conduct FPT under normal and seasonal operating conditions as practical.

C. Document results in test forms, noting pass/fail status and corrective actions.

D. Correct deficiencies and retest until satisfactory performance is demonstrated.

3.03 **SYSTEM-SPECIFIC FUNCTIONAL TESTING**

A. Lighting Controls

1. Verify lighting control devices and control systems are calibrated, programmed and in proper working order according to the construction documents for the following (where applicable):

a. Occupancy sensors.

b. Automatic time switches.

c. Daylight controls.

B. Electrical Power and Distribution

1. Verify the control elements are configured and operating according to the construction documents for the following:

a. Automatic receptacle controls.

b. Electrical energy monitoring systems, including recording and reporting.

3.04 **ACCEPTANCE**

A. Submit completed FPT reports for each system.

B. Engineer and Owner will review and issue acceptance or request additional corrective action.

C. Successful completion of FPT is a condition of Substantial Completion.

END OF SECTION

SECTION 28 1000 – TECHNOLOGY OVERVIEW

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section provides a project overview and general project and Contractor requirements for technology work.

B. The “Contractor” as referred to in these specifications, shall be the bidder whose bid is eventually chosen as the winner.

C. The “Engineer” as referred to in these specifications, shall be Commtech Design and its representative on this project.

D. The “Owner” as referred to in these specifications, shall be Dexter Community Schools and its representatives.

E. In the detailed specifications and on the contract drawings, the phrases “or equivalent,” “approved equivalent,” “approved equal,” “or equal” and “engineer approved equivalent” shall be used interchangeably and shall mean the same thing.

F. All equals, equivalents, or alternates shall be approved by the Engineer prior to ordering or installation. Without approval, deviation from the products listed in the specifications and on the drawings, shall be presumed to be nonconforming and shall be removed and replaced at the direction of the Engineer and at the Contractor’s expense.

1.02 DESCRIPTION OF PROJECT

A. Cabling and communications infrastructure.

1. The communications portion of the project encompasses communications cabling and termination equipment. The work shall include but not be limited to:
    a. Communications room racks and cabinets.
    b. Communications Cabling and Termination Equipment:
    a. User UTP Plenum rated CAT-6 and CAT-6A cabling
    b. Fiber optic cabling and termination.
        1) Terminate and test each fiber strand. Terminate into panels at each end.
    c. Audio Paging Systems
2. All cables shall be labeled according to the drawings and the specifications.
3. All cables shall be terminated and tested as per the specifications.
4. Contractor shall provide personnel and equipment for full training and commissioning of the system.
2. All cables shall be supported by J-hooks or cable tray/ladder.
3. Label all cables
4. Test all cables.
5. The extent of the work shall be as shown on the drawing and detailed in these specifications

B. Audio and Video Systems

1. The audio and video systems in the building shall consist of but not be limited to:
    a. Classroom AV Systems
2. Test all AV systems
3. The extent of the work shall be as shown on the drawing and detailed in these specifications

C. Access Control System

1. Install an access control system in the building(s).
    a. Provide and install all equipment and software required.
    b. The existing system is a Lenel S2 System
    c. Expansion of this system shall include Mercury hardware for all new doors equipment.
2. Install all cabling required connect each door to the security panels

a. Security panels shall be located in each communications room. See drawings.
b. Wire from each power supply to the panels and to the devices at the doors

3. Configure the system as per the owner's requirements. Meet with them to determine configuration parameters
4. The extent of the work shall be as shown on the drawing and detailed in these specifications

D. Video Security System
1. The existing system is a Digital Watchdog video security system. It shall remain and be expanded as part of this project.
2. See drawings and specs for CAT-6/6A cable installation and who is responsible for installing cabling.
3. Provide and install all cameras at all locations noted
4. Provide and install servers and software for monitoring and recording all new security cameras plus any spare processing and space as detailed in the Security Recording specification.
5. Fully configure all software and hardware required for recording of camera images
6. Install viewing software on owner's computers and devices.
7. The extent of the work shall be as shown on the drawing and detailed in these specifications

E. Paging Systems
1. Provide and install new Paging system equipment at the locations noted.
2. The owner uses Informacast by Singlewire and that shall be the basis for expanded paging in all new and renovated spaces
3. Paging system shall be a combined Paging and Bell system that shall support the entire building or buildings as noted
4. Work shall include but not be limited to:
a. Expansion of Informacast software.
b. Interfaces of the paging system to other systems noted
c. New paging speakers
d. Audio line to IP devices
e. Analog speakers and amplifiers for hall and exterior areas.
f. System Configuration, Bell schedules and system training
g. Integrate to existing system at the building.
5. All cables shall be terminated and tested as per the specifications.
a. All cables shall be supported by J-hooks in the ceiling.
b. Label all cables
c. Test all cables.
6. Contractor shall provide personnel and equipment for full training and commissioning of the system.
7. The extent of the work shall be as shown on the drawing and detailed in these specifications.

F. Post installation documentation
1. Each contractor shall provide post installation documentation as per the specifications. Shall include but not be limited to:
a. Red-lined as-built drawings
b. As-built detailed connectivity and floorplan locations of cabling, AV, security Systems
c. As-built cable locations and cable labels at each location.
d. Mark all splice locations for any cabling.
e. Update of all access control locations and equipment at each door
f. Camera locations and camera numbers.
g. Spreadsheet (hard copy and Excel file) for all network, Wireless, telephones and cameras detailing:
1) Mfg. Part number
2) IP Address

3) MAC Address
4) Device number (Camera #, Telephone # etc)

1.03 STORAGE OF MATERIALS

A. All materials shall be secured when not in use by the Contractor.
B. It shall be the Contractor's responsibility to secure all equipment including all material to be installed as part of the contract. No changes shall be made to the contract due to loss or theft of equipment and materials not officially accepted by the Owner.

1.04 PERMITS

A. The State of Michigan requires that the Contractor apply for and obtain permits for data telecommunication installation.
B. This is required under State of Michigan Public Act 230. The inspector at the State of Michigan states that the code never exempted data telecommunications from permits and previous rules had overstepped their bounds. Only exemptions to the permit requirements are found in Public Act 230 MCL125.1528a.
    1. There is not a license required to apply for a permit per Public Act 407 MCL339.5737(3)(o).
C. The Permit is required under Public Act 230. The permit is under 2017 Michigan Electrical Code rules Part 8.
D. People who can obtain the permit include the Owner of the building or a company representing the owner. See Public Act 230 MCL125.1510.
    1. Contractor shall be required to apply for and obtain the permit
    2. Contractor shall be required to install the data telecommunications system to fully meet all code requirements and requirements of the Inspector and Authority Having Jurisdiction (AHJ)
E. State inspector has noted that the inspection process for data telecommunications is the same as any other inspection.
    1. Do not cover or conceal any wiring without approval.
    2. Electrical Inspectors will be conducting the inspections.
    3. Contractor shall be responsible for scheduling the inspections and attending the inspections with the inspector
F. State inspector has noted that the inspectors will be inspecting for code compliance including manufacture's installation instructions for the cables and terminations.
G. An installation may not pass inspection if there is any Non-compliance with the code.

1.05 REFERENCE SPECIFICATIONS-CABLING

A. All work applicable shall conform to the following standards:
B. ANSI/TIA-568-C.0, "*Generic Telecommunications* Cabling *for Customer Premises*",
C. ANSI/TIA-568-C.1, "*Commercial Building Telecommunications Cabling Standard*",
D. ANSI/TIA-568-C.2, "*Balanced Twisted-Pair Telecommunication Cabling and Components Standard*", ANSI/TIA-568-C.3, "*Optical Fiber Cabling Components Standard*",
E. ANSI/TIA-568-C.4, "*Broadband Coaxial Cabling and Components Standard*",
F. ANSI/TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
G. IA-606-B: Administration Standard for the Telecommunications Infrastructure of Commercial Buildings including all Updates and Addenda.
H. TIA-607-C: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
I. EIA-472 General Specification for Fiber Optic Cable
J. EIA-472A Sectional Specification for Fiber Optic Communication Cables for Outside Aerial
K. EIA-472B Sectional Specification for Fiber Optic Communication Cables for Underground and Buried Use
L. EIA-472C Sectional Specification for Fiber Optic Communication Cables for Indoor Use
M. EIA-472D Sectional Specification for Fiber Optic Communication Cables for Outside Telephone Plant Use

N. NEC, 2015, or latest edition available
O. IEEE 802.3af PoE • Ratified in 2003 • 15.4W at the PSE, with min of 12.95W available to the PD
P. IEEE 802.3at PoE+ • Ratified in 2009 • 34.2W at the PSE, with min of 25.5W available to the PD
Q. IEEE 802.3bt-2018 - IEEE Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 pairs

1.06 REERENCE STANDARDS NETWORKING
A. EE 802.3™: Ethernet
B. IEEE 802.11™: Wireless Lans
C. IEEE 802.22™: Wireless Regional Area Networks
D. TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant.
E. IEEE 802.3af PoE • Ratified in 2003 • 15.4W at the PSE, with min of 12.95W available to the PD
F. IEEE 802.3at PoE+ • Ratified in 2009 • 34.2W at the PSE, with min of 25.5W available to the PD
G. IEEE 802.3bt-2018 - IEEE Standard for Ethernet Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 pairs

1.07 CONTRACTOR-ALL
A. Each contractor shall be responsible for inspecting their own work and ensuring it meets the project requirements.
B. Contractor shall have a project manager who will be responsible for all work, workers, equipment, cabling and project management for their work. The project manager shall have the authority to make decisions for the contractor and schedule all workers.
C. Contractor shall attend all project meetings throughout the project.
D. All work on the project shall meet all applicable state, federal, local and industry codes and be installed according to the requirements of he Authority Having Jurisdiction (AHJ).
E. Contractor shall provide all equipment, man-lifts, ladders, transportation etc, required to install all specified cabling and equipment.

1.08 CONTRACTOR -CABLING
A. The Contractor shall have a BICSI certified Registered Communications Distribution Designer (RCDD) identified that will be responsible for all aspects of the installation. (This person does not have to be a direct employee of the bidder but must inspect the work to ensure that it is done based on standards)
    1. The resume of the RCDD, and a list of past projects the RCDD has worked on, shall be submitted with the submittal package. The Engineer reserves the right to reject the RCDD, and require the Contractor to assign another if the RCDD is found not to have sufficient experience in projects of relatively the same scope.
    2. If during the course of the work, the Contractor changes the RCDD assigned to the project, the Contractor shall provide the resume of the new RCDD and a list of projects of similar scope the new RCDD has worked on.
B. The Contractor shall show proof of an existing contractual relationship with the approved equipment manufacturer of the horizontal cabling system, and shall pass through the manufacturer's certification and warranty to purchaser.
C. All faceplates and termination hardware shall be sourced from the certifying manufacturer to assure quality control and validity of the manufacturer's warranty.
D. The Contractor shall accept complete responsibility for the installation, certification, and support of the cabling system. Contractor must show proof that he has the certifying manufacturer's support on all of these issues.
E. All work shall be performed and supervised by Telecommunications Technicians and Project Managers who are qualified to install voice, data, and image cabling systems, and to perform related tests as required by the manufacturer in accordance with the manufacturer's methods.

F. The Telecommunications Technicians employed shall be fully trained and qualified by the manufacturer on the installation and testing of the equipment to be installed. Evidence that the vendor is a current Certified Installer of the manufacturer must be provided in writing prior to work commencing on the structured cabling for the building.
G. The Contractor (including Subcontractor(s) if any) shall have a proven track record in cabling projects. This must be shown by the inclusion of details of at least 3 projects involving Category 6 or better cabling and optical fiber, which have been completed by the vendor in the last 2 years. Names, addresses, and phone numbers of references for the 3 projects shall be included.

1.09 CONTRACTOR –AUDIO/VIDEO
A. The Contractor shall accept complete responsibility for the installation, certification, and support of the system. Contractor shall show proof that they have the certifying manufacturer's support on all of these issues.
B. All work shall be performed and supervised by Audio/Video Technicians and Project Managers who are qualified to install audio/video systems and cabling and to perform related tests as required by the manufacturer in accordance with the manufacturer's methods.
C. The Audio/Video Technicians employed shall be fully trained and qualified by the manufacturer on the installation and testing of the equipment to be installed.
D. The vendor (including Subcontractor(s) if any) shall have a proven track record in audio/video system configuration and installation. This must be shown by the inclusion of details of at least 3 projects involving the installation of like sized audio/video systems that have been completed by the vendor in the last 2 years. Names, addresses, and phone numbers of references for the three projects shall be included.

1.10 CONTRACTOR –SECURITY
A. The Contractor shall show proof of an existing contractual relationship with the approved equipment manufacturer of the video security system and access control system and shall pass through the manufacturer's certification to purchaser.
B. All hardware shall be sourced from the certifying manufacturer to assure quality control and validity of the manufacturer's warranty.
C. The Contractor shall accept complete responsibility for the installation, certification, and support of the security system. Contractor must show proof that he has the certifying manufacturer's support on all of these issues.
D. All work shall be performed and supervised by security technicians and project managers who are qualified to install security systems, and to perform related tests as required by the manufacturer in accordance with the manufacturer's methods.
E. The security technicians employed shall be fully trained and qualified by the manufacturer on the installation and testing of the equipment to be installed. Evidence that the vendor is a current certified installer of the manufacturer must be provided in writing prior to work commencing on the video security system.
F. The Contractor (including Subcontractor(s) if any) shall have a proven track record in security projects. This must be shown by the inclusion of details of at least 3 projects similar in scope and requirements which have been completed by the vendor in the last 2 years. Names, addresses, and phone numbers of references for the 3 projects shall be included.

PART 2 - PRODUCTS

2.01 FIRESTOPPING
A. Each contractor shall be responsible for firestopping around their cables and the raceways.
B. Shall be completed inside and around all conduits after cable installation.
C. Firestop for the area between the cable and the edge of the conduit shall be Nelson No. FSP, CLK or LBS+. Contractor shall install the best firestop for each individual installation.

1. Firestop shall be installed with regard to local and national building codes.
2. The firestop shall be a putty like substance that expands under heat and will not allow flame to pass for a designated period of time.
3. Firestop shall conform to all NEC, NFPA, and UL requirements.
4. Some wall pass-thru' s are shown on the drawings. The Contractor shall utilize these where possible.
5. Where the contractor must install cables through a wall where there is no pass-thru already provided, the Contractor shall be responsible for installing a fire-rated pass-thru and fire-stopping the conduit after cable installation.

D. Firestopping is required at all riser conduits and all pass thru's.
1. Each cable tray penetration of a wall shall be firestopped after cable installation. Use pillow type firestop to allow additional cables to be installed in the future.
2. Where riser conduits pass through floors, the area between the concrete and the conduit shall be firestopped. This shall be completed with a putty or liquid firestop product. Fill in the space with mineral wool, and then install the firestop on top. All firestop shall be of sufficient thickness to secure the rating required by code.
3. After final cable installation, install a putty firestop around all cables where they enter and exit conduit pass thru's and conduit risers.
4. All firestop shall be installed to provide the fire rating as described by local fire code.
5. It shall be the responsibility of the Contractor to verify that all conduits, walls, and raceways required to be firestopped have been firestopped.

E. Contractor shall provide a label at each penetration and firestop location detailing the UL rated fireproofing solution that was used in the specific application.
1. Apply sticker to the wall near the firestopped conduit.
2. Provide a sample of the label to the designer for review as part of the submittals.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Contractor shall be familiar with the location(s) where the work will be done. No additional compensation will be made for items the Contractor claims he was not aware of during bidding.

B. Work Area:
1. All work areas shall be cleaned at the end of each day. All debris shall be cleaned and removed from the site and disposed of in the approved container for the site.
2. All equipment shall be moved out of common areas and stored in the Contractor's lay down area, or in other approved storage locations on site.
3. Any work that is low hanging, or may otherwise impede the general use of the space, and cannot be removed, shall be flagged and cordoned off by the Contractor.

C. All equipment and parts shall be installed in a neat and workmanlike manner. Good installation principles shall be used throughout the project.

D. All cables routed above the drop ceiling or in the ceiling area shall be installed square to the building. Diagonal cable runs are not permissible.

E. All cut edges of conduits, boxes, raceway, etc., shall be trimmed and filed so that no burrs or rough edges will damage cable as it is installed.

F. All surface raceways, including conduits in exposed areas shall be painted to match the existing colors of the surrounding area.

G. If, in the course of the work, the Contractor damages, marks, or misplaces any ceiling tiles, the Contractor shall repair, and/or replace the ceiling tile to the original condition.
1. The Engineer shall decide if ceiling tiles have been damaged. Based on the Contractors proposed fixes, the Engineer shall decide the best course of action to repair any damage done by the Contractor to the ceiling tiles.

H. It shall be the responsibility of the Contractor to repair any damage done to the structure or finishes in the building by the Contractor. The building shall be returned to its original condition prior to final sign off of the project.
I. Firestop shall be installed to meet national and local codes.

3.02 DOCUMENTS
A. The Contractor shall fully read the contract documents including the detailed specifications, and the detailed drawings.
B. No additional compensation shall be made for any portion of the project which the Contractor did not know of or understand prior to providing the bid response.
C. In the case of any discrepancies between the detailed drawings and the detailed specifications, the Contractor shall provide the higher quality or more stringent requirement.

3.03 WORK PLAN-POST BID (CHOSEN CONTRACTOR ONLY)
A. Along with the submittals the Contractor shall provide a work plan for the implementation of the system they are installing. The plan shall include scheduled dates for major milestones, and all phases required for completion prior to final cutover.
B. The work plan shall list all items that must be completed by the Contractor or Owner to provide a smooth install of the system. The Contractor shall be responsible for all costs associated with the planning and cutover. The Owners only responsibility is to act as a liaison between the Contractor and the users.
C. The work plans shall include a time-line and a cutover date for the systems within each building. Contractor shall be responsible for all aspects of scheduling the work, including notification of the users, the administration, and the telephone service provider.
D. The work shall commence within 10 days of award of the contract. The Contractor shall be responsible for attending weekly project meetings at the Owner’s site to report on progress and keep the project team informed of the work being done
E. The work plan will be reviewed at each project meeting for compliance and updates.
F. Work shall immediately begin on site surveys to determine the existing infrastructure, conduit and raceway placement and determining placement of new system equipment. The Contractor shall be responsible for moving, relocating, and reconnecting any and all existing equipment required for the installation of the new systems.
G. After work plan and system approval by the Engineer the Contractor can begin work on infrastructure work that does not impede users.
H. The Contractor shall be responsible for working with the Owner’s Information Technology staff and administrators.

END OF SECTION

SECTION 28 1100 – COMMUNICATIONS ROOM

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. Parts and equipment required for equipment in the communications room (Comm Room)

1.02 SYSTEM DESCRIPTION
- A. All equipment in the communications room shall be installed so that access is provided to all components, mechanical and electrical.
- B. All components of the communications room shall work together to form a cohesive and complete communications infrastructure.

1.03 COORDINATION
- A. Coordinate rack/cabinet work with the Electrical Contractor for placement of electrical connections.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved Equals for Racks and Cable Ladder Hardware:
  1. Hubbell.
  2. Ortronics
  3. Panduit.
  4. Great Lakes Case and Cabinet.
  5. Middle Atlantic.
  6. Hoffman

2.02 CABINETS -WALL MOUNTED
- A. Wall Mount Cabinet:
  1. The wall mount cabinets shall be black in color.
  2. Cabinets shall provide adjustable 19-inch rack mounting rails.
  3. Each cabinet shall have a center swingout feature that allows access to the front and back of equipment after it is installed in the cabinet.
  4. Knockouts for different size conduits shall be provided on the top and bottom of the cabinet.
  5. Swing side of the cabinet shall be reversible.
  6. Each cabinet shall be no less than 23.5 inches deep.
  7. 48” tall cabinet shall be Hoffman # EWMWG482425
  8. Each cabinet shall be provided with the following hardware:
     a. Plexiglas front door with lock.
     b. Fan assembly mounted in the top of the cabinet. Hoffman #EWMF2
     c. 6 position power strip with circuit breaker and surge suppressor.
        1) Hubbell #PH20A10S or equal.

2.03 CABLE LADDER
- A. Equip communication racks with cable ladder system for cable support and routing. Refer to Figure 28 110-A below.
  1. All cable ladders shall be custom cut to fit.
  2. Install cable ladder vertically behind each vertical organizer.
  3. Center the cable ladder on the vertical organizer so that when additional racks are added, the cable ladder can be used to serve both racks, and will not interfere with the components mounted in the rack.

B. Cable Ladder - Black and cut to length.
   1. 12” wide, 10’ long cable ladder with channels. Hubbell #hsls1012B or equal.
   2. Equip with the following as required for a full installation as per the details and specifications:
      a. Relay Rack Mounting Kit, Hubbell #HLMPK19 or equal
      b. Wall support angle bracket, Hubbell #HLTSB12B or equal
      c. Corner clamp for connecting horizontal ladder on the top to the cable ladder that attaches to the wall. Hubbell #HLTK or equal.
      d. Wall saddle for attaching horizontal cable ladder section to the wall. Equipped with “J” bolts. Hubbell #HLX0612 or equal
      e. Cable Radius Drop for dropping cables down to vertical cable ladder between and to the side of each rack, Hubbell #HLCD12 or equal
      f. Foot Kit for Cable ladder at back of rack, Hubbell #HLRF or equal
      g. Butt Splice Kit, Hubbell #HSBSK or equal
      h. Swivel Splice kit, Hubbell #HLSSK or equal
      i. When mounting cable ladder along the wall, install supports to the wall, Hubbell #HLVWBK or equal
      j. Attach all cable ladders to the rack with unistrut and unistruts “L” and “T” connectors.
      k. Approved equals, Newton and Hubbell.

2.04 COMMUNICATIONS ROOM EQUIPMENT

A. Patch Cord Organizers:
   1. Patch cords organizers shall be steel and shall allow routing of patch cables from electronics to the patch panels.
   2. Single rack unit organizer shall be Hubbell #HS13C with cover. Refer to PCO-1 on detailed drawings.
   3. Approved equals, Ortronics and Great Lakes Case and Cabinet.

B. Tie Wraps:
   1. Tie wraps shall be used on exterior cables only.
   2. Tie wraps should not be used above the drop ceiling or in cable tray. The pathway shall support the cables without the use of extra tie wraps.
   3. Tie wraps shall never be used to support cables from building structure, electrical conduits, or lighting systems.
   4. Panduit No. PLT2S-C or equal standard tie wrap. For use in general locations that are not plenum rated.
   5. Panduit No. PLT2S-C702 or equal plenum rated tie wrap. Use only this type of tie wrap in plenum rated areas.
   6. Panduit No. PLT2H-L00 or equal ultraviolet rated outside plant tie wrap. Use only this type of tie wrap for outside uses.

C. Hook and Loop Wraps:
   1. Hook and Loop wraps shall be used on the cable ladder of the rack systems to bundle the cables as they pass along the cable ladder. Cables shall be bundled in groups of no more than 24 cables.
   2. Hook and Loop wraps should not be used above the drop ceiling or in cable tray except in limited circumstances. The pathway shall support the cables without the use of extra tie wraps.
   3. Wraps shall never be used to support cables from building structure, electrical conduits, or lighting systems.
   4. Panduit HLT2I or equal.

D. Grounding and bonding of racks and cable ladder
   1. Bond each rack and all parts of the cable ladder as 1 ground system.
   2. Use Erico Eriflex woven copper grounding braids to attach racks and ladder.

3. Erico # 556700 or other lengths as required.

E. Rack Mounted shelf
1. Install shelves where equipment needs to be installed but is not rack mountable.
2. Identify equipment and depth of equipment and order shelf to match
3. Cantilevered shelves:
a. 1.75” tall rack mount shelf shall be Startech #Shelf-1U20-FIXED-V

F. Blank Panels
1. Where there is equipment that needs to be mounted in the rack and needs to be vertically mounted install a blank panel.
2. Blank Panels shall be steel, black in color, Hubbell #MCCBPXXX where XXX is the height of the blank panel.

2.05 WALLFIELD EQUIPMENT
A. Plywood for Wallfields:
1. Plywood shall be American Plywood Association (APA), Grade A-C at minimum. Meaning that the “A” side is smooth and paintable, neat repairs are permissible. “C” side allows knotholes to 1 inch and limited splits are permitted. “A” side is used for mounting; “C” side is installed towards the wall.
2. Plywood shall be 3/4-inch-thick and shall come in 4 foot x 8 foot sheets with a quantity of sheets installed as per the detailed drawings.
3. All plywood used for wallfields shall be fire-retardant plywood and shall be stamped as such.
a. Shall have a Flame-spread rating of 25 or less,
4. Each piece of plywood with one coat of white paint. Paint all edges.
a. Do not paint over one of the Fireproof stamps on the plywood. Leave this so that the owner can identify that the plywood installed is fire-retardant.

PART 3 - EXECUTION

3.01 EXAMINATION
A. Location of the communications infrastructure shall be finalized in the communications room prior to installation.
B. Locate all equipment to be installed, and make certain that space is available for maintenance and service during the life of the system.
C. If any changes from the drawings are required, the Contractor shall submit a proposed layout of the communications room to the Engineer for approval prior to installation.

3.02 PREPARATION
A. Clean floor prior to installation of the communications racks.
B. Coordinate with all other Contractors and ensure that the locations of all cable tray and conduits are correct and will feed the rack system adequately.

3.03 INSTALLATION OF WALL MOUNTED CABINETS
A. Cabinets mounted to the wall shall be securely attached.
1. Where the cabinets are to be mounted to a wall, the Contractor shall first install a piece of plywood to be used to mount the cabinet on. Secure the plywood to the wall then secure the cabinet to the plywood and wall where possible.
2. Review the facilities above a cabinet prior to installation. When possible, cabinets should not be installed below water pipes or other facilities in the ceiling.
3. Mount the cabinet so that the top of the cabinet is not more than 7 feet AFF.
4. Check to make sure that the cabinet will be able to fully open from both hinges after installation. Change mounting location to accommodate the opening.
5. Install support wheels to the cabinet to support the weight of the cabinet when it is closed.

3.04 INSTALLATION OF COMM ROOM EQUIPMENT
A. Patch cord organizers shall be installed between all patch panels and electronics.

1. Horizontal organizers shall be used for routing fiber and copper patch cords between patch panels and electronics.
2. Refer to Rack layouts on detailed drawings for quantity of organizers to provide.
3. Organizers shall be installed side by side where multiple racks are installed.
4. If changes in the rack layout are required, contact the Engineer and get changes approved prior to installation.

B. Tie wraps shall be used sparingly in the overall installation.
1. Tie wraps shall not be used in the cable tray or above the drop ceiling for support of cables. All cables shall utilize J-hooks, conduits, cable ladder, or cable tray for support in the ceiling area.
2. Tie wraps can be used to group cables on the cable ladder of the rack systems. Group cables in bundles of no more than 24 cables.
3. Trim all tie wraps so that the cut edge is smooth.

C. Hook and Loop shall be used sparingly in the overall installation.
1. Hook and Loop should not be used in the cable tray or above the drop ceiling for support of cables. All cables shall utilize J-hooks, conduits, cable ladder, or cable tray for support in the ceiling area.
2. Hook and Loop can be used to group cables on the cable ladder of the rack systems. Group cables in bundles of no more than 24 cables.

D. Power strips shall be installed so that they do not interfere with the cable routing, or the installation of components into the rack.
1. Modular plug for the outlet strip shall be installed at the bottom of the outlet strip.
2. The outlet strip shall plug into 1 of 2 duplex receptacles installed at the bottom of the rack. Refer to the detailed drawings for receptacle locations.
3. Coil any extra cord from the outlet strip and tie wrap it to the bottom of the vertical cable ladder.
4. Securely attach the outlet strips to the back edge of the vertical cable ladder.
5. Electrical outlets are installed by others. Communications Contractor shall be responsible for connecting power strip to the outlets.

E. Shelves and blank panels
1. Install in the rack where required and/or where shown on the drawings.

3.05 WALLFIELD EQUIPMENT

A. Paint plywood with prior to installation on the wall.
1. Plywood shall be installed from 12 inches AFF to 7 feet above the floor or as noted on the drawings.
2. Mount plywood to the wall with screws attached to studs in the wall. Contractor is responsible for securely mounting the plywood to the wall.
3. Grade “A” side of the plywood shall be used for mounting all communications components.
4. If the plywood will cover an electrical receptacle, the Contractor shall cut the plywood to allow access to the receptacle.

END OF SECTION

SECTION 28 1150 – COMMUNICATIONS GROUNDING

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. This section includes parts and equipment required for a communications grounding system installation.

1.02 SYSTEM DESCRIPTION
- A. The grounding system from the ground bar in each communications room to the electrical ground shall be installed by the Electrical Contractor.
  - 1. This shall include connection of the ground bar in each communications room to the electrical ground. Shall also include:
    - a. Connection of ground cables in the cable tray,
    - b. Ground connections to electrical panels,
    - c. Grounding of any riser conduits.
- B. Telecommunications grounding systems shall be connected to the electrical ground at the Main Distribution panel.

1.03 INSTALL BASED ON STANDARDS INCLUDING:
- A. NFPA 70-99,
- B. National Electrical Code (latest edition adopted by AHJ)
- C. TIA-607-C Generic Telecommunications Bonding and Grounding

1.04 COORDINATION
- A. Coordinate ground connections to ground bar with Electrical Engineer and Contractor.
- B. Coordinate the location of ground bars in the communications room with the Electrical Contractor prior to installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved equals for ground components are:
  - 1. Newton.
  - 2. Erico
  - 3. Hubbell

2.02 MATERIALS
- A. Ground Bar shall be Hubbell #HBBB14210A or equal
- B. Compression (crimp) type ground lugs for connection of ground cables shall be Burndy No. YCA series or equivalent.
  - 1. Use only manufacturer approved crimp tools with all crimp lugs.
- C. Ground wire shall be No. 6 AWG for all ground connections from the equipment to the ground bar. Ground wire in plenum areas shall be bare with no insulation. All other ground wires shall have green insulation.
  - 1. Approved ground cable vendors are Southwire, The Okonite Company, and Pirelli or equal.

PART 3 - EXECUTION

3.01 EXAMINATION
- A. Location of the ground bar shall be finalized in the communications room prior to installation.
- B. Locate and note all equipment to be connected to the ground system. Routes for ground cables shall be planned prior to final location of the ground bar.
- C. Identify location of racks, cabinets, and all electronic equipment. Connections from the ground bar to these are required for a complete ground system.

D. Connect the cable ladder to the ground bar in each communications room. Connect with a #6 AWG ground cable.

3.02 PREPARATION

A. Plan routes of all ground cables.
B. For components that are to be connected to the ground system, remove paint from the connecting point and attach to the ground cable with a star washer.
C. Ground cables shall be connected from the ground bar in each communications room with a No. 6 AWG ground cable. Items to be connected by the Communications contractor include, but are not limited to:
    1. Each individual rack and cabinet
    2. Cable ladder.
    3. Access Control Panels

3.03 INSTALLATION

A. Cabling Contractor shall Install the ground bar to the wallfield.
    1. Coordinate location with other systems.
    2. Work with Electrical contractor to have them connect the ground bar to the electrical service panel and building steel.
B. Ground connections shall meet all applicable codes, and shall be located such that they are accessible for maintenance.
    1. All grounding conductors shall be continuous without splice.
    2. Metal boxes, cabinets and fittings, or noncurrent carrying metal parts of other fixed equipment, if metallically connected to grounded cable armor or metal raceway, are considered to be grounded by such connection. If not connected, they shall be grounded in 1 of the following ways:
        a. By a grounding conductor run with circuit conductors, this conductor may be uninsulated. But if it is provided with an individual covering, the covering should be finished to show a green color.
        b. By a separate grounding conductor installed the same as grounding conductor for conduit and the like.
    3. Metal raceways, cable armor, cable sheath, enclosures, frames, fittings, and other metal noncurrent carrying parts that are to serve as grounding conductors shall be effectively bonded where necessary to assure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them.
        a. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings so designed as to make such removal unnecessary.
    4. Continuity of metal raceway or metallic sheathed cable shall be assured throughout the system.
    5. National electrical code shall be used as guide for grounding in hazardous areas.
C. Ground cables shall be installed in a neat and workmanlike manner.
    1. All cables shall be supported or routed against a wall and attached to the wall. No free-floating cables between components will be allowed.
    2. Fully support ground cable so that it does not sag between connections.
    3. There shall be no sharp bends in the ground cables.
D. Terminate and connect all ground cables with crimp type connectors.
    1. Use star washers on all connections of ground cables to ground bars and racks and equipment.
E. Ground systems shall be tested after installation to ensure proper installation and connectivity.
    1. Test procedures shall be fully spelled out. They shall minimally include, the time and date of the test, name of tester, device used to test ground potential, and test results.
    2. The Contractor shall provide test results, to the Engineer for final approval and sign off.

3. Ground connections shall be tested at each rack in each communications room. The system shall not be considered complete until the ground tests have been completed and acceptable results are provided.

END OF SECTION

SECTION 28 1500 – FIBER CABLING

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. This section includes parts and equipment required for installation, termination and testing of a fiber optic cable backbone.

1.02 SYSTEM DESCRIPTION
- A. The fiber optic backbone shall include all components of the system from the patch panels to the backbone fiber and everything in between.

1.03 CONTRACTOR
- A. Contractor company shall have a minimum of 3 years' experience installing and testing fiber optic cabling systems.
  1. Unless otherwise specified, multimode and single mode fiber cable must meet the transmission performance parameters as specified in ANSI/TIA/EIA-568-B.3.
  2. Test equipment used under this contract shall be from manufacturers that have a minimum of 5 years' experience in producing field test equipment. Manufacturers must be ISO 9001 certified.
  3. Test equipment shall be capable of measuring relative or absolute optical power in accordance with TIA/EIA-526-14A, "Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant," and TIA/EIA-526-7 Method A, "Measurement of Optical Power Loss of Installed Single Mode Fiber Cable Plant, Insertion Loss Using An Optical Power Meter."
  4. Traces and records shall be provided to the Engineer and Owner in hard (paper) and soft (disk) copy.

1.04 COORDINATION
- A. Coordinate work under provisions in Division 1 of these specifications.
- B. All fiber cables shall be coordinated with the installation of the telecommunications raceways.
- C. Coordinate location of the spare coiled fiber cables with Engineer prior to installation.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved vendors for fiber cable are:
  1. Optical Cable Corporation.
  2. General Cable.
  3. Berk-Tek.
  4. Corning
  5. Hubbell
- B. Approved vendors for fiber termination equipment are:
  1. Hubbell.
  2. Panduit.
  3. Optical Cable Corporation
  4. Corning

2.02 FIBER CABLE
- A. All fiber cables shall be of tight buffered construction. A tight buffered optical fiber shall consist of a central glass optical fiber surrounded by a primary polymer buffer and an optional tight fitting secondary buffer.
  1. The outer jacket of each fiber strand shall be colored according to the fiber color code in TIA 598-B.

2. Individual multimode fiber strands shall be 50/125μm for the core/cladding measurements.
3. Individual singlemode fiber strands shall be 9/125μm for the core/cladding measurements.
4. All fiber strands shall be surrounded by synthetic yarn for added strength and crush resistance.
5. All fiber installed in plenum rated areas shall be UL listed OFNP.
6. The outer jacket of the cable shall be surface printed with the manufacturer's identification and required UL markings.
7. All fibers shall be subjected to a minimum fireproof stress of 0.7 GPa (100 kpsi).
8. The minimum bend radius of the cable under full rated tensile load shall be no larger than 15 times the outside diameter of the cable and no more than 10 times the outside diameter of the cable with no load on the cable.
9. Optical and mechanical performance shall not be degraded and the cable shall not be damaged in any way by immersion in ground water.
10. The fiber optic cable shall meet or exceed the requirements of this specification when measured in accordance with the methods of the individual requirements or the following methods as defined in EIA-STD-RS-455.
    a. Fiber dimensions.
    b. Attenuation.
    c. Bandwidth.
    d. Numerical aperture.
    e. Fiber proof test.
    f. Cable bending.
    g. Tensile load
    h. Impact resistance.
    i. Crush resistance.
    j. Attenuation vs. temperature.
11. Manufacturer shall provide ISO 9001 certification.
12. The cable shall withstand an impact force 1500 times per ANSI/TIA/EIA-RS-455 (FOTP-25A).
13. The cable shall withstand compression load of 1800 N/cm per ANSI/TIA/EIA-RS-455 (FOTP-41A).
14. Fiber shall be indoor/outdoor rated based on the areas in which the fibers will be installed. Do not install riser rated fiber through a plenum rated area unless the fiber is inside an EMT conduit.

B. Indoor or outdoor Armored fiber cable.
1. The multi-fiber sub-cables shall consist of tight buffered optical fibers surrounded by a synthetic yarn strength member and a color-coded flame-retardant elastomeric polymer jacket. The strength member shall be composed of individually and precisely tensioned elements such that tensile loads are equally shared by each element.
2. Cable shall be inside of Aluminum Interlocking Armor
3. Single-mode indoor/outdoor fiber cable
    a. Wavelength: 1310/1550nm
    b. Industry Standard: ITU-T G.652.D
    c. 1 Gigabit Ethernet Distance: 5 km
    d. 10 Gigabit Ethernet Distance: 10 km
    e. Max Attenuation: .5/.5 dB/km
    f. Plenum Rated Armored
        A) 12-strand Singlemode, OCC # DZ012TSLA9YPI8

2.03 RACK MOUNT FIBER PATCH PANELS

A. 12-36 port, rack mount fiber patch panels.
1. Rack mount fiber patch panels shall be modular in design. Mounting brackets shall be provided for 12 pack adapters. Adapter packs shall sit horizontally in the panel.

2. Panels shall mount into standard 19-inch relay racks.
3. Panels shall be no more than 1-3/4 inch or 1 rack unit high.
4. Provide splice tray and splice shelf or splice cassettes for termination of all fiber strands.
5. Fiber panel shall be Hubbell #FPR3SP or equal
   a. Equip with Splice trays as required. Hubbell #Stray12F or Stray24F
   b. Equip with Label Kit, Hubbell #LBLKTFCR1U12
6. Provide Hubbell Fiber Splice cassettes or pigtails and panels for splicing and termination of all fiber strands. See Below:

2.04 FIBER PIGTAIL SPLICE CONNECTORS

A. All fiber cables shall be terminated with spliced pigtails matching the fiber cable that was installed.

B. LC Style Connectors pigtails
   1. Singlemode connectors shall be LC style.
   2. Provide 1-meter, pre-connectorized pigtails for fusion splicing to each fiber strand.
   3. Singlemode Pigtails shall be Yellow in color
   4. All spicing shall be Fusion splicing. Mechanical splicing is not allowed.
   5. Match the size of the glass in the pigtail to the size of the glass in the fiber.
   6. Work with fiber cable manufacturer on specifying pigtails that exactly match the fiber cable being terminated.
   7. Singlemode LC terminated single strand, fiber pigtails shall be Hubbell #FHPBKR12LC6S or equal.

2.05 FIBER PATCH PANEL ACCESSORIES

A. Fiber stowage ring
   1. Install a ring on the wall near the racks for stowage of 30’ of spare fiber or as noted on the drawings.
   2. Fiber stowage ring shall be Leviton # 48900-OFR.
   3. Label the fiber at the stowage ring with both termination points. Install label Panduit PST-FO or equal

2.06 SPLICE CASE

A. Underground Splice Case
   1. Spice case shall be sized to meet the splicing requirements shown on the drawings
   2. Case shall be manufactured as waterproof and approved for use in handholes or direct buried or aerial installations.
   3. Provide Butt splice case with space for no less than three cables.
   4. All splices shall be fusion splices
   5. Provide the quantity of splice trays as required for splicing of all strands.
   6. Splice case shall be Optical Cable Corporation Fibreguard or equal. Equip with:
      a. Plugs for unused openings
      b. Mounting equipment for mounting to side of handhole
      c. Splice trays
      d. Fusion splices
      e. Case shall be OCC Fiber # FG5-1S OR FG6-1S OR FG8-1S or equal. Size as required for the quantity and type of fiber optic cables.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all pathways prior to installation of fiber cable.

B. Identify location of racks, and position of fiber patch panels prior to fiber installation.

C. Inspect fiber cable prior to installation for damage during shipping. The Contractor shall be responsible for all damaged or nonfunctional fiber cables. If any strands of a fiber cable are

not working, the Engineer has the right to order the complete replacement of the entire fiber cable.

3.02 PREPARATION

A. Contractor shall designate the location of the spare coil of fiber at each end of the run prior to installation.

3.03 INSTALLATION

A. Installation of fiber cable shall be by a trained installer.
   1. All fiber, if not installed inside cable tray, shall be attached to the building structure with conduit clamps or supports a minimum of every 5 feet.
   2. Fiber shall be continuous from end to end, no splices are allowed unless specifically noted.
   3. At each termination point of the fiber, the Contractor shall provide a service coil consisting of a minimum of 30 feet of fiber cable.
   4. Contractor shall adhere to all manufacturer's recommended pull tensions during installation.
   5. As part of the as-built drawings, provide the actual footage of each fiber cable installed. Mark this on the drawings.
   6. Any fiber strands that do not pass a sufficient signal light signal will be identified as noncompliant, and the Engineer has the right to order the complete replacement of the fiber cable by the Contractor.
   7. Where fiber cable passes vertically through a building, the fiber cable shall be supported against the wall or from the ceiling a minimum of every 5 feet.
   8. Do not exceed recommended bend radius of fiber cable during or after installation.

B. Fiber patch panels shall be located at the top of the relay rack or cabinet at which they are installed. Install on wall or inside cabinet where shown for wall mounted fiber panels.
   1. Provide patch panels as described on the contract drawings or additional panels as required to terminate all fiber strands of all fiber cables.
   2. Install fiber panels in the top of the rack where possible
   3. If a splice shelf is required for splicing of fibers, install the shelf directly below the associated patch panel.
      a. Provide and install splice panels as required for splicing of all pigtails to terminate the fiber strands.
   4. Route fiber cable into side of the panel. Provide a wrap-around label at this location to identify the fiber cable as it enters the fiber panel.
      a. Label the fiber cable just outside of the fiber panel with a yellow fiber optic cable label, Panduit No. PST-FO.
   5. The sheath of the fiber cable shall extend to the side of the panel. Individual fibers or subgroups shall not be seen outside of the panel, except for the single mode bundles.
   6. Fibers shall be installed in the adapter packs in color code order. For vertical mounted 12 pack adapters, top to bottom then left to right. In panels where the couplers are horizontally mounted, left to right for each 12 pack, then top to bottom. Contact the Engineer with any questions.
   7. All individual fiber strands shall be neatly installed in the back of the panel after termination. Provide a minimum of 4 feet of spare fiber in the back of each panel. This spare shall be coiled in a Figure 8.
   8. Secure the fiber to the entrance of the patch panel with tie wraps.
   9. After installation and termination of the fiber cable, install labels on the patch panel showing what strand each connector is connected to, and where the overall fiber cable is terminated at the other end.
   10. Attach a self-adhesive clear plastic sleeve to the inside of the Plexiglass cover of the rack mount panel. Slide in a laser printed label showing all information about the fiber cable.

11. Label door of wall mount panels to detail the fiber cable type, strand count and termination locations

C. Fiber cables shall be terminated with fusion spliced Pigtails.
1. All Singlemode and multimode fiber cables shall be terminated with a pre-terminated fiber optic pigtail which matches the diameter and type of fiber being installed.
2. Fusion splice all pigtails to the fiber cables. Terminate each strand of the fiber cable.
3. Each strand shall be thoroughly cleaned and all coverings shall be removed prior to splicing
4. To cleave the fiber, use the method and equipment recommended by the manufacturer of the fusion splicer that will be used.
5. Fibers shall be properly aligned prior to splicing.
6. The splicer used shall be able to inject light directly into the fiber just after it is spliced, and provide an estimate of the loss through the splice.
7. After splicing, a heat shrink tube with a rigid skeleton shall be used to protect the splice. Coordinate this heat shrink tube with the splice tray to be installed in the splice shelf. Heat shrink tubes shall fit into the grooves in the splice tray.
8. Loss through the splice shall be no more than .15dB.
9. Fiber pigtails shall be labeled with a self-laminating, laser printed, wrap around label at the connector. The label shall detail the strand count of the fiber cable, the buildings and rooms in which the fiber is terminated and the color and strand number the pigtail is spliced to.

24MM/12SM
WRT#234-OLS #021
Brown Fiber # 16

END OF SECTION

SECTION 28 1600 – CAT-6 CABLING

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. This section includes parts and equipment required for installation, termination, and testing of user communications cables.

1.02 SYSTEM DESCRIPTION
- A. The horizontal cabling consists of all systems from the user faceplate, to the patch panel in the communications room, and all connections in between.
- B. Products and installation detailed in this section shall comply with all applicable requirements.
  1. ANSI/TIA-568-C.0, "*Generic Telecommunications* Cabling *for Customer Premises*",
  2. ANSI/TIA-568-C.1, "*Commercial Building Telecommunications Cabling Standard*",
  3. ANSI/TIA-568-C.2, "*Balanced Twisted-Pair Telecommunication Cabling and Components Standard*", ANSI/TIA-568-C.3, "*Optical Fiber Cabling Components Standard*",
  4. ANSI/TIA-568-C.4, "*Broadband Coaxial Cabling and Components Standard*",
  5. ANSI/TIA/EIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces
  6. IA-606-B: Administration Standard for the Telecommunications Infrastructure of Commercial Buildings including all Updates and Addenda.
  7. TIA-607-C: Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
  8. IEEE 802.3af PoE • Ratified in 2003 • 15.4W at the PSE, with min of 12.95W available to the PD
  9. IEEE 802.3at PoE+ • Ratified in 2009 • 34.2W at the PSE, with min of 25.5W available to the PD
  10. IEEE 802.3af PoE • Ratified in 2003 • 15.4W at the PSE, with min of 12.95W available to the PD
  11. IEEE 802.3at PoE+ • Ratified in 2009 • 34.2W at the PSE, with min of 25.5W available to the PD
  12. IEEE 802.3bt -Amendment 2. Ratified in 2018 PoE standards powering all 4 pairs:

1.03 COORDINATION
- A. All cables shall be coordinated with the installation of the telecommunications raceways.
- B. Coordinate all user cables with the furniture to be installed in the building. Make any adjustments prior to cable being installed.
- C. Contractor shall walk the site during construction and shall verify all raceways are being installed as required to install the user data cables. Walk the site prior to drywall being installed or floors being installed when Floor boxes are being installed.

1.04 STANDARDS
- A. Cabling shall be installed in accordance with NEC code for grouping/bundling of cables in relation to Type 3 and Type 4 PoE
- B. Install as per NEC 840.160 in reference to bundling cables:

AWG	Numberof 4-Pair Cables in a Bundle																				
	1			2-7			8-19			20-37			38-61			62-91			92-192		
	Temp Rating			Temp Rating			Temp Rating			Temp Rating			Temp Rating			Temp Rating			Temp Rating		
	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C	60°C	75°C	90°C
26	1.0	1.0	1.0	1.0	1.0	1.0	0.7	0.8	1.0	0.5	0.6	0.7	0.4	0.5	0.6	0.4	0.5	0.6	NA	NA	NA
24	2.0	2.0	2.0	1.0	1.4	1.6	0.8	1.0	1.1	0.6	0.7	0.9	0.5	0.6	0.7	0.4	0.5	0.6	0.3	0.4	0.5
23	2.5	2.5	2.5	1.2	1.5	1.7	0.8	1.1	1.2	0.6	0.8	0.9	0.5	0.7	0.8	0.5	0.7	0.8	0.4	0.5	0.6
22	3.0	3.0	3.0	1.4	1.8	2.1	1.0	1.2	1.4	0.7	0.9	1.1	0.6	0.8	0.9	0.6	0.7	0.8	0.5	0.6	0.7

C. Cables shall be installed with no more than 24 cables in a single J-hook. Install additional J-hooks as required.
D. If cables are to be bundled/grouped in larger bundles then the cable shall be LP listed per UL.
E. All cables shall be no smaller than 23 AWG.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Approved vendors for copper user cables are:
1. Panduit
2. Hubbell
3. Belden
4. CommScope
5. Mohawk
6. Superior Essex
7. Paige
B. Approved vendors for CAT-6 termination equipment are:
1. Hubbell.
2. Panduit (Net Key not allowed)
3. Belden
4. CommScope

2.02 CAT-6 CABLING
A. All UTP user/cabling installed shall be CAT-6 rated or above.
1. Category 6 cabling shall consist of 4 pairs of unshielded twisted pair, 23 AWG cables.
2. All CAT-6 cables shall be installed in cable tray or supported by J-Hooks.
3. Individual pair shall be marked in the standard 4 pair color code of blue/blue-white, orange/orange-white, green/green-white, and brown/brown-white.
4. Each cable shall be marked sequentially with the footage of the cable. Each cable shall also be marked with the manufacturer of the cable and the type of cable installed or the cable part number.
5. Cable and all connectors and patch panels shall meet or exceed the following electrical and physical requirements:

DC RESISTANCE (max)	23 AWG
Ohms/100m @ 20°C	9.38ohms
DC RESISTANCE UNBALANCED (max)	
Individual Pair %	5%

CHARACTERISTIC IMPEDANCE	
Frequency (f)	Ohms
1-500 Mhz	100 ±15

DELAY SKEW (max)	
ns/100m	45

NOMINAL VELOCITY OF PROPAGATION (NVP)	
% Speed of light	72

INPUT IMPEDANCE	
Frequency (f)	Ohms
1.0-100 Mhz	100 ±15
100-350 Mhz	100 ±20
350-500 Mhz	100 ±25

REFERENCE ELECTRICAL CHARACTERISTICS

FREQ (MHz)	INSERTION LOSS (dB/100m)		NEXT (dB/100m)		ACR (dB/100m)	PS-NEXT (dB/100m)		PS-ACR (dB/100m)	ELFEXT (dB/100m)	PS-ELFEXT (dB/100m)	RL (dB)
	avg	max	avg	min	min	avg	min	min	min	min	min
.772	1.7	1.8	82	76.0	74.2	77	74.0	72.2	–	–	–
1.0	1.9	2.0	80	74.3	72.3	75	72.3	70.3	67.8	64.8	20.0
4.0	3.6	3.8	71	65.3	61.5	66	63.3	59.5	55.8	52.8	23.0
8.0	5.1	5.3	67	60.8	55.5	62	58.8	53.5	49.7	46.7	24.5
10.0	5.7	6.0	65	59.3	53.3	60	57.3	51.3	47.8	44.8	25.0
16.0	7.3	7.6	62	56.2	48.6	57	54.2	46.6	43.7	40.7	25.0
20.0	8.1	8.5	61	54.8	46.3	56	52.8	44.3	41.8	38.8	25.0
25.0	9.1	9.5	59	53.3	43.8	54	51.3	41.8	39.8	36.8	24.3
31.25	10.2	10.7	58	51.9	41.2	53	49.9	39.2	37.9	34.9	23.6
62.5	14.8	15.4	53	47.4	32.0	48	45.4	30.0	31.9	28.9	21.5
100.0	19.0	19.8	50	44.3	24.5	45	42.3	22.5	27.8	24.8	20.1
155.0	24.2	25.2	47	41.4	16.3	42	39.4	14.3	24.0	21.0	18.8
200.0	27.8	29.0	46	39.8	10.8	41	37.8	8.8	21.8	18.8	18.0
250.0	31.5	32.8	44	38.3	5.5	39	36.3	3.5	19.8	16.8	17.3
300.0	35.0	36.4	43	37.1	0.7	38	35.1	--	18.3	15.3	16.8
350.0	38.2	39.8	42	36.1	--	37	34.1	--	16.9	13.9	16.3
400.0	41.3	43.0	41	35.3	--	36	33.3	--	15.8	12.8	15.9
500.0	47.0	48.9	40	33.8	--	35	31.8	--	13.8	10.8	15.2
550.0	49.7	51.8	39	33.2	--	34	31.2	--	13.0	10.0	14.9

6. All cables installed above a drop ceiling or fixed ceiling shall be Plenum Rated
7. CAT-6, 4 pair cabling shall be plenum rated unless specifically noted.

Cable Use	Manufacturer	Color	Part number	Rating
Data Cabling	Mohawk	Blue	M58281	Plenum
Security Camera	Mohawk	Green	M58286	Plenum
IP/POE locks at doors	Mohawk	White	M58280	Plenum
Audio/ video	Mohawk	Black	M58289	Plenum
Backbone	Mohawk	Purple	M58290	Plenum
USB	Mohawk	Orange	M58288	Plenum
Paging -MDOC	Mohawk	Brown	M58756	Plenum
Underground	Mohawk	Black	M58772	Underground
Shielded Underground Rated	Belden	Black	OSPF6F	Underground / Shielded

8. Ensure that cable passes all CAT-6 tests after installation.

2.03 CAT-6A CABLE -SMALL DIAMETER

A. Unshielded Twisted Pair (UTP) CAT-6A cable

B. Shall meet standards:

1. ANSI/TIA-568-C.2 AND ISO/IEC 11801:2002 CATEGORY 6A ELECTRICAL CHARACTERISTICS.

C. Cable shall consist of:
1. 23 AWG solid bare copper insulated conductors, assembled into 4 pairs cabled together with a assembly: flexweb core separator
2. Jacket shall include footage markers
   a. Outer diameter shall be .25”
3. The cable shall be plenum rated for use in air handling ducts and spaces in accordance with article 800 of the National electrical code (NEC).
4. Shall be US Listed C(UL)US OR C(ETL)US TYPE CMP UL OR ETL VERIFIED CAT 6A
5. Supported Applications
   a. IEEE 802.3 10BASE-T (ETHERNET),
   b. 100BASE-T (FAST ETHERNET),
   c. 1000BASE-T (GIGABIT ETHERNET),
   d. ANSI.X3.263 FDDI
   e. TP-PMD, IEEE 802.5 4 AND 16 Mbps TOKEN RING,
   f. 550 MHz BROADBAND
   g. VIDEO AND ATM UP TO 4.8 Gbps.
   h. IEEE 802.3an 10gbase-t (10 gigabit Ethernet),
   i. Access points and PoE / PoE+.

D. Physical Characteristics
1. Bending radius: 1” (25 mm) min)
2. Pulling tension: 25 lbf (110 n) max
3. Operating temp.: -20°c to +75°c (-4°f to +194°f)
4. Storage temp.: -20°c to +75°c (-4°f to +194°f)
5. Installation temp.: 0°c to +50°c (+41°f to +122°f)

E. Shall meet or exceed following testing parameters.

REFERENCE ELECTRICAL CHARACTERISTICS

FREQ (MHz)	INSERTION LOSS (dB/100m)	NEXT (dB/100m)	PS NEXT (dB/100m)	ACRF (dB/100m)	PS ACRF (dB/100m)	RETURN LOSS (dB)	PROP. DELAY (ns/100m)	ALIEN CROSSTALK PS ANEXT (dB/100m)	ALIEN CROSSTALK PS AACRF (dB/100m)
	max	min	min	min	min	min	max	min	min
1.0	2.1	74.3	72.3	67.8	64.8	20.0	575.0	67.0	67.0
4.0	3.8	65.3	63.3	55.8	52.8	23.0	557.0	67.0	66.2
8.0	5.3	60.8	58.8	49.7	46.7	24.5	551.7	67.0	60.1
10.0	5.9	59.3	57.3	47.8	44.8	25.0	550.4	67.0	58.2
16.0	7.5	56.2	54.2	43.7	40.7	25.0	548.0	67.0	54.1
20.0	8.4	54.8	52.8	41.8	38.8	25.0	547.0	67.0	52.2
25.0	9.4	53.3	51.3	39.8	36.8	24.3	546.2	67.0	50.2
31.25	10.5	51.9	49.9	37.9	34.9	23.6	545.4	67.0	48.3
62.5	15.0	47.4	45.4	31.9	28.9	21.5	543.6	65.6	42.3
100.0	19.1	44.3	42.3	27.8	24.8	20.1	542.6	62.5	38.2
155.0	24.1	41.4	39.4	24.0	21.0	18.8	542.1	59.6	34.4
200.0	27.6	39.8	37.8	21.8	18.8	18.0	541.5	58.0	32.2
250.0	31.1	38.3	36.3	19.8	16.8	17.3	541.3	56.5	30.2
300.0	34.3	37.1	35.1	18.3	15.3	16.8	541.1	55.3	28.7
350.0	37.2	36.1	34.1	16.9	13.9	16.3	540.9	54.3	27.3
400.0	40.1	35.3	33.3	15.8	12.8	15.9	540.8	53.5	26.2
500.0	45.3	33.8	31.8	13.8	10.8	15.2	540.6	52.0	24.2

SWEEP TESTED TO 500 MHz

F. CAT-6A, 4 pair cabling shall be plenum rated unless specifically noted.

Cable Use		Manufacturer	Color	Part number	Rating
Wireless AP		Mohawk	Yellow	M59230	Plenum
IP/POE locks at doors		Mohawk	White	M59233	Plenum
Audio/ video		Mohawk	Black	M59234	Plenum

USB		Mohawk	Orange	M59229	Plenum

G. Ensure that cable passes all CAT-6A tests after installation.

2.04 UTP JACKS

A. 8-position modular jacks for termination at user and at the patch panel. Match cable color except where noted on drawings.
   1. Each jack shall be an individually constructed unit and shall snap mount in an industry standard keystone opening (.760 inches x .580 inches).
   2. Jack housings shall be high impact 94 V-0 rated thermoplastic.
   3. Jack housings shall fully encase and protect printed circuit boards and IDC fields.
   4. Modular jack contacts shall accept a minimum of 1000 mating cycles with 5.0 milliohm (maximum) increase over initial with the use of an FCC compliant plug.
   5. Modular jack contact wires shall be formed flat for increased surface contact with mated plugs.
   6. Modular jack contacts shall be constructed of beryllium copper for maximum spring force and resilience.
   7. Contact plating shall be a minimum of 50 micro inches of hard gold in the contact area over 50 micro inches of nickel.
   8. Jack termination shall follow the industry standard 110 IDC.
   9. Jacks shall have a designation indicating CAT-6 or CAT-6A as required.
   10. Jacks shall utilize a paired punch down sequence. Cable pair twist shall be maintained up to the IDC, terminating all conductors adjacent to its pair mate to better maintain pair characteristics designed by the cable manufacturer.
   11. Jacks shall terminate 22-26 AWG stranded or solid conductors.
   12. Jacks shall terminate insulated conductors with outside diameters up to .050 inches.
   13. Jacks shall be compatible with single conductor, 110 impact termination tools.
   14. Jacks shall include translucent wire retention stuffer cap that holds terminated wires in place and allows the conductors to be visually inspected in the IDC housing.
   15. Jacks shall be compatible with EIA/TIA 606A color code labeling.
   16. Jacks shall accept snap on icons for identification or designation of applications.
   17. Jacks shall be marked for T568A and T568B wiring schemes. TIA 568B wiring shall be used in all terminations throughout the communications system.
   18. All CAT-6 modular jacks and panels shall meet or exceed the following transmission characteristics:
      a. Jacks shall be designed for 100 Ohm UTP cable termination.
      b. Jacks shall be UL verified for TIA/EIA Category 6 electrical performance.
      c. Jacks shall be UL listed 1863 and CSA certified.
      d. Jacks shall be manufactured by an ISO 9002 registered manufacturer.
   19. CAT-6, 8-pin modular jacks shall be:
      a. Data Jacks shall be Hubbell # HXJ6OW or equal. Office White.
      b. Data Jacks for Security Cameras shall be Hubbell #HXJ6GN-Green
      c. Data jacks for Wireless Access Points shall be Hubbell #HXJ6Y-Yellow
      d. Data jacks for backbone connectivity shall be Hubbell #HXJ6P-Purple
      e. Data Jacks for IP/POE locks at doors shall be Hubbell #HXJ6W -White
      f. Data Jacks for Audio and Video connections shall be:
         1) Hubbell #HXJ6BK-Black
      g. Data Jacks for USB connections shall be Hubbell #HXJ6OR-Orange
      h. Data Jacks for Paging Systems shall be Hubbell #HXJ6BN-Brown
   20. CAT-6A, 8-pin modular jacks shall be:
      a. Data jacks for Wireless Access Points shall be Hubbell #HJU6AY-Yellow

2.05 FACEPLATES

A. Modular Standard flush mount faceplates shall support all the jacks and connectors required.
   1. Faceplates shall be UL listed and CSA certified.

2. Faceplates shall be constructed of high impact thermoplastic or stainless steel. See drawings for specific requirements.
3. Faceplates shall be 2-3/4 inches wide x 4-1/2 inches high (69.8 mm x 114.3 mm) for single gang, and 4-1/2 inches x 4-1/2 inches (114.3 x 114.3 mm) for double gang.
4. Faceplates shall be available to mount 1, 2, 3, 4, or 6 jacks in a single gang and up to 12 jacks in a double gang configuration.
5. Faceplates shall provide for TIA/EIA 606 compliant station labeling.
6. Faceplates shall have plastic covers over the mounting screws that can be replaced with a clear plastic window over a printable paper insert.
7. Each plate shall be fully configured with modular inserts. There shall be no open spaces in the faceplate.
8. Match the color of the modular inserts to the color of the faceplate. All faceplates and inserts shall be office white unless otherwise noted.
9. Single gang plastic faceplate shall be Hubbell # IMF1OW.
10. Double gang plastic plate shall be Hubbell # IMF2OW.
11. Sing Gang, stainless steel, modular faceplates shall be Hubbell #IMSS1
12. Double Gang, stainless steel, modular faceplates shall be Hubbell #IMSS2
13. Each single gang plate has 3 faceplate units (FPU's) available to install inserts. Double gang plates have 2 sides, each with 3 FPU's.
14. Equip plates with the following parts as directed on the construction drawings.

FPU	ITEM	PART NUMBER
	Blank Jack	SFB10
.5	Blank	IMB05OW
1	Blank	IMB1OW
1.5	Blank	IMB15OW
1	1 Port Flat	IM1K1OW
1	2 Port Flat	IM2K1OW
1.5	1 Port Angled	IM1KA15OW
1.5	2 Port Angled	IM2KA15OW

B. Integrated furniture outlets, GFI style inserts and plates, and standard 106 style inserts and plates.
1. These may be required at some surface raceway location. Field verify prior to ordering.
2. The Contractors shall identify which type of outlet or frame is required at each location throughout the system.
3. Match the outlet with the faceplate required.
4. GFI, more commonly referred to as style line inserts, are rectangular and fit in a rectangular plate used for GFI receptacles.
5. 106 style inserts are configured to fit in a common duplex electrical receptacle faceplate. The inserts hold 2 or 4 modular jacks.
6. Each type of modular furniture has certain requirements for its voice and data modules. The Contractor shall coordinate with the furniture installer and provide the correct faceplate and outlets to match the color and style of the furniture.
7. For all connections that do not have a faceplate with a location for a laser printed paper label, the Contractor shall provide an engraved lamacoid label detailing the location number of each cable.
8. GFI/Style line Stainless Steel Plates shall be:
   a. Single Gang, Hubbell #SS26
   b. Double Gang, Hubbell #SS262
   c. Three Gang, Hubbell #SS263
9. GFI/Style line Plastic plates without a Label Field shall be:
   a. Single Gang, Hubbell #NPJ26GY-Gray
   b. Double Gang, Hubbell # NPJ262GY-Gray
   c. Three Gang, Hubbell # NPJ263GY-Gray

10. GFI/Style line Plastic Plates with Label Field shall be:
    a. Single-Gang, Hubbell #IFP126OW -Office White
    b. Double-Gang, Hubbell #IMFP2OW -Office White
11. GFI/Style Line Inserts shall be:
    a. Provide an insert to support all Modular jacks that are to be installed.
    b. One Port Hubbell #NS611W
    c. Two port, Hubbell # NS612W
    d. Three port, Hubbell # NS613W,
    e. Four port, Hubbell # NS614W
    f. Six port, Hubbell # NS616W.
    g. Blank, Hubbell #NS620W
12. 106 style inserts shall be:
    a. Two port, Hubbell #BR106W
    b. Four Port, Hubbell #Q106W
13. Examples




    a. 106 Style GFI/Style-Line

C. Brush opening plate
    1. Where routing AV cables through an open backbox the contractor shall install a “brush” plate that covers the backbox and allows cable to pass thru
    2. Provide a single or double gang cover plate with GFI openings.
    3. Single-gang plates shall be Hubbell #SS26 with Leviton #41078-DBW, White in color or equal
    4. Double-gang plates shall be Hubbell #SS262 with Two (2), Leviton #41078-DBW, White in color or equal
D. Wall mount phone plates shall be stainless steel.
    1. Each plate shall be equipped with a CAT-6, 8 port modular jack.
    2. Each plate shall be equipped with stainless steel studs for mounting a wall mount telephone to the plate.
    3. Single gang wall mount phone plate shall be Hubbell #SP6F or #SP6R base on telephone type. Coordinate with owner prior to ordering.

2.06 SURFACE MOUNT BOXES
A. Provide surface mount boxes for termination of cables as shown on the drawings.
    1. Install a surface mount box at location for termination of the modular jacks.
    2. One port surface box shall be Hubbell #HSB1OW.
    3. Two port surface box shall be Hubbell #HSB2OW
    4. Four Port Surface box shall be Hubbell #HSB4OW
    5. For all plenum rated ceilings and areas the contract shall provide plenum rated surface mount boxes. For Hubbell products. Add a “P” to the end of the part number.

2.07 CABLE SUPPORTS
A. All cables shall be supported in the ceiling a minimum of every 5 feet. Support can be provided by installing cable inside cable tray or conduit, or by installing J-hooks or bridle rings with saddles every 5 feet.
    1. J-hooks
        a. Hooks shall provide a smooth steel or plenum rated plastic, support for cables as they route through the ceiling. Shall be rated for the ceiling area where they

are being installed. Verify any plenum rated areas and only install plenum rated supports

1) Metal J-hooks supports shall have a galvanized finish.





2)

3) Shall be UL listed, ultimate static load limit 50 pounds rated to support Category 5e and higher cables, and optical fiber cables.

b. If required, assemble to manufacturer recommended specialty fasteners, including beam clips and flange clips.

c. Acceptable products shall be:

1) CADDY #CAT HP series with retainer hooks or Panduit J-Pro series supports

1) Minimum square inch size of support for cables on the J-hook shall be 2.25”

2) Caddy HP21xxxx series or

3) Panduit JP2Wxxxx series or equal

d. Provide with interfaces and clamps required to support J-Hooks from the building structure.

2. Bridle Rings

a. Bridle Rings with saddles shall provide a smooth plenum rated plastic, support for cables as they route through the ceiling. Shall be rated for the ceiling area where they are being installed. Verify any plenum rated areas and only install plenum rated supports

1) Bridle ring supports shall have a zinc plated finish.

2) Bridle ring saddles shall be yellow in color and plenum rated. Shall meet CAT-6 and CAT-6A cable support standards.



3)

b. If required, assemble to manufacturer recommended specialty fasteners, including beam clips and flange clips.

c. Acceptable products shall be:

1) 1.5” diameter, Minerallac 646RS series or equal

2) 2” diameter, Minerallac 648RS series or equal

d. Provide with interfaces and clamps required to support Rings from the building structure.

B. Ceiling supports

1. J-Hooks and Rings shall be supported from the building structure. This includes connections to the walls, concrete ceiling, building steel and contractor installed vertical supports that are attached to the building structure.

2. Contractor can install threaded rod or other supports such as Unistrut or Drop ceiling tiles to support the J-hooks and subsequently the cables.
3. Supports shall be installed every 5 feet and shall be installed to keep cables from resting on pipes, ducts, structural steel, lights, ceiling grid, electrical conduits and any other structure that cable could possibly rest against.
4. Provide threaded rod and associated hardware required to support all J-Hooks
   a. Paint threaded rod Yellow prior to installation
5. Above Drop ceilings, or accessible hard ceilings, the contractor can install support wire to support the J-Hooks.
   a. Drop ceiling support wire shall be 12 AWG minimum
   b. Attach to building structure.
   c. Attach to drop ceiling grid.



   d.
   e. Paint support wire Yellow prior to installation.
   f. Provide associated hardware required to support all J-Hooks.



   g.
6. No more than 24 data cables in each J-hook. No more than 32 able sin each 2” Bridle Ring. Provide additional hooks and rings as required to support all cables.

2.08 RACK MOUNTED PATCH PANELS

A. Patch panels for termination of UTP cabling shall be provided to terminate all cables installed in the building.
B. All patch panels shall be installed into 19” racks and/or cabinets as shown on the drawings.
C. Provide panels to terminate all cables even if the panels are not specifically shown on the rack layout drawings.
   1. Provide the quantity and color of Modular jacks to match the color and quantity of all cables installed.
D. Panels shall be steel and shall allow mounting of all CAT-6 an CAT-6A jacks. Panels shall be blank panels that accept all modular jacks.
E. CAT-6 patch panels for mounting in a 19-inch rack or cabinet. Shall be;
   1. Panels shall be made of black anodized aluminum, in 24 and 48 port configurations.
   2. Panels shall accommodate 24 ports for each rack mount space or "U" (1U = 44.5 mm [1.75 inch]).

3. Panels shall be manufactured with a rolled edge at the top and bottom for stiffness.

F. 24 port empty patch panels shall be Hubbell #HPJ24 or equal
1. Panels shall have rear cable support bar for strain relief which shall clip to the rear of the patch panel or to the rear of the rack rail.
2. Each 24-port patch panel shall be equipped with one (1) rear cable organizer. Organizer shall be Hubbell #HPRCMB or equal.
3. Ports shall be marked 1-24 on top of the openings by factory.
4. Label all Panels for the panel, communications room and rack with a large laser-printed label.

2.09 PASS THRU'S
A. Where no pass-thru is provided by others the contractor shall install conduit or UL listed wall pass thru's sized as required to route all cables through all walls.
B. Pass thru's shall be EMT conduit or another UL listed rated device.
C. Install thru all drywall, block, concrete walls and through any floors required to be penetrated
D. Conduit shall be supported mechanically from the wall or floor structure. After installation, the raceway shall be firestopped to meet the requirements of the wall or floor.
E. Install a sticker on the wall, next to the pass thru, listing the UL approved method that was used to firestop the pass thru or conduit.

2.10 PATCH CORDS
A. Contractor shall provide one patch cord for each data cable installed. Patch cords shall be at the communications room.
1. Provide a patch cord for each CAT-6 or CAT-6A cable installed
B. Patch cords shall match the type of cables installed. Provide CAT-6 patches for CAT-6 cables. Provide CAT-6A patches for CAT-6A cables
C. Patch cords shall be 8" or 12" long and shall match the color of the cable/jack they are being plugged into.
1. Provide Yellow Patch Cords for Wireless Access Points
2. Provide Green Patch Cords for Security Cameras
3. Provide Blue Patch Cords for all other data cable connections.
D. Patch cords shall be 28 AWG, small diameter cords
1. CAT-6 cords shall be Panduit #UTP28SP8IN* where * is the color
2. CAT-6A cords shall be Panduit #UTP28X8IN* where * is the color
E. Patch cords shall be 28 AWG, small diameter cords
1. CAT-6 cords shall be Hubbell #HCL6xxyy where xx is the color and yy is the length. 01 length is 12"
2. CAT-6A cords shall be Panduit # HCL6Axxyy where xx is the color and yy is the length. 01 length is 12"

PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine all pathways prior to installation of all cables.
B. Identify locations of all user conduits and backboxes prior to cable installation.
1. Walk the site during conduit installation and ensure that all boxes are installed where required for termination of all cables.
2. If any missing locations are not noted during electrical raceway installation the contractor shall be required to fish the wall or install surface raceway to support the cable terminations
C. The Engineer or the Owner has the right to make adjustments to the location of any outlet to a new location within 7 wall-feet of the original location. If the change is made prior to final cable termination, and prior to any raceway being installed, then the changes shall be a no cost change to the contract.

D. Identify all locations where cable will route through furniture raceway or other nonstandard conduit or raceway installation. Make arrangements to install and terminate all cables in accordance with TIA/EIA 568 standards.

3.02 PREPARATION

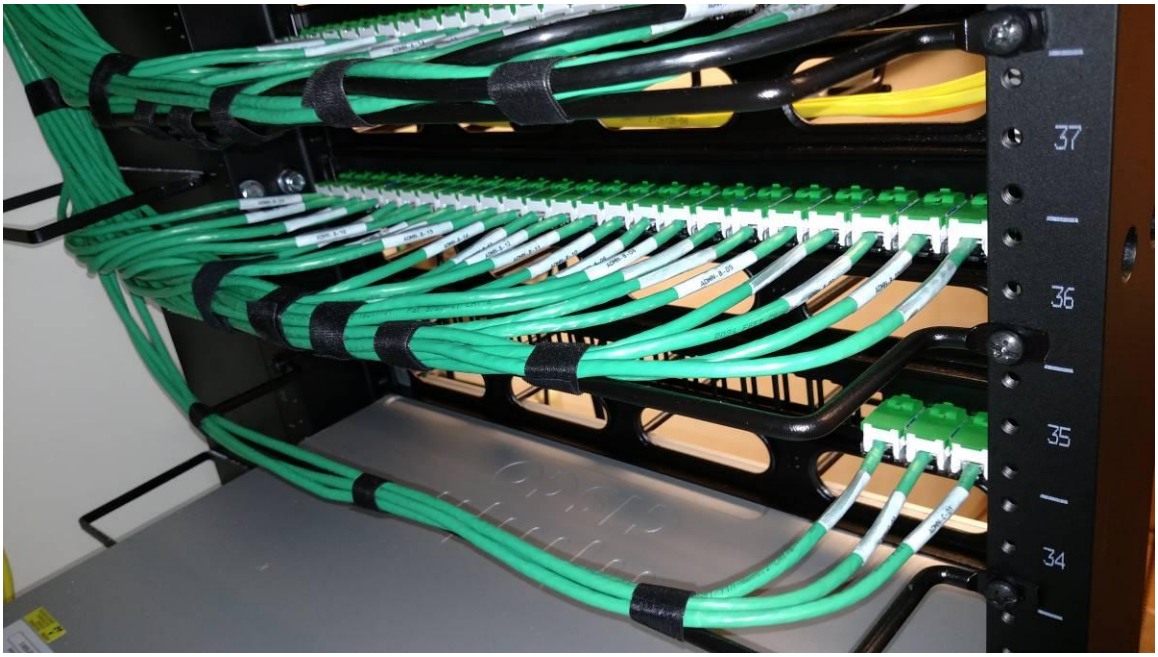
A. Locate main path for all cables and install J-hooks where cable tray or raceway is not provided.
B. Coordinate with other trades to install a clear, straight path down major corridors for the routing of user cables back to the communications closet.
C. Plan installation of cables along cable ladder of rack system in communications room. All cable shall be neatly routed in groups of no more than 24 cables.

3.03 INSTALLATION

A. CAT-6 and/or CAT-6A cabling shall be installed according to TIA/EIA 568 standards, including all updates and addenda.
    1. When installing CAT-X cables, care shall be taken to avoid crimping or bending the cable past the manufacturer's recommended bend radius.
    2. During installation, the cables shall not be pulled across the ceiling tiles or the structure of the building. This may cause damage to the cable jacket.
    3. Adhere to all pulling tensions and bend radii during installation. Excessive pulling or bending can cause the cable to fail tests after installation. Any cable that does not pass the certification tests after installation shall be fixed or replaced at the Contractor's expense.
    4. All cables shall route neatly in the ceiling. Whether they route in cable tray or J-hooks, the cables shall be neat and orderly.
    5. Cables shall not be laying on or against the building structure. Cables shall not be laying on or against electrical or HVAC pipes.
    6. Cables shall not be installed between the building structure and corrugated steel of the roof deck.
    7. There shall be no more than 24 cables in each J-hook. Provide additional J-hooks as required.
    8. Support all cables at a minimum of every 5 feet.
    9. Provide a short coil of extra cable where the cable enters the vertical conduit. The coil shall consist of no less than 1-1/2 feet.
    10. Provide enough slack in the backbox to fully remove the faceplate and jack and allow work to be done on the cable.
    11. When installing cables in the communications room, all cable shall route neatly through the cable tray and cable ladder.
    12. When transitioning from the ceiling area to the cable ladder of the rack system, all cable shall route through conduits or be attached to vertical section of cable ladder. The Contractor shall provide the conduits shown and any additional conduits or cable ladder required to neatly transition cables from the ceiling to the rack.
    13. Bundle cables in groups of no more than 24 cables as it routes along the cable ladder.
    14. Cables shall route down each side of a rack for termination. Split each panel into 2 sides. The first 12 positions on a panel are on the left, and positions 13 through 24 are on the right. Route the cables for panel positions 1 through 12 down the left cable ladder and route the cables for positions 13 through 24 down the right cable ladder.
    15. Each patch panel shall utilize a rear organizer for holding the cables as they route to the punchdown field.
    16. Cables shall be bundled in groups of 4 as they route through the rear cable organizer.
    17. When terminating cables, ensure that the smallest amount of jacket is removed from the final termination point of the cables.
    18. Pair twists shall be maintained up to the IDC jack for all the cables.

19. Provide a service loop of the cables on the vertical cable ladder. The loop shall extend no less than 1 foot below the termination point on the patch panel. Route the cables 1 foot below the patch panel, and then back up to the panel. This will provide room for future moves and additions to the rack.
20. Each cable shall have a self adhesive, self laminating, laser printed label at each end. The label shall show the location identifier of that cable. Labels shall be installed no more than 4 inches from the termination point of the cable.

B. All work on the project shall meet all applicable state, federal, local and industry codes and be installed according to the requirements of he Authority Having Jurisdiction (AHJ).



Detail 01. Proper routing and support of cables on rear organizer. Where possible route 12 cables from right side and 12 cables from left side. This rack in picture did not have right side organizer.



Detail 02. Cable routing from above ceiling to cable ladder and to racks Route all cables neatly.

C. CAT-6 and CAT-6A data jacks shall be installed at the user end of each UTP cable installed in the system.
   1. Jacks shall be installed to provide minimal signal impairment by preserving wire pair twists as close as possible to the point of mechanical termination.
   2. Jacks shall be installed per manufacturer's instructions and properly mounted in plates, frames, housings, or other appropriate mounting devices.
   3. Jacks shall be installed such that cables terminated to the jacks maintain minimum bend radius of at least 4 times the cable diameter into the workstation outlet. Cables shall be terminated on jacks such that there is no tension on the conductors in the termination contacts.
   4. See drawings for the color requirements of all modular jacks.

D. Faceplates shall be mounted straight and level with the floor and walls of the building.
   1. Jacks and/or connectors shall be terminated to the appropriate cable and inserted in the correct orientation into the faceplate prior to the mounting of the faceplate.
   2. Jacks shall be inserted into the faceplate left to right, then top to bottom. 2 gang plates shall be labeled left to right, then top to bottom for each gang.
   3. Cable slack shall be stored behind the faceplate in such a way that allows the minimum bend radius of the cables to be maintained as per the following:
   4. Care shall be taken when mounting the faceplate to avoid crimping or kinking the cables.
   5. Faceplates shall be securely mounted to a surface mounted housing, a recessed box, or box eliminator bracket.
   6. Each faceplate shall be labeled with laser printed paper inserted behind the clear plastic label strips.
   7. The label shall show the location identifier of the faceplate and the letter designation for each cable. The label shall be as large a font as possible and easily readable.
   8. Each faceplate comes with a label strip at the top and the bottom.

E. Wall mount phone plates shall be mounted to a backbox or a drywall ring securely installed to the wall.
   1. Terminate the cable to the 8-position jack on the wall mount faceplate.

2. Ensure that the faceplate is at the correct height for all ADA requirements.
3. Provide an adhesive label on the faceplate identifying the cable with its location identifier number.

F. When utilizing 106 style or GFI/Style-Line brackets, the Contractor shall provide self adhesive labels detailing which cable is at each position.
1. 106 plates and GFI plates will primarily be located in floorboxes or surface raceway.
2. The contractor shall coordinate the faceplates required with the actual floorboxes installed by the electrical contractor.
3. Provide the quantity of GFI and 106 style plates required.

G. Surface Mount boxes
1. Modular Jacks and/or connectors shall be terminated to the appropriate cable and inserted in the correct orientation into the surface mount box.
2. When the surface mount jack is mounted above the ceiling the cable shall be coiled and the cable and surface mount box shall be kept off of the ceiling grid
3. Attach the coil to the building structure with a plenum rated tie-wrap.
4. Label each surface mount box for the cable number. Also, install a wrap-around label on each cable.
5. When attaching a surface mount box to a piece of furniture or to a power pole the contractor shall drill a hole in the furniture/pole that is larger than the hole on the back of the surface box.
6. Screw the surface box to the furniture or to the pole. Adhesive only solutions are not adequate.

H. Proper support of cables is of paramount importance when installing a cable infrastructure. All cables not in conduit or cable tray shall be supported via J-hooks a minimum of every 5 feet.
1. Routes of cables shall be parallel or perpendicular to the walls of the building.
2. Install the J-hooks to minimize changes in the level of the cables as they route through the J-hooks.
3. Do not install more than 50 cables in any 1 J-hook. Provide additional hooks where more than 50 cables route along a main route.
4. All communications shall route as high in the ceiling as possible while still being accessible and staying away from other utilities.
5. When installing the cable through the J-hooks, they shall all have relatively the same droop between hooks. All cables shall be installed neatly and squarely.
6. Secure the J-hooks to the building structure with beam clamps and threaded rod as required to support the cables.
7. J-hooks shall never be attached to drop ceiling support wires. Cables shall never be supported by drop ceiling wires.

I. CAT-6 patch panels shall be installed in the racks.
1. Panels shall be installed to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. The amount of untwisting in a pair as a result of termination to the modular jack at the patch panel shall be no greater than a 1/2 inch (13 mm).
2. Panels shall be installed per manufacturer’s instructions and properly mounted to a rack, cabinet, bracket, or other appropriate mounting device.
3. Panels shall be installed such that cables terminated to the panel can maintain minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Cables shall be terminated on the panels such that there is no tension on the conductors in the termination contacts.
4. Each patch panel shall have a rear cable organizer for routing cable from the vertical cable ladder to the patch panel. 1 organizer for each row of 24 cables.
5. The label for each outlet on the panel shall be the same as the wraparound label on each end of the cable.
6. Each label shall line up directly below or above the outlet on the panel. Misaligned labels will not be permitted.

J. Patch Cords
   1. Provide patch cords into the communications room where they are to be installed
   2. Mark the box with the date they are placed in the room and quantity of each type of patch cable.
   3. Send picture of the box to the designer and owner

END OF SECTION

SECTION 28 1810 – PAGING AND BELL SYSTEM-IP Speakers with clock

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section provides detailed specifications for the new audio Paging/Bell system in the building.

1.02 DESCRIPTION OF PROJECT

A. The school shall receive new audio paging/bell/clock equipment
B. The district has an existing Singlewire Informacast system that shall be expanded to support the new and renovated space(s).
C. Where new equipment is being installed it shall include but not be limited to:
    1. Analog and IP speakers, cabling, headend equipment, an interface to the telephone system and programmable control software.
    2. System shall be two-way with talkback for each classroom. Teacher shall be able to have a two-way conversation with the person calling into the room through the speakers.
    3. Integral to the system shall be a programmable bell system that will work through the paging system speakers. The bell system shall allow multiple bell schedules and programming of bell schedules by the owner.
        a. The owner has an existing Singlewire #informacast system that shall be expanded
    4. Speakers shall be installed where shown on the drawings. The different paging zones shall be configured individually for occupied spaces.
    5. Control of the zones and bells and other configuration parameters shall be via a Web Page interface. The control system shall allow dynamic change of paging and bell groupings as well as the bell schedule.
    6. The paging system shall be fully integrated into the telephone system so that announcements can be made from any phone within the school.
    7. The paging system shall derive its time from the internet or from a national standard time device. The paging system shall be set to exactly the same time as the clock system.

1.03 SHOP DRAWINGS

A. Shop drawings shall be submitted by the Contractor for approval prior to installation of the work. The shop drawings shall show all data relating to the structural, electrical, wiring diagrams, etc.
B. The wiring and connectivity to be added to any racks and wallfields shall further be shown. Changes shall be reflected on existing layouts where applicable. For all new racks or wallfields required, the Contractor shall show a total elevation view of the layout.
C. Shop drawing shall specifically detail speaker zones and their associated zone designations.

1.04 CONTRACTOR

A. The Contractor shall accept complete responsibility for the installation, certification, and support of the system. Contractor must show proof that they have the certifying manufacturer's support on all of these issues.
B. All work shall be performed and supervised by technicians and project managers who are qualified to install Integrated paging/bell systems and cabling and to perform related tests as required by the manufacturer in accordance with the manufacturer's methods.
C. The vendor (including Subcontractor(s) if any) shall have a proven track record in paging and bell system configuration and installation. This must be shown by the inclusion of details of at least 3 projects involving the installation of like sized systems that have been completed by the vendor in the last 2 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The manufacturer of the paging/bell system shall have been designing, manufacturing, and installing systems for a period of no less than 5 years.

B. Approved manufacturers,

1. Software shall be Singlewire, #informacast
2. Hardware shall be #Atlas IED

2.02 PAGING/BELL SYSTEM

A. The actual system being installed shall be based around the Singlewire Informacast software

B. Hardware shall be Atlas IED.

C. The paging system and associated bell system shall provide at a minimum the following functions and features:

1. The integrated paging/bell system shall allow administrators to make announcements or sound tone events to any individually wired speaker or configurable group of speakers.
2. Shall be a talk-back, two-way system that supports calling from the telephone system and allows two-way communications between the caller and person in the room. This communication shall be through the in-room speaker.
3. Administrators shall be able to access the speakers through any telephone tied directly into the telephone system or designated paging system handset.
    a. Shall allow two-way communications thru the owner telephone system.
4. System shall interface with any telephone system, thus allowing an upgrade or replacement of the telephone system without suffering a requirement to replace, or lose any feature of, their paging system. Any system that limits system features based upon any selected telephone system, and/or is proprietary to one or only a few telephone systems shall not be acceptable.
    a. Shall be completely SIP (Session Initiation Protocol) compatible.
5. Pass codes shall be available to restrict access to the system if the owner deems them necessary.
6. Speaker zones shall be software assignable to different owner required groups. These groups shall be independent of the time/bell groups.
7. Provide time/bell schedules with the ability to automatically administer 8 or more schedules per building at any given time.
    a. Each scheduled event shall be capable of utilizing any one of 50-user defined internal tones/auxiliary sources. Automatically administered schedules shall be capable of simultaneous operation.
    b. Schedule administration, modification and creation functions must be available through administration Web Interface on the owners PC.
    c. Systems that do not allow the management of schedules with a web interface shall not be acceptable.
    d. Bell tones shall be through windows Media files or equal and shall be fully customizable by the owner.
        1) Work with the owner to load their chosen tones or announcements.
8. Distribution of general announcements shall be possible from any administrative telephone, staff telephone, or classroom telephone. The system shall be capable of providing all-call, group call, multiple group call, individual classroom calls or dial-on-the-fly page groups.
9. The system shall provide for the distribution of emergency announcement(s) from any authorized telephone to all areas furnished with a loudspeaker. Emergency announcements shall have the highest system priority
10. The system shall be a global switching system, providing eight (8) unrestricted simultaneous private telephone paths.

D. The electronics of the paging/bell system shall have the following capabilities:
   1. The owner has an existing Server or appliance based that is capable of handling up to the number of points shown on the drawings or more as the system connectivity requires.
   2. Software and hardware shall be capable of connecting to:
      a. IP speakers
      b. SIP telephone system
      c. SIP endpoints
      d. Dry contact inputs and outputs. (see drawings and specs for interface requirements)
      e. Desk based IP microphones
      f. Auxiliary analog audio input. Shall stream audio to the SIP speakers
   3. System functionality must include the capability to manually distribute any number of tones or pre-recorded files via pushbuttons, contact closure, webpage scheduler or dial up tones from any administrative telephone or other input buttons. These tones shall be customizable with respect to cadence, type, and duration.
   4. The system shall have the ability to control all system relays. All relays must be software programmable with the flexibility to change as required.
   5. The system shall be capable of adding auxiliary inputs such as an IPod, MP3 player or CD player to play over any group of speakers at a certain time. The auxiliary input shall be assignable just like bell tones and announcements.
      a. Shall be assignable to play during pre-set times of the day and for a pre-set duration.
      b. Shall be able to play music or other audio input or streamed audio.
   6. See the drawings for the paging zones required.
   7. Shall tie to the national time clock to keep the bell system on the correct national time. Provide equipment and cabling required to keep the bell system on the correct time.

E. The actual system electronics (where required for integration to analog speakers or dry contacts) shall be capable of being mounted in a standard 19-inch relay rack or being mounted on a communications wallfield.
   1. Power shall be from a standard 110V AC outlet or PoE network power.
   2. Shall be Ethernet Attached to owner's data network.
   3. The system shall manage announcements and messages using dynamically routed data on a standard POE Ethernet Network connections.
   4. The system shall manage other peripherals including Digital Communications Stations, Network Power Amplifier Systems, Input/Output Devices, Zone Controllers and IP End Points.
   5. The system shall include internal support for (4) logic inputs, (4) relay outputs, and (2) balanced audio inputs plus:
      a. Line input
      b. Mic Input
   6. The system shall manage dynamic requests for live and delayed announcements, pre-recorded and assembled messages, actions, defined events, and two-way full duplex intercom connections.

F. The interface for control of the time events and paging groups shall be via a PC with an Ethernet connection to the network.
   1. Control software shall be installed and reside on three (3) administrator's PC's. The software shall guide the user through the setup and control of all aspects of the paging and bell system.
   2. Provide a 3, or 4-digit numbering plan, thus allowing the zone to be custom numbered as per the owner's requirements.
   3. Individual groups of speakers wired in sequence shall be assignable to a distinct number. The system shall have the capability of assigning numerous groups of wired speakers to one dialing group. All groups shall be programmed by the Contractor prior to acceptance of the system.

2.03 MASS NOTIFICATION, EMERGENCY ALERTS AND ROUTING PAGING/COMMUNICATIONS

A. Contractor shall provide a complete solution for mass notification, emergency alerts and paging system and clock system that supports internal communications
B. The system shall include software to support the connection of the IP Telephone system to the software
C. This software shall integrate at a network level with the existing telephone system and shall distribution audio to IP/SIP endpoints and analog systems.
D. The software shall support I/O integration between different systems.
E. The software shall include and support:
    1. Mobile device notification and event triggering
    2. Two-way messaging and audio communications thru audio speakers
    3. Multimedia push notifications, and support for
    4. Geofencing for mobile devices.
    5. Unlimited creation of live, pre-recorded, or scheduled broadcast events
        a. Activations initiated from on or off-premise devices
        b. Multimodal notifications to desktop devices, mobile devices, overhead speakers, email, loud horns, strobes, digital/LED signs, and more
    6. Integration with SMS services to alert via text messages
    7. Out-of-the-box integrations with automated alerts and early-warning systems
    8. Geo-location controls to ensure mobile recipients receive relevant information based on their current location
    9. Multilingual text-to-speech engine support to translate dynamic text into intelligible audio broadcasts
    10. One-touch building lock downs triggered via silent alarms using integrated panic buttons or dialing a set number
    11. Automatic sending of alerts from external early-warning systems to everyone across the organization, facility, or campus
    12. Creation of school bell schedules and daily announcements
F. Shall allow and support multiple bell schedules and these shall be assignable based on a calendar.
G. System shall be integrated with following manufacturers
    1. Atlas IED
    2. Valcom
    3. CyberData
    4. Algo
H. Software shall be virtualized on the owners existing server platform
I. Software shall be Singlewire, #Informacast or equal.

2.04 ANALOG SPEAKERS

A. Speakers for all drop-ceiling areas, unless otherwise noted shall be 8 inch speakers that fit directly into the drop ceiling tile.
    1. Speaker shall be an 8-inch loudspeaker with a painted white baffle.
    2. Each speaker shall have a 6oz. magnet.
    3. Sensitivity shall be 95dB at 4ft/1W.
    4. Speaker voltage shall be 25 or 70 volt.
    5. Provide a tile bridge with each speaker for installation in a standard drop ceiling.
    6. Provide a backcan for each speaker.
    7. Speaker shall have taps at 1/8W, 1/4W, 1/2W, 1, 2 and 4 watts.
    8. Shall be capable of talkback through intercom/paging system.
    9. Each speaker shall have an individual volume control on the speaker.
    10. Paging system speakers for drop ceilings shall be Atlas Sound # SD72WV or equal.
    11. Where the speaker shall be mounted flush into the drywall the contractor shall provide a backbox for the speaker.
B. Speakers for exterior, gymnasium, and mechanical spaces shall be horn type speakers:
    1. Horns for the exterior of the building shall be 15-watt horns that are weather-resistant.

2. Each horn shall be capable of being mounted to a standard double-gang backbox. Speaker cables shall route through the base of the speaker and shall not be exposed.
3. All horns shall be white in color and be capable of being positioned anywhere in a 360-degree axis.
4. Exterior 30-watt horns shall be Atlas Sound GA-30T or equal.

2.05 70 VOLT PAGING AMPLIFIER / ZONE CONTROLLER -SIP ENABLED

A. Where there are to be existing speakers that remain or where new analog speakers are to be installed, the contractor shall provide and install a SIP enabled zone controller/amplifier and connect to the analog audio speakers.
B. Shall be rack or shelf mounted. Provide shelf where the device is not rack mounted.
C. Amplifier shall support SIP input from the Ethernet network.
D. Shall support multicast receive input.
E. 25 watt minimum output at 8 Ohm or 70 volt
F. Control Board with amplifier:
   1. The amplifier / control board shall receive announcements and messages using dynamically routed data on a standard Ethernet Network.
   2. It shall include a Single-Channel Class D Topology amplifier with Primary and Secondary Outputs capable of producing 25-watts RMS when using an IEEE 802.3at compatible PoE+ switch or 24VDC local power supply.
   3. Interconnect shall be via female RJ-45 connector mounted to the PCB.
   4. Shall include (2) logic inputs, (1) relay output, (1) Auxiliary Unbalanced line level audio input and (1) Unbalanced line level audio output.
   5. The Auxiliary Line Level input shall include an auto mute function that is activated when a broadcast is sensed from the control application.
G. Single Zone Controller shall be Atlas IED #IP-ZCM1RMK. Include rack mount kit for each device

2.06 IP SPEAKERS WITH CLOCK AND STROBE -WALL MOUNT

A. Speakers for all ceiling areas, unless otherwise noted shall be 8-inch speakers that are mounted based on their installation location.
B. These speakers shall be used for the following installation types:
   1. Wall mount with custom mount box
C. Speaker/clock/strobe shall meet the following requirements:
   1. The speaker shall be an 8" Coaxial driver with low-frequency reproducer cone shall be a full 8" (203mm) in diameter and the high frequency reproducer cone shall be 3" (76mm) in diameter.
   2. The woofer shall have a 10oz. (260g) ceramic magnet; the tweeter shall have a 2.35oz. (67g) ceramic magnet.
   3. Control Board with amplifier:
      a. The amplifier / control board shall receive announcements and messages using dynamically routed data on a standard Ethernet Network.
      b. It shall include a Single-Channel Class D Topology amplifier with Primary and Secondary Outputs capable of producing 25-watts RMS when using an IEEE 802.3at compatible PoE+ switch or 24VDC local power supply.
      c. Interconnect shall be via female RJ-45 connector mounted to the PCB.
      d. Shall include (2) logic inputs, (1) relay output, (1) Auxiliary Unbalanced line level audio input and (1) Unbalanced line level audio output.
      e. The Auxiliary Line Level input shall include an auto mute function that is activated when a broadcast is sensed from the control application.
   4. The unit shall incorporate an integrated microphone to allow full duplex talkback communication functionality based upon chosen software platform.
   5. Clock and Messaging:
      a. The unit shall incorporate a High-Resolution Back-Lit color LCD display with viewable dimensions of 8.66" (221mm) wide x 2.23" (57mm) high.
      b. Shall display correct time.

c. Shall allow custom messages to be played on the screen.

6. Strobe/Flasher
   a. The unit shall incorporate a LED flasher with viewable dimensions of 0.5" (13mm) height x 3.5" (89mm) wide.
   b. The LEDs shall be able to produce RGB color spectrum with brightness of 83-lux (Red), 545-lux (Green), 90-lux (Blue), 570-lux (White).
   c. It shall have the capability of multi-speed flash rate and will be software controllable.
7. Connectivity to Software
   a. All control functionality shall be determined via software.
   b. It shall be compatible with:
   c. AtlasIED's GCK,
   d. Syn-Apps' Revolution,
   e. Singlewire's InformaCast
   f. and SIP standalone operation.
8. Combo speaker/clock and LED Flasher shall be Atlas IED #IP-SDMF or equal
9. Equip with Backbox
   a. Straight Backbox, Atlas IED #IP-SEST-SD

2.07 IP SPEAKERS WITH CLOCK AND STROBE -DUAL-SIDED, WALL/CEILING MOUNT

A. Speakers and Clocks for wall/Ceiling mount, dual-sided installation in hallways, ETC

B. Description:
1. Dual-sided, IP Endpoint Visual System shall consist of a factory assembled double sided wall or ceiling mount enclosure containing 2 LCD displays that can display
2. time and date as well as scrolling text.
3. The model shall also feature LED flashers located below the display can be used to alert room occupants of an incoming scrolling text message in accordance with ADA
4. compliance.
5. The unit shall incorporate 3" loudspeaker drivers on each side of the display.

C. Speaker/clock/strobe shall meet the following requirements
1. 3" (76mm) in diameter full range transducer
2. Control Board with amplifier:
   a. The amplifier / control board shall receive announcements and messages using dynamically routed data on a standard Ethernet Network.
   b. It shall include a Single-Channel Class D Topology amplifier with Primary and Secondary Outputs capable of producing 25-watts RMS when using an IEEE 802.3at compatible PoE+ switch or 24VDC local power supply.
   c. Interconnect shall be via female RJ-45 connector mounted to the PCB.
   d. Shall include (2) logic inputs, (1) relay output, (1) Auxiliary Unbalanced line level audio input and (1) Unbalanced line level audio output.
   e. The Auxiliary Line Level input shall include an auto mute function that is activated when a broadcast is sensed from the control application.
3. Clock and Messaging:
   a. The unit shall incorporate a High-Resolution Back-Lit color LCD display with viewable dimensions of 8.66" (221mm) wide x 2.23" (57mm) high.
   b. Shall display correct time.
   c. Shall allow custom messages to be played on the screen.
4. Strobe/Flasher
   a. The unit shall incorporate a LED flasher with viewable dimensions of 0.5" (13mm) height x 3.5" (89mm) wide.
   b. The LEDs shall be able to produce RGB color spectrum with brightness of 83-lux (Red), 545-lux (Green), 90-lux (Blue), 570-lux (White).
   c. It shall have the capability of multi-speed flash rate and will be software controllable.

5. Combo wall or ceiling mount, dual sided speaker/clock and LED Flasher shall be Atlas IED #IP-DDS or equal

D. Connectivity to Software for all clocks and IP speakers
   1. All control functionality shall be determined via software.
   2. Speakers shall be compatible with:
      a. AtlasIED's GCK,
      b. Syn-Apps' Revolution,
      c. Singlewire's InformaCast
      d. and SIP standalone operation.

2.08 AUXILIARY EQUIPMENT

A. Auxiliary audio input for the paging system:
   1. The paging system has the ability to take an auxiliary audio input for playing audio through the paging system speakers.
   2. Install a wire and faceplate in the school office to allow auxiliary input. Label for paging system input.
   3. See drawings for equipment and cabling required.
   4. Input to the system shall be thru the IP to analog gateway. This device has Mic and Line Level audio inputs. Shall be Atlas IED #IP-ZCM or equal

B. Cables:
   1. The contractor shall install all cables required for connectivity of each speaker zone throughout the building. All cabling routed above the drop ceiling shall be plenum rated.
   2. Install cabling required for connection of the paging/bell system to the microphone and auxiliary audio inputs.
   3. All cabling required for complete system functionality and control and interface with the telephone system shall be installed, labeled and terminated by the contractor.
   4. Speaker Wire for analog speakers:
      a. The Contractor shall size the speaker wire for the distance between the amplifier and the speaker, as well as the impedance of the speaker.
      b. Speaker wire resistance shall not exceed 7 percent of the speakers' impedance.
      c. Speaker wire shall be no smaller than 18 AWG.
      d. Speaker wire shall be high conductivity, copper cable. Cable shall be of single pair, stranded construction. Cable shall be 2 parallel cables, black in color and 1 of the conductors shall be marked for identification at each end.
      e. Cable shall be a minimum of 99.95 percent copper.
      f. Provide plenum rated wire when the cable will route through a plenum area. Contractor shall be responsible for identifying plenum areas.
      g. Speaker cables for these systems shall be homeruns from the speaker to the terminal strip. There shall be no splices in the cable.
         1) 18 AWG plenum Speaker cable shall be West Penn #25224B
         2) 16 AWG plenum Speaker cable shall be West Penn #25225B

2.09 ETHERNET NETWORK ELECTRONICS

A. Ethernet switchers are not part of the paging system bid category.
B. Contractor shall install patch cables at the speaker and at the Ethernet switch in the communications room

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION

A. Contractor shall be familiar with the location(s) where the work will be done. No additional compensation will be made for items the Contractor claims he was not aware of during bidding.
B. Work Area:
   1. All work areas shall be cleaned at the end of each day. All debris shall be cleaned and removed from the site and disposed of in the approved container for the site.

2. All equipment shall be moved out of common areas and stored in the Contractor's lay down area, or in other approved storage locations on site.
3. Any work that is low hanging, or may otherwise impede the general use of the space, and cannot be removed shall be flagged and cordoned off by the Contractor.

C. All equipment and parts shall be installed in a neat and workman like manner. Good installation principles shall be used throughout the project.

D. All cables routed above the drop ceiling or in the ceiling area shall be installed square to the building. Diagonal cable runs are not permissible.

E. If in the course of the work, the Contractor damages, marks, or misplaces any ceiling tiles the Contractor shall repair, and or replace the ceiling tile to the original condition.
1. the Engineer shall decide if ceiling tiles have been damaged, and based on the Contractor's proposed fixes, shall decide the best course of action to repair any damage done by the Contractor to the ceiling tiles.

F. It shall be the responsibility of the Contractor to repair any damage done to the structure or finishes in the building by the Contractor. The building shall be returned to its original condition prior to final sign off of the project.

G. The Contractor shall be responsible for locating the speakers of the audio systems in each room. The speakers shall be installed to provide complete coverage with no "dead" spots. Approximate locations are shown on the drawings, the Contractor shall review these and advise the Engineer of any proposed changes prior to installing/ordering speakers. If no changes are suggested the contractor shall be responsible for coverage and meeting all specifications

3.02 70 VOLT CABLING INSTALLATION

A. At some locations the IP Paging system shall feed a group of 25/70 volt speakers. See drawings for these speakers and zones.

B. Provide and install speakers and plenum rated speaker cabling.

C. All cabling for connection of the audio devices and any 25/70 volt speakers in the system shall be routed above the drop ceiling or in other raceways as required. No speaker cabling shall be visible other than in the communications room.
1. 25/70 volt Paging speaker cabling shall be terminated on terminal blocks on the communications wallfield.
2. All 25/70-volt speaker cabling shall be labeled at each end and at each interconnection point for those cables that serve multiple speakers. The labels shall display the extension number of the group of speakers that are connected. Along with the extension number, the label shall reflect the room if it is a specialized use room, such as ART, GYM, CAF, etc.
3. 25/70-volt Speaker cables shall be routed through the ceiling and supported the same as voice and data UTP cabling is supported. Cables shall route through cable tray or J-hooks.
4. All speaker cables shall be supported a minimum of every 5 feet. No cables shall be supported directly by the building structure, conduit, or mechanical piping.
5. Cables shall be terminated in sequence on the terminal blocks according to extension/room number.
6. Speaker cables shall not be in the same J-hooks as data or telephone cables. Provide additional J-hooks as required.

3.03 SYSTEM INSTALLATION

A. The electronics and components of the paging/bell system shall be in the communications room or where directed by the owner.
1. All components shall be mounted in rack/cabinet.
2. Locate the components as required for connections to power and the ground bar.
3. Ensure that the components are securely mounted to the wall or in the rack/cabinet on a shelf.
4. The Contractor shall install all patch cables required for connection of the components to the Ethernet network.

B. The control software shall be installed on three (3) administrator's PC as directed by the Owner.
   1. The control software shall be fully configured and shall be installed with any cabling or associated software required to connect it to the paging/bell system.
   2. Meetings shall be held by the Contractor that includes the Owner and the Engineer. During the meetings, the Contractor shall provide all possibilities for configuration of the system to the Owner. Decisions shall be made on speaker/bell groupings, a numbering scheme, naming, etc.
      a. See drawings for the extent of the zones and how to connect the speakers. In example; each hallway on each floor shall be a separate zone. Other zones would include the cafeteria, gymnasium, administration offices etc.
   3. The Contractor shall be fully responsible for configuring the system per the Owner's requests. This configuration shall be done on site and shall be attended by 2 or more of the Owner's Representatives. This will allow the Owner to better understand the interface and control of the system.
   4. All configurations shall be recorded on a spreadsheet that notes the speakers, the room numbers, extensions, and the extension numbers of all the different groupings of speakers. The spreadsheet shall be up to date at the time of acceptance by the Owner and shall be printed. Handwritten spreadsheets are not acceptable.
      a. Provide spreadsheet to the owner for their records
   5. Work with the owner to determine all IP addresses for each speaker, server and end point devices.
   6. Input all names of zones and each individual speaker's into the system.

C. Bells
   1. The bell system shall be completely configured by the contractor.
   2. Work with the owner to define the different bell schedules and input and label those schedules. These shall include but not be limited to:
      a. General class schedule
      b. Half-day schedule
      c. Pep rally schedule
      d. Two-hour delay in start of school schedule
   3. Work with the owner to input numerous .wav files that can be used for bell tones.
   4. Make the system capable of playing music during passing time if the owner wishes. Configure which zones music will be able to be heard from.

3.04 SPEAKER/CLOCK INSTALLATION

A. Work with the owner on IP addressing of all devices.
   1. Record IP address of each speakers and endpoint in a spreadsheet in Excel.
   2. Work with the owner on the IP addressing scheme.
   3. Set all IP address in each speaker and endpoint device.
   4. Provide and install a patch cable at the communications room.

B. Speakers mounted in the drop ceiling shall be fit into the ceiling supports. Provide a tile bridge for each speaker.
   1. Speakers shall be located to provide maximum coverage possible in each room or each area. Changes from the drawings in the location of speakers are acceptable but must first be approved by the Engineer.
   2. Contractor shall work with the ceiling installer and others prior to and during installation of the speakers. The Contractor shall identify the ceiling tiles that will not need to be installed because a speaker will be installed in those spaces.
   3. The cable connecting to the speaker shall be supported directly over the speaker from a J-hook. The Contractor shall provide a CAT-6 patch cable so that the speaker can be lifted from the tile and moved without causing a disconnection of the cable.

C. Speakers in rooms with no drop ceiling shall be mounted directly to building structure.
   1. The speakers shall be mounted in a backbox that entirely covers the back of the speaker.

2. The backbox shall be mounted securely to building structure. It shall be mounted so that the sound is not impeded by obstructions between the speaker and the listener.
3. Provide a CAT-6 patch cable for connection of the speaker to the CAT-6 network cable. A coil of at least 5 feet of cable shall be left at each speaker so that they can be removed from the backbox without disconnecting the speaker.
4. The grill of the speaker and the backbox shall be painted to match the existing ceiling color.
5. Install a conduit or raceway to route the speaker cable from the speaker to the accessible drop ceiling in the hallway.

D. Horn style speaker shall be mounted to a backbox or building structure for support.
1. Horn style speakers mounted outside
a. Drill thru the wall into the building.
b. Install a conduit thru the wall and a backbox on the outside of the building.
c. Weatherproof the conduit and wall. Seal between the base of the horn and the backbox. The seal shall be by an epoxy or other water resistant substance.
2. Horn style speakers mounted inside
a. Shall be mounted to building structure.
b. Aim the speakers to cover the most area.
3. Speakers shall be mounted to provide maximum coverage of the area intended to be served.
4. Provide a CAT-6 Patch cable for each speaker.

E. Speakers that are to be wall-mounted shall be mounted to a wall-mounted box.
1. The speakers shall be mounted in a backbox that entirely covers the back of the speaker.
2. The backbox shall be mounted securely to wall over top of a single-gang backbox. It shall be mounted so that the sound is not impeded by obstructions between the speaker and the listener.
3. Provide a CAT-6 patch cable for connection of the speaker to the CAT-6 network cable. A coil of at least 2 feet of cable shall be left at each speaker so that they can be removed from the backbox without disconnecting the speaker.
4. If there is no backbox then fish the wall and install the patch cable to connect the speaker.

F. Set all custom messages on clock devices. Couple all message with buttons on the console and with time schedules for bells.
G. Custom create messages based on input from the owner.
H. Create buttons on the console/software for distribution of each custom message. Set start and finish times for messages.
I. Create custom colors for messages and strobes based on input from the access control system. Set time frames for strobes and messages.
J. Create button on console and in software to reset system to normal operation.

3.05 SYSTEM TESTING

A. The Contractor shall be responsible for all aspects of the sound of the system once installed.
1. The sound of the system is of utmost importance to the Owner. The Owner requires a system that is intelligible when the space is occupied or unoccupied.
2. Each room shall be tuned and the audio output level of each speaker shall be set to provide the best sound possible.
3. The Contractor shall go into each room and conduct a listening test to determine that the sound is intelligible and that the gain is not set too high. This shall be done in each room and each area.
4. In each classroom, test the talkback thru each speaker and the telephone system.
5. Test each configurable zone and ensure that audio comes thru the speakers and that they are only attached to each zone.
6. Prior to acceptance of the system, the Contractor shall conduct a system walk-thru with the Owner and the Engineer.

7. The walk-thru shall consist of entering each room, making a call from a telephone and making an announcement into that room through the paging system.
8. The Owner and Engineer will be checking for complete coverage in each room and correct volume setting of the speakers and the associated volume controls. Any changes required shall be the responsibility of the Contractor.

END OF SECTION

SECTION 28 3100 - FIRE ALARM

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 26 Section “Electrical General Requirements.”

1.02 SUMMARY

A. This Section includes design and installation of a new fire alarm system cross tied onto an existing fire alarm system.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.03 **DEFINITIONS**

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.04 **SYSTEM DESCRIPTION**

A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

B. Fire alarm system shall consist of the following:

1. New fire alarm control panel, devices, and wiring cross tied into existing fire alarm system.
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. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
5. Audible and visual notification appliances in all public and common areas of the building.

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. Coordinate with fire protection contractor and approved shop drawings for all control and monitoring requirements of the fire protection system.

J. Premises protection includes Education 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.

K. 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.

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 01 7823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:

a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.

b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.

c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.

d. Riser diagram.

e. Device addresses.

f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.

g. Record copy of site-specific software.

h. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.

2) Frequency of testing of installed components.

3) Frequency of inspection of installed components.

4) Requirements and recommendations related to results of maintenance.

5) Manufacturer's user training manuals.

i. Manufacturer's required maintenance related to system warranty requirements.

j. Abbreviated operating instructions for mounting at FACU and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.

2. Program Software Backup: On USB media.

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. Keys and Tools: One extra set for access to locked or tamper-proofed components.

2. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

3. 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.

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. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.11 **PROJECT CONDITIONS**

A. Interruption of Existing Fire Alarm Service: Do not interrupt fire alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify the Owner’s representative no fewer than seven days in advance of proposed interruption of fire alarm service.

2. Do not proceed with interruption of fire alarm service without written permission from the Owner’s representative.

1.12 **SEQUENCING AND SCHEDULING**

A. Existing Fire Alarm Equipment: Maintain fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of the new fire alarm system, remove existing disconnected fire alarm equipment.

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.

1) Provide new voice fire alarm system cross tied to existing National Time & Signal fire alarm system.

2.02 **EXISTING FIRE ALARM SYSTEM**

A. Compatibility with Existing Equipment: Fire alarm system and components shall operate as an extension of an existing system.

2.03 **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: Surface.

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, 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. 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.

F. 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.

G. 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.

H. 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.

I. 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. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones, or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall be UL 1711 listed.

a. Allow the application of and evacuation signal to indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.

b. Programmable tone and message sequence selection.

c. Standard digitally recorded messages for "Evacuation" and "All Clear."

d. Generate tones to be sequenced with audio messages of the type recommended by NFPA 72 and that are compatible with tone patterns of the notification-appliance circuits of the FACP.

2. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

J. 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.

K. 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."

L. 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.

M. Surge Protection:

1. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.

N. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.04 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.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure, hinged at the top to permit lifting for access to initiate an alarm.

2.05 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.

2.06 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.

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.

2.07 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.

2.08 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.

2.09 **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.

2.10 **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.

2.11 **WIRE AND CABLE**

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.

C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):

1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

D. Non-Power-Limited Fire Alarm Circuits (NPLFA):

1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   a. Low-Voltage Circuits: No. 16 AWG, minimum.
   b. Line-Voltage Circuits: No. 12 AWG, minimum.
2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI

PART 3 EXECUTION

3.01 **EQUIPMENT INSTALLATION**

A. Connecting to Existing Equipment: Verify that existing fire alarm system is operational before making changes or connections.

1. Connect new equipment to the existing control panel in the existing part of the building.
2. Connect new equipment to the existing monitoring equipment at the Supervising Station.

3. Expand, modify, and supplement the existing control and monitoring equipment as necessary to extend the existing control and monitoring functions to the new points.

4. New components shall be capable of merging with the existing configuration without degrading the performance of either system.

B. Smoke Detector Spacing:

1. Smooth ceiling spacing shall not exceed 30 feet, or the listed spacing of the detectors, whichever is less.

2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.

3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

C. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

D. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

E. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector that is above 10’-0” aff, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.

F. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

G. Visible Alarm Notification Appliances: Install wall mounted appliances at 96” AFF or 6 inches below the ceiling, whichever is less.

H. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

I. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.

J. Install notification appliances on existing CMU walls on surface back-boxes matching the dimensions and finish of the notification appliance.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. 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).

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 and similar service spaces.

4. Drops to surface mounted devices shall be installed in conduit or surface raceway. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.

5. Drops to devices recessed in partition walls shall be installed in conduit.

6. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

7. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits, if the system manufacturer permits it.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section “Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.04 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections**,** and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

a. Include the existing system in tests and inspections.

2. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

3. Testing: Follow procedure and record results complying with requirements in NFPA 72.

   a. Detectors that are outside their marked sensitivity range shall be replaced.

4. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.06 **PROGRAMMING**

A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.07 **ADJUSTING**

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

3.08 **WARRANTY**

A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.09 **DEMONSTRATION**

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1 Section "Closeout Procedures/Demonstration and Training."

END OF SECTION

SECTION 28 3500 – PHYSICAL ACCESS CONTROL SYSTEM (PACS)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes parts and equipment required for installation and termination of a building-wide Physical Access Control System (PACS). This system shall be referred to as the “security system”, “system” or PACS throughout these specifications.

1.02 SYSTEM DESCRIPTION

A. The security system shall be supplied and installed by a Contractor able to show examples of similar projects and installations within the last 3 years.

B. The security system shall serve the building but shall be able to be expanded to serve additional buildings in the future.

C. The Security System shall provide a solution for access control and alarm monitoring. This shall be through a central server with PC attached workstations for monitoring and control. Shall include:

1. Access Control
2. Alarm Monitoring

D. Contractor shall provide all software required for connection of the security system to the in-house data network and associated control PC’s.

E. The security system client-server architecture shall communicate with native TCP/IP over an existing Ethernet TCP/IP enterprise network.

1.03 COORDINATION

A. All cables shall be coordinated with the door hardware and security devices being installed as part of this project.

B. PACS cable shall be a unique color from the Telecommunications cable, fire alarm cable and lighting control cable. Coordinate this with the Electrical Contractor prior to ordering the equipment and installation of the cables.

1.04 PROJECT PLAN

A. Prior to ordering equipment and installation, the contractor shall provide a project plan to the owner and contractor that describes the system and its capabilities and the possible configurations.

B. Provide a project approach which describes the installation and implementation plan and schedule and all sequencing.

C. Meet with the owner numerous times to determine how the system should work and how it should be monitored.

1. Configure the system prior to installation to meet these requirements. Demonstrate the system use to the owner prior to installation and obtain approval to move forward with the installation.

D. Generate a testing plan and have that plan approved by the owner and engineer prior to installing the system.

E. The system shall be installed and tested prior to cutting over any doors to the system. Provide and install temporary card readers, door contacts etc to the system for testing. Demonstrate that this works prior to cutover.

F. Conduct all testing of the system

G. Conduct user training on the system

H. Provide as-built documentation of the installed system

1.05 RELATED STANDARDS

A. The security system shall conform to the following international and national standards:
   1. FCC Rules and Regulations
   2. UL 294 Access Control Systems
   3. UL 1076 Line Supervision
   4. 21 CFR part 11
   5. Part 15, Radio Frequency Devices
   6. National Electrical Manufacturers Association (NEMA.)
   7. Applicable Federal, State and Local laws, regulations, codes
   8. National Electrical Code (NEC)
   9. NFPA 80 National Fire Protection Agency - Fire Doors & Windows (edition is jurisdiction dependent).
   10. NFPA 101 National Fire Protection Agency - Life Safety Code (edition is jurisdiction dependent).
   11. NFPA 105 National Fire Protection Agency - Smoke Control Door Assembly (edition is jurisdiction dependent)
   12. ANSI 117.1 1992 Edition Providing Accessibility and Usability for Physically handicapped People.
   13. A.D.A.A.G Americans with Disabilities Act Accessibility Guidelines.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approved vendors for security cables are:
   1. General Cable.
   2. Belden.
   3. West Penn Wire and Cable.
   4. Equivalent manufacturers.

B. Approved manufacturer for panels and power supplies are:
   1. Altronix
   2. Life Safety

C. Approved vendor for Physical Access Control System (PACS) equipment is:
   1. Lenel S2 OnGuard
   2. The owner has an S2 system existing. Expand this to the new spaces or renovated spaces to support new door and access control systems.
   3. Expansion of the system shall utilize Mercury boards for all new panels.

2.02 DESCRIPTION OF PROJECT

A. The owner has an existing Lenel S2 OnGuard system in place
B. Expand this system to support new end point devices.
C. Fully integrate the new panels and end point devices to the system.
D. See drawings for end points and devices to be connected.
E. The access control system shall be an all-encompassing system that is large enough to serve numerous employees and be extended to numerous buildings. The system shall, collect data and monitor doors and entrances at:
   1. No less than 10 Buildings
   2. Support no fewer than 2000 users
F. The original installation will be for the building(s) noted on the drawings. The system installed shall not preclude the extension of the system to other buildings.
G. The system shall include all equipment, software, cabling, data collection points, card readers and hardware to monitor and control the specified devices and provide reports to a security station as required by the owner.

H. If an Intrusion Detection system is specified, then the access control and intrusion detection system shall act as one system. They shall be integrated such that the presentation of a known access card will shunt all intrusion alarms for the door where the card was presented.
I. The system shall keep records of all access control card presentations.
J. The system shall connect to and interoperate with all the door hardware that which is existing and being added as part of this project.
K. The system shall be able to be connected to other buildings via the existing data network. Specify how the system will connect to other buildings as part of your bid response.
L. The Owner shall be able to change and monitor all settings for intrusion and access to all the buildings through the control PC.

2.03 MATERIALS
A. All security and control cables shall be plenum rated.
1. Contractor shall provide all appropriate cable from the door security hardware to the security system. All cabling shall be plenum rated.
2. Some locations require outdoor rated cabling. The contractor shall provide the cabling to match the required area.
3. There will be requirements for many different types of cabling and the contractor shall provide for each.
4. Provide a coil of cable at each location for moves and maintenance.
B. The system shall be fully configurable and compartmentalized so that any user can be assigned and they will only see the status of doors at one building.
1. Based on a user's login, the system shall be configurable to restrict persons from seeing or controlling doors and lock schedules at building that they do not have permission to see or control.

2.04 SECURITY SYSTEM SERVER
A. Management Server:
1. Server/Appliance for Lenel S2 OnGuard is existing
2. Configure new devices and new users on the system.
3. Contractor shall connect the Server to the Ethernet in the building.
4. Provide all equipment required to mount the Server in the cabinet/rack
5. Server shall connect to the Access Control Module via the Ethernet network

2.05 ACCESS CONTROL SYSTEM SOFTWARE
A. Software shall be Lenel S2 OnGuard
B. Provide, install and configure

2.06 SECURITY ENCLOSURE
A. Shall be provided to hold power supplies, controllers, access control panels, card reader panels, input/output cards (now to be referred to as security panels) and any other components required for a complete access control system.
B. Security enclosures are the physical boxes and cabinets that support the intelligent controllers, I/O boards, power supplies and power distribution equipment.
C. Security panels hall be wall mounted and large enough to hold power equipment and access control system controllers and cards.
D. Security panel shall be:
1. UL: Listed: UL 294 approved
2. Enclosure shall accommodate power supply and sub-assemblies such as controllers and security cards to be provided as part of the project.
3. Primary power input shall be 115VAC
4. Physical
a. Size enclosure as required to hold power supplies and security panels. Provide multiple enclosures where required.

b. Made of 16 AWG sheet metal
c. Shall have conduit knockouts or custom cut holes for access to the panels for cabling.
d. Be equipped with an internal cam lock
e. Be equipped with a tamper switch that shall be wired to the I/O for software alarm when the panel is opened.
f. Shall have space for batteries to support the access control system.

5. Equip with a backplate that shall support direct mounting of the security panels and power devices
6. Equip with magnetic cable supports that attach to the backplate to support cables.

E. Security Enclosure shall be Altronix Trove series or equal.

2.07 PLYWOOD TO BE MOUNTED BEHIND ALL SECURITY PANELS.

A. Plywood shall be American Plywood Association (APA), Grade A-C at minimum. Meaning that the “A” side is smooth and paintable, neat repairs are permissible. “C” side allows knotholes to 1 inch and limited splits are permitted. “A” side is used for mounting; “C” side is installed towards the wall.
B. Plywood shall be 3/4-inch-thick and shall come in 4 foot x 8 foot sheets with a quantity of sheets installed as per the detailed drawings.
C. All plywood used for wallfields shall be fire-retardant plywood and shall be stamped as such.
1. Shall have a Flame-spread rating of 25 or less,
D. Each piece of plywood with one coat of white paint. Paint all edges.
1. Do not paint over one of the Fireproof stamps on the plywood. Leave this so that the owner can identify that the plywood installed is fire-retardant.

2.08 POWER SUPPLIES AND POWER DISTRIBUTION

A. Power supplies and power equipment shall be provided that support the entire access control system, security panels/controllers, door locks and all other field equipment of the access control system.
B. All power supplies shall be connected to 120VAC power with a hardwired connection. Install cable and connect to power.
1. Provide and install conduit, wiring and connections required for 120-volt power connectivity.
C. Power supply shall be mounted to the enclosure. Shall include:
1. Shall provide power to the panels in the enclosure and field devices.
2. Shall include multiple 12 or 24 volt outputs. Shall be settable on the panel
3. Input voltage of 120VAC with a fuse
4. Classified as a Power-Limited stand-alone power supply with stand-by battery and suitable to power sensors and electro-mechanical devices (e.g. electric door strikes), as defined in the National Electrical Code/NFPA70/NFPA72
5. Shall be sized for outputs of 1 thru 16 unique outputs.
6. Battery connection for charging on-board batteries.
7. Fire alarm disconnect
a. Shall support Normally Open or Normally Closed trigger
b. Shall be set to latching or non-latching
8. LED indicators for:
a. AC input
b. DC output
c. Battery discharged or no battery
9. Over Voltage protection
10. Short Circuit protection
11. Power supply shall be Altronix #eFlow series or equal.
a. Provide actual part that provides for all power and control of the system as required to meet the manufacturers requirements and these specifications.
12. Equip with an Ethernet Module for panel control and monitoring:

a. Shall support remote supervision, control and monitoring over an Ethernet connection.
b. Connect to the owner's network and setup monitoring.
c. Altronix #Linq2 or equal

D. Access Power Controllers
1. The Power Controller shall have the following characteristics:
a. Powered by 12 VDC or 24 VDC from the power supply/charger board or via 8-Pin connector to stack with Voltage Regulator for dual voltage (12VDC & 24VDC) outputs from a single 24VDC input, up to 6 Amps
b. Spade lug connectors to facilitate the transfer or sharing of 12VDC and/or 24VDC power between Access Power Controllers or Power Distribution Modules
c. 8 trigger inputs to correspond with similarly numbered triggered controlled outputs, with each trigger input being in one of the following forms:
1) Normally open (NO) contact
2) Open collector
d. 8 independently trigger-controlled outputs with the following output options:
1) Fail-Safe filtered and electronically regulated power outputs
2) Fail-Secure filtered and electronically regulated power outputs
3) Form "C" relay outputs, rated 5 amps @ 28 VDC/VAC.
4) For each triggered output, LED indication of an active output.
5) Bi-colored LEDs for visual verification of voltage (12VDC or 24VDC) per output
6) An unswitched auxiliary power output, rated at 2.5 amps (fused) or 2 amps (PTC), used in lieu of a trigger-controlled output.
7) Fuse protected
e. FACP (Fire Alarm Control Panel) interface
1) input options from the FACP:
A) polarity reversal
B) Normally Open - Non-Latching or Latching with reset
C) Normally Closed - Non-Latching or Latching with reset
2) Ability for the FACP to trigger any of the trigger-controlled outputs
3) Trigger indications:
A) LED indicator on the module
B) Form "C" output relay contact rated 1 amp @ 24 VDC
f. Current protection
1) access control module: 10 amp fuse
2) individual outputs: 2.5-amp Class 2 rated PTC device
2. Access power controller shall be Altronix #ACMS8 or equal.

E. Power Distribution board with voltage regulator.
1. The Power Distribution Module shall be a UL Listed Sub-Assembly board level product comprised of fused protected outputs to furnish 12 VDC, 24 VDC or 24 VAC power to surveillance, security, access control systems and components, and other security-related equipment.
2. Power distribution module shall include:
a. The Power Distribution Module shall employ a single distribution board.
b. The Power Distribution Module shall output 5VDC to 24VDC up to 10A each or 16VAC to 28VAC up to 14A each.
c. Fused protected outputs.
d. Individual voltage LEDs indicate 12VDC (Green) or 24VDC (Red and Green)
3. Modules shall provide for:
a. Dual Power Supply Inputs.
b. Outputs shall be switch selectable as to route power via Input 1 or Input 2.
c. Shall be stacked with a voltage regulator and connected via eight (8) pin connector.

d. Individual voltage LEDs indicate 12VDC (Green) or 24VDC (Red and Green).
e. Eight (8) individually fused device protected outputs.

4. Power distribution board shall be Altronix #PDS8 or equal
   a. Equip with a voltage regulator Altronix #VR6 or equal.

F. Battery Backup
1. The enclosure shall have battery backup UPS circuit with built-in battery charger that shall provide automatic battery backup UPS power in event of AC line failure.
2. Each controller enclosure panel shall have a battery for power failure. Battery shall be fully enclosed in a metal cabinet.
3. The battery shall provide for full UPS operation for a minimum of 30 minutes
4. Batteries shall not be mounted in the enclosure where they would cover a control or door panel in the enclosure.
5. Provide larger enclosure or secondary enclosure for batteries.
6. Where a battery only enclosure is provided, label this enclosure with a label that says “ACCESS CONTROL PANEL BATTERIES”

2.09 ACCESS CONTROL MODULE/CONTROLLER

A. The Contractor shall provide intelligent controller modules / cards for the security system that utilize a true distributed processing technology with local processing at each controller.
1. Shall provide for an open architecture.

B. One module per communications room or immediate adjacent enclosures shall provide for communications with the server/software via on-board 10BaseT/100BaseTX Ethernet port and support TLS encryption as a minimum security implementation.

C. In the event system communications is lost or the server/cloud fails, all networked intelligent controller, (controllers or security panels or modules, terms will be used interchangeably) shall provide complete control, operation, and supervision of all monitoring and control points based on the latest database information.

D. The controller shall provide centralized biometric template management and support a wide range of reader technologies, including OSDP, Wiegand, magnetic stripe and biometric.
1. Control module shall support, as a minimum the following open standards:
   a. PSIA Area Control,
   b. SNMPv3/v2c,
   c. OSDP and OSDP SC.
2. The controller shall utilize a cryptographic module, like OpenSSL FIPS Object Module RE, that is validated to FIPS 140-2 thus providing a certified implementation of Transport Layer Security.
3. Security on the controller shall include:
   a. Host/Controller connection protected by TLS 1.2/1.1 or AES-256/128
   b. Controller/IO Expansion connection protected by AES
   c. Generate and load custom peer certificates for TLS
   d. Port based network access control using 802.1X
   e. Crypto memory chip
   f. FIPS 140-2 user of OpenSSL
   g. HTTPS protection for installer web pages
   h. Secure cookies
   i. SNMPv3/v2c
   j. DIP switch toggle sets 5-minute time to disable webpage access
   k. Disable default login credentials
   l. Authorized IP address filtering
   m. IP Client Proxy
   n. Bulk erase controller and periphery devices during replacement
   o. Strong password enforcement
4. Door Control on controller shall support:
5. One or two-reader ports: Clock and Data, Wiegand, or RS-485
   a. Eight programmable inputs, four relays, diagnostic LEDs

6. Access Control shall support:
    a. 240,000 Cardholder capacity
    b. 50,000 Transaction buffers
    c. If/Then Macro capability
    d. Adjustable cardholder capacity
    e. Supports up to 520 inputs and 516 outputs
7. Card Formats supported shall include:
    a. 16 card formats per active reader, 8 per offline reader
    b. Entire card number reported on invalid read
    c. 19-digit (64-bit) User ID and 15-digit PIN numbers maximum
    d. PIV, CAC, TWIC card compatible
    e. 255 Access Levels per card holder
    f. Activation/Deactivation Date or Date & Times
8. Card Reader Functions shall include:
    a. Multiple card format support by reader
    b. Paired reader support
    c. Alternate reader support
    d. Elevator support
    e. Turnstile support
    f. Biometric device support
    g. Open Supervised Device Protocol (OSDP) and OSDP SC compliant
    h. Occupancy count
    i. Support of multi-occupancy rules
    j. Anti-pass back support
    k. Area-based, reader-based, or time based
    l. Nested area, hard, soft, or timed forgiveness
    m. Supports host-based approval rules
    n. Keypad support with programmable user commands, card input
    o. Shunt relay support
    p. Strike follower relay support
    q. Threat level and Operating Modes
    r. Host controlled OSDP reader passthrough
    s. Elevator floor override

E. The controller shall be configured to avoid system failure. In the event of a server or system failure, transactions are to be stored at the controller until the server and connection is back online. Once it is online then the information shall be downloaded to the server.
    1. The controller shall be utilized as the “brains” of the security and access system. All door contacts, card readers, request to exit contacts, assisted openers, door controllers, electric latch devices, electric strikes and other devices shall connect to the controller.
        a. Controllers shall be microprocessor-based, multi-tasking, multi-user, and use real-time, digital control processors.
        b. Each control panel shall consist of modular hardware including power supply, CPU board, and various input/output modules.
        c. Memory at the controller shall be large enough to store 10,000 card holder information points.
        d. Controllers shall be able to be updated via remote connectivity or direct connectivity. Updates shall be for new firmware or software updates.
    2. Controller shall be fully configurable by the Owner via a Microsoft Windows type interface through the operator workstation or through offsite connectivity through the IP network.
    3. Controllers shall mount in enclosure on the wall where noted on the drawings.
    4. Provide the quantity of controllers required for all electronic door locks, card readers and all other devices noted on the drawings and specifications.
        a. Each controller shall have onboard LED’s for self-diagnosis.

5. Each controller shall support IP communications. Additional communications shall be via RS-232 and or RS-485.
6. Shall include a real-time on-board clock synchronized with Server.
7. Where the door hardware installer provides a door interface or door controller card that works with the electric latch/strike and request to exit button, the communications contractor shall provide the correct interface to read data and send data to the door controller.
8. The link to other systems shall take place at the controller as well as through the I/O boards so that in the event of failure or an alarm. the rest of the system shall continue to function correctly.
9. The maximum time for door opening from the proper presentation of a card shall be less than one second.
10. ADA assisted Openers
    a. Controller shall interface with ADA openers and ADA door buttons.
    b. At some doors, there are assisted openers. At these doors, the controller shall completely work with the opener. Include equipment, cabling, connections and programming to allow the doors to function as per below:
        1) When approaching from the exterior and doors are locked:
            A) Present a card and then door shall be unlocked. Push the auto opener and the door shall open.
        2) When approaching from the exterior and doors are unlocked:
            A) Push the auto opener button and the door opens.
        3) When approaching from the interior and doors are locked:
            A) Push the auto opener button and the door shall unlock and open.
        4) When approaching from the interior and doors are unlocked:
            A) Push the button and the door opens.
11. Controller with Ethernet connectivity shall be Mercury LP Series or equal
12. Controller with RS-485 connectivity shall be Mercury MR Series or equal

F. I/O Cards/Modules shall be installed in the enclosures and attached to the controller to allow input and output to the field devices throughout the building(s).
1. Provide additional modules or boards to support all control, access and security points shown on the drawings and described in the specifications.
    a. I/O boards shall pop in and pop out. Replacing a board for a certain point shall not require shutting the entire controller down.
2. Modules shall be installed to connect to the field devices, including but not limited to:
    a. Door contacts,
    b. Request to exit devices,
    c. Push buttons/Panic buttons
    d. Toggle Switches
    e. Assisted door opener devices and door opener buttons
    f. Motion sensors.
    g. Strobe lights
    h. Embarrassment alarms / exit alarms
    i. Lockdown buttons with Lockdown Status Light
    j. Other field devices noted
    k. All other security devices required and shown on the drawings.
3. Modules shall translate information from the field devices to the controller and thus the server for records and access control.
4. I/O Card shall be provided that serve access control devices such as door contacts and garage contacts. These cards shall provide alarms when the contact is “open”. The time before alarm shall be fully configurable by the owner.
5. Output types shall be digital/analog for control of doors. In addition to the door output, the control module shall contain auxiliary outputs for ON/OFF control of other devices.

6. Shall provide inputs and outputs to monitor and control non-reader-based system points, such as door contacts, motion sensors, gate actuators, ADA Buttons and ADA openers etc.

2.10 CREDENTIALS

A. ID Cards/Keyring Fobs:

1. All Credentials for users are existing.

2.11 DOOR LOCKING DEVICES

A. Latch Retraction device: “LR” on drawings

1. The door hardware installer will install a Latch Retraction device as shown on the drawings.
2. Provide and install a power supply in the communications room to power the LR device. Review the door hardware and match the power supply to the Latching Retraction devices. Provide quantity as required to power all LR devices
3. The security contractor shall wire from the LR device to a power supply in the communications room and then to the controller panel in the communications room.
4. Provide cards in the controller panel and equipment to allow the security system to interface with the LR.
5. The LR shall be able to be held open based upon a time schedule put forth in the security system. It shall also be able to be retracted upon presentation of a valid card or fob to the card reader.
6. See door hardware specifications for transfer hinge and wiring harness provision plans.
   a. If wiring harness is provided as part of door hardware:
      1) Wire from door harness, through raceway and back to the power supply in the comm room. Wire to security panel for control of the door.
      2) Provide custom wiring and connectors to connect to the wiring harness
   b. If no wiring harness is provided as part of the door hardware.
      1) Wire from the LR, through the hinge and back to the Power Supply in the comm room. Wire to security panel for control of the door.
   c. Provide manufacturers recommended cabling type and wire gauge.

2.12 READER DEVICES

A. Card Readers: “CR” on drawings

1. Refer to the drawings for locations where card readers “CR” are required.
2. Card readers shall be combo readers that read standard 125 khz readers for standard prox and 13.56 MHz “smart” cards and 2.4Ghz (Bluetooth) compatibility.
3. Card readers shall be completely compatible with the security/access system.
4. Card readers shall be mountable in a single gang box or in the frame of a door. Refer to drawings for locations.
5. Readers shall be sealed to allow outdoor installation.
6. Power requirements for the card shall be between 12 volts DC.
7. Reader must be capable of providing a read range up to 2” for proximity/Smart cards without modification.
8. Mobile credential range shall be 3”. In Tap mode. Tap mode is a setting on the card reader.
9. Reader shall operate in a temperature range of minus -31°F to 150°F.
10. Reader shall be designed for both surface mounting and mounting on a single-gang electrical box.
11. Reader shall have a tri-color light emitting diode (LED. and audible tone for noting of accepted read or rejected card read.
12. Reader shall flash the LED green momentarily and emit a short beep to indicate that a card was read.
13. Shall communicate via Wiegand and or OSDB (Secure RS-485)
14. Card readers on single-gang boxes shall be HID Signo #40NKS—00-000000 or equal.

15. Card readers on the frame of a door shall be HID Signo #20NKS—00-000000 or equal.

2.13 DEVICES AT THE DOOR

A. Door Contacts; “DC” on drawings. Single Pole, Double Throw, Form C
   1. Contractor shall install magnetic door contacts in the top of each door required to be monitored. See drawings for door contact “DC” locations.
   2. Install industry standard magnetic door contacts into the top of the door and the matching contact into the header of the door.
   3. Contacts shall be compatible with the security/access system and intrusion detection system. Each contact point shall be defined in the software and shall be given an alphanumeric designation.
   4. Contacts shall connect back to the controller **and** intrusion detections system.
      a. Connect cable to the PACS System as an input.
      b. Coil second cable from door contact at the Intrusion panel location. Label for door at which it is connected. Use door number
   5. In locations where there are double doors, two contacts shall be installed and the connections shall be made so that the opening of each door is detected.
   6. When the contact is installed in the recessed part of a metal doorframe, an appropriate, solidly attached metal support shall be used. The tolerance “gap” shall be adjusted to the frame and the door.
   7. Wire door contacts back directly to an I/O card in the controller panel. DC’s shall not be wired through Request to Exit devices.
   8. Door contacts shall be 1” diameter.
   9. Door Contacts shall be George Risk Industries, GRI #194-12 or equal



   10.

B. Hard-wired Request to Exit devices “RX” on drawings
   1. These devices are located in the latch retraction devices or electric lock devices.
   2. These devices are provided and installed by the door hardware contractor.
   3. Security contractor shall wire from the RX to the I/O panel in the network controller.

2.14 AUTO OPERATOR DOOR INTERFACES

A. Assisted Opener “AO” on drawings
   1. The contractor shall wire to the assisted door openers where shown on the drawings.
   2. The wiring shall allow integration of the working of the door locks, card readers and the push to open buttons.
   3. The work shall include wiring and integration at the doors and at the controller panel to allow the Assisted Openers to work as required by the owner. See specs and drawings for additional information.
   4. Connect cabling to the security panel and the assisted opener and assisted opener buttons to complete system connectivity and configuration.

B. Assisted Opener Buttons. “AB” on drawings
   1. Assisted opener button is provided by others.
   2. Wire from the “AB” devices inside the vestibule and inside the building to unlock the door and then trigger the door to open when exiting the building.

3. Provide all cabling to connect the AB devices to the access control system.
4. Configure the security system to unlock doors as people exit the building and push the opener buttons to exit.

2.15 INTERCOM –IP BASED

A. Intercom (Audio/Video) at doors; “IC“ on drawings
   1. At locations shown on the drawings, the Contractor shall install audio/video (IC) Intercom devices to allow visitors to contact the office to announce themselves and to gain entry into the building.
      a. Connectivity of the components shall be via manufacturer CAT-6 cables to the data network. This shall be from the exterior interfaces, throughout the system and to the Ethernet network inside the building.
      b. Shall connect to standard SIP devices for audio and video connectivity.
      c. Shall interface with standard video security software to allow recording of camera on each intercom.
      d. Power and data shall be via the Ethernet network and CAT-6 cabling.
   2. Audio/video intercoms “IC” at the door shall have the following characteristics:
      a. Device shall have a single, 1-touch, push-button for calling into the interior base station. This shall open a 2-way communications path between devices.
      b. Shall have a color camera inside the intercom that is viewable at the interior base station.
      c. Include the backbox for custom mounting. Provide weather proof equipment outdoors.
   3. Outdoor intercom, Surface mounted audio/video intercom, IP based,
      a. Surface mounted Stainless Steel intercom shall be Aiphone #IX-DVF or equal.
         1) Equip with Surface box, Aiphone #SBX-IDVF

B. Base Station (BS) There shall be an audio/video intercom station at the noted offices.
   1. The audio/video intercom shall be connected to the IP network and logically attached to all intercoms at the doors.
   2. The audio portion of the station shall have a volume control.
   3. The video portion of the station shall control camera view.
   4. There shall be a door release button that interfaces with the access control system and unlocks the door that is calling.
   5. Shall include:
      a. SIP 2.0 Compliant allowing integration with Cisco Unified Call Manager®.
      b. ONVIF® Profile S Compliant
      c. 802.3af PoE, Class 0
      d. 7″ TFT LCD touchscreen
      e. Hands-free or push-to-talk communication
      f. 8 customizable speed dial buttons
      g. 2 contact outputs, 4 trigger inputs
      h. 8Ω 1/2 watt speaker output provides better coverage for announcements
      i. 600Ω audio input.
   6. The interior audio/video intercom shall be Aiphone #IX-MV7-HW-JP or equal

C. IP Adapter for control of doors
   1. Provide an adapter in the comm room near the access control panel to interface between the intercom system and the intercom
   2. Provide a 4 contact inputs and 10 relay outputs. Provide quantity required for control of all doors equipped with an intercom (IC)
   3. Relay adapter shall be Aiphone #IXW-MAA Programmable Relay Adaptor:
      a. This shall contain no less than 4 Contact Closure Inputs and 10 Contact closure outputs.

D. Cabling for the audio/video interfaces at the doors and other components shall be plenum rated.

1. Provide the type and quantity of cables required for connectivity. Review manufacturer's requirements and provide adequate cabling.
2. Install a wrap-around cable at each termination point of the interconnection cables. The label shall detail which device the cable connects to.
3. Install cabling to allow the office device to release the lock on the door where the exterior intercom is located.
4. Install cabling and configure the system to support integration between the intercom and the push button that is installed at ADA height.

E. Pass Thru's
1. Where no pass-thru is provided by others the contractor shall install conduit or UL listed wall pass thru's sized as required to route all cables through all walls.
2. Pass thru's shall be EMT conduit or another UL listed rated device.
3. Install thru all drywall, block, concrete walls and through any floors required to be penetrated
4. Conduit shall be supported mechanically from the wall or floor structure. After installation, the raceway shall be firestopped to meet the requirements of the wall or floor.

2.16 WIRES AND CABLES

A. The contractor shall be responsible for supplying and installing all cabling to make the system operational.
1. Size conductors as required to transmit all power and signal to all devices.
2. All cabling shall be Plenum rated
3. All cabling shall be installed in raceways and in accessible ceiling spaces through cable supports.
4. Provide manufacturer specified cabling based on use and length of signal transmission from panel to device.
5. Generate drawings showing the cables required and get those reviewed by the designer prior to installation.
6. All cabling shall be labeled at each end with laser printed wrap-around labels

B. Plenum type, multi-conductor "Banana-Peel" type cabling shall be used where a Card Reader and door contact and electronic lock are utilized on one door or close two-door group.
1. Overall cable shall contain numerous other sub-cables within. Those shall minimally include:

Element Description	Element	Number of Element	Size	Stranding	Material
Card Reader	Pair(s)	3	18 AWG	7x26	BC - Bare Copper
Door Contact	Conductor(s)	2	18 AWG	7x26	BC - Bare Copper
REX/Spare	Conductor(s)	4	18 AWG	7x26	BC - Bare Copper
Lock Power	Conductor(s)	4	16 AWG	19x29	BC - Bare Copper

2. Inner Jacket

Element Description	Color
Card Reader	Orange
Door Contact	White
REX/Spare	Blue
Lock Power	Gray

3. All jackets and portions of the cable shall be Plenum Rated.
4. Cable shall be Belden #638AFS or equal

C. Install individual cables where required or where individual devices are to be installed. Identify cable type required by the device and provide and install the appropriate cable.
   1. Install Plenum rated cable in all plenum rated areas.
   2. Plenum-Type, RS-232 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
      a. NFPA 70, Type CMP.
      b. Flame Resistance: NFPA 262 Flame Test.
   3. Plenum Rated, PVC-Jacketed, RS-485 Cable: Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, PVC insulation, unshielded, PVC jacket, and NFPA 70, Type CMG.
   4. Plenum-Type, RS-485 Cable: Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and fluorinated-ethylene-propylene jacket.
      a. NFPA 70, Type CMP.
      b. Flame Resistance: NFPA 262 Flame Test.
   5. Multi-conductor, Readers and Wiegand Keypads Cables: No. 22 AWG, paired and twisted multiple conductors, stranded (7x30) tinned copper conductors, semirigid PVC insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage, plus tinned copper braid shield with 65 percent shield coverage, and PVC jacket.
      a. NFPA 70, Type CMG.
      b. Flame Resistance: UL 1581 Vertical Tray.
      c. For TIA/EIA-RS-232 applications.
   6. Paired Readers and Wiegand Keypads Cables: Paired, 3 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
      a. NFPA 70, Type CM.
      b. Flame Resistance: UL 1581 Vertical Tray.
   7. Paired Readers and Wiegand Keypads Cable: Paired, 3 pairs, twisted, No. 20 AWG, stranded (7x28) tinned copper conductors, polyethylene (polyolefin) insulation, individual aluminum foil-polyester tape shielded pairs each with No. 22 AWG, stranded (19x34) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
      a. NFPA 70, Type CM.
      b. Flame Resistance: UL 1581 Vertical Tray.
   8. Plenum-Type, Paired, Readers and Wiegand Keypads Cable: Paired, 3 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, individual aluminum foil-polypropylene tape shielded pairs each with No. 22 AWG, stranded tinned copper drain wire, 100 percent shield coverage, and fluorinated-ethylene-propylene jacket.
      a. NFPA 70, Type CMP.
      b. Flame Resistance: NFPA 262 Flame Test.
   9. Plenum-Type, Multiconductor, Readers and Keypads Cable: 6 conductors, No. 20 AWG, stranded (7x28) tinned copper conductors, fluorinated-ethylene-propylene insulation, overall aluminum foil-polyester tape shield with 100 percent shield coverage plus tinned copper braid shield with 85 percent shield coverage, and fluorinated-ethylene-propylene jacket.
      a. NFPA 70, Type CMP.
      b. Flame Resistance: NFPA 262 Flame Test.
   10. Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
      a. NFPA 70, Type CMG.
      b. Flame Resistance: UL 1581 Vertical Tray.

11. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    a. NFPA 70, Type CMP.
    b. Flame Resistance: NFPA 262 Flame Test.
12. Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    a. NFPA 70, Type CMG.
    b. Flame Resistance: UL 1581 Vertical Tray.
13. Plenum-Type, Paired Lock Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
    a. NFPA 70, Type CMP.
    b. Flame Resistance: NFPA 262 Flame Test.
14. Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, overall aluminum foil-polyester tape shield with No. 22 AWG, stranded (7x30) tinned copper drain wire, 100 percent shield coverage, and PVC jacket.
    a. NFPA 70, Type CMR.
    b. Flame Resistance: UL 1666 Riser Flame Test.
15. Plenum-Type, Paired Input Cable: 1 pair, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, aluminum foil-polyester tape shield (foil side out), with No. 22 AWG drain wire, 100 percent shield coverage, and plastic jacket.
    a. NFPA 70, Type CMP.
    b. Flame Resistance: NFPA 262 Flame Test.
16. Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (7x26) tinned copper conductors, PVC insulation, unshielded, and PVC jacket.
    a. NFPA 70, Type CMG.
17. Plenum-Type, Paired AC Transformer Cable: 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors, fluorinated-ethylene-propylene insulation, unshielded, and plastic jacket.
    a. NFPA 70, Type CMP.
    b. Flame Resistance: NFPA 262 Flame Test.
18. Elevator Travel Cable: Steel center core, with shielded, twisted pairs, No. 20 AWG conductor size.
    a. Steel Center Core Support: Preformed, flexible, low-torsion, zinc-coated, steel wire rope; insulated with 60 deg C flame-resistant PVC and covered with a nylon or cotton braid.
       Shielded Pairs: Insulated copper conductors; color-coded, insulated with 60 deg C flame-resistant PVC; each pair shielded with bare copper braid for 85 percent coverage.
       1) Jute Filler: Electrical grade, dry.
       2) Binder: Helically wound synthetic fiber.
       3) Braid: Rayon or cotton braid applied with 95 percent coverage.
       4) Jacket: 60 deg C PVC specifically compounded for flexibility and abrasion resistance. UL VW-1 and CSA FT1 flame rated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all pathways prior to installation of all cables and raceways.

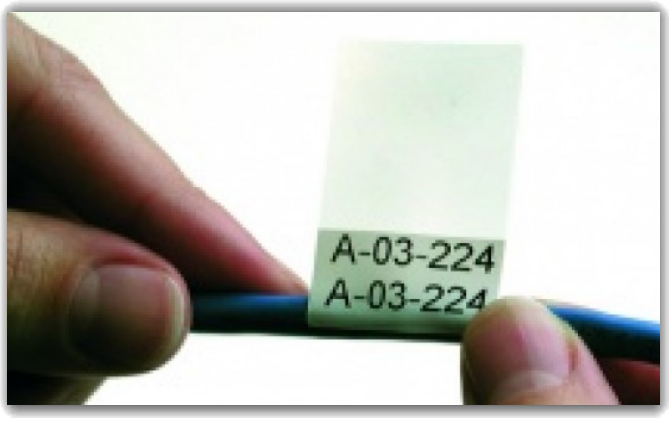
3.02 PREPARATION

A. Locate main path for all cables and install J-hooks where cable tray is not provided.

B. Coordinate with other trades to install a clear, straight path down major corridors for the routing of security/access cables back to the communications closet.
C. Plan installation of cables along wallfield in communications room. Provide finger-duct and D-rings for support of cables. See drawings

3.03 INSTALLATION-GENERAL

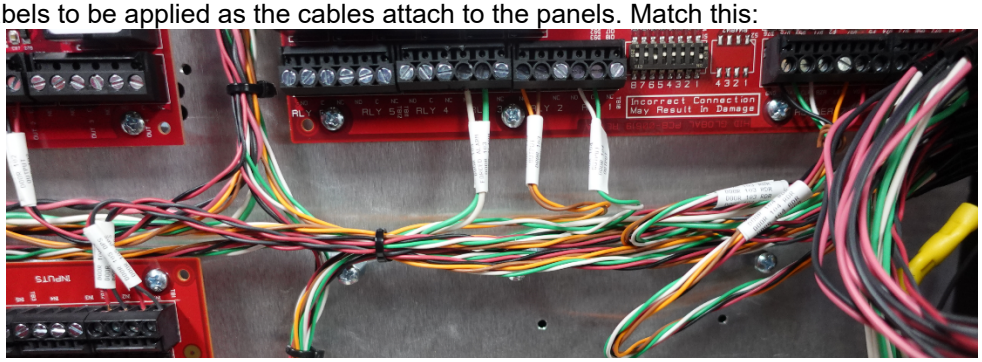
A. Security/access cable shall be installed per industry standards.
1. Install all cabling required for complete system connectivity. Cabling shall be plenum rated.
2. Care shall be taken to avoid crimping or bending the cable past the manufacturer's recommended bend radius.
3. During installation, the cables shall not be pulled across the ceiling tiles or the structure of the building. This may cause damage to the cable jacket.
4. Adhere to all pulling tensions and bend radii during installation.
5. All cables shall route neatly in the ceiling. Whether they route in cable tray or J-hooks, the cables shall be neat and orderly.
6. Support cables at a minimum of every 5 feet.
7. When routing security/access cables parallel to electrical conduits and lighting ballasts, the cable shall maintain a clearance of at least 12 inches. When running perpendicular to electrical conduits and lighting ballasts the cable shall maintain 6 inches of clearance.
8. Provide a short coil of extra cable where the cable enters the vertical conduit. The coil shall consist of no less than 1-1/2 feet.
9. When installing cables in the communications room, all cable shall route neatly through the cable tray and cable ladder.
10. Provide a service loop of the cables on the wallfield.
11. Each cable shall have a self adhesive, self laminating, laser printed label at each end. The label shall show the location identifier of that cable. Labels shall be installed no more than 4 inches from the termination point of the cable.



12.
13. Door labels on exterior of panel. Match this.

a. 

14. See labels to be applied as the cables attach to the panels. Match this:

a. 

B. Firestopping is required at all riser conduits, and all pass thru's.
   1. Each cable tray penetration of a wall shall be firestopped after cable installation. Use pillow type firestop to allow additional cables to be installed in the future.
   2. Where riser conduits pass through floors, the area between the concrete and the conduit shall be firestopped. This shall be completed with a putty or liquid firestop product. Fill in the space with mineral wool, and then install the firestop on top. All firestop shall be of sufficient thickness to secure the rating required by code.
   3. After final cable installation, install a putty firestop around all cables where they enter and exit conduit pass thru's and conduit risers.
   4. Firestop as per AHJ requirements.

C. Cabling at the Panel.
   1. Contractor shall coil all spare cable from the door devices outside the security panel and shall neatly coil the cable on the wall. Provide 5' minimum in the coil for future movement of the panel.

a. 

2. Cables shall route into the panels through a grommeted hole that is sized for the cables entering.
3. All cables shall be installed in a neat and workmanlike manner.
4. Cables shall be terminated and shall allow for removal of a card without un-terminating the cables.
5. All cables shall be neatly distributed to the card in the panel.
6. All labels shall be visible inside the panel near the termination point. Label cables equidistant from their termination point.
    a. Typical routing and cable organization in an access control panel.
    b. Route all cables along a central path.
    c. Label the cables as they entre the panel for the door to which they connect.
    d. Support cables along the backplate
    e. Label all interconnection cables with wrap-around labels that detail what they connect to.
7. Typical Trove Style panel

a. 

D. Proper support of cables is of paramount importance when installing a cable infrastructure. All cables not in conduit or cable tray shall be supported via J-hooks a minimum of every 5 feet.
   1. Routes of cables shall be parallel or perpendicular to the walls of the building.
   2. Install the J-hooks to minimize changes in the level of the cables as they route through the J-hooks.
   3. All communications shall route as high in the ceiling as possible while still being accessible and staying away from other utilities.
   4. When installing the cable through the J-hooks, they shall all have relatively the same droop between hooks. All cables shall be installed neatly and squarely.
   5. Secure the J-hooks to the building structure with beam clamps and threaded rod as required to support the cables.
   6. J-hooks shall never be attached to drop ceiling support wires. Cables shall never be supported by drop ceiling wires.

3.04 CONTROL PANEL INSTALLATION

A. Enclosure and power
   1. Contractor shall mount the enclosure on top of ¾” fireproof plywood.
   2. Mount enclosure in the location noted. Coordinate other equipment and wallfield systems.
   3. Locate the 120 volt power outlet and install enclosure in relation to power
   4. Size the enclosure to support all PACS devices noted on the drawings and in the specifications.
   5. Provide magnetic cable support devices in the panel to route cables inside the panel to the controllers and power devices
   6. Power.

a. Install cabling and raceway to connect the power supply in the enclosure to the 120 volt power outlet.
b. Shall be hard-wired power. Plug-in power is not allowed
c. Provide an electrician for connection of the power supplies if required by AHJ.

7. Battery backup
   a. Provide and connect the batteries to the power supply for the enclosure
   b. Test the battery supports the panel by removing 120 volt power after the system is fully up and operational.
8. Network connectivity
   a. Provide and install CAT-6 cable from the enclosure for the power supply to the communications rack. Connect to the Ethernet switch
9. Other Controllers and I/O Board connectivity.
   a. Provide and install cabling to connect the Ethernet controller to the other controllers and I/O boards via RS-485.
   b. Do not install RS-485 between communications rooms. Each comm room shall have an Ethernet attached Controller.

B. Controller:
1. Controller(s). shall be mounted in the enclosure as shown on the drawings.
2. Controller shall be sized for all security, access, control, and monitoring points existing on the drawings and shall be expandable.
3. Controller shall be able to be linked to additional controllers in other communications rooms/buildings via the Ethernet network.
4. Each port in the controller that is connected to a security point shall be labeled inside the controller box.
5. Label the outside of the panel with the door numbers and list of devices that are connected in that panel. Shall be laser printed adhesive labels.
6. Label the inside of the panel door with the layout of the panel and which controllers attach to which devices. Include door numbers on the diagram.
7. Depending on the type of panel the contractor shall provide cable routing hardware and equipment to neatly install cabling.
   a. Route cable to allow easy change and replacement of the individual control cards in the panel.
   b. Cabling shall be neatly bundled. See example below of adequate cabling being routed into a panel.
8. Network connectivity
   a. Provide and install CAT-6 cable from the controller to the communications rack. Connect to the Ethernet switch
   b. Connect on the Ethernet to the Switch.

C. Plywood behind panels.
1. Install all panels onto plywood in each comm room.
2. Paint plywood with prior to installation on the wall.
3. Plywood shall be installed from 12 inches AFF to 7 feet above the floor or as noted on the drawings.
4. Mount plywood to the wall with screws attached to studs in the wall. Contractor is responsible for securely mounting the plywood to the wall.
5. Grade “A” side of the plywood shall be used for mounting all communications components.
6. If the plywood will cover an electrical receptacle, the Contractor shall cut the plywood to allow access to the receptacle.

3.05 SERVER AND SOFTWARE INSTALLATION

A. Management Server:
1. Server/appliance is existing for the existing Lenel S2 On Guard system
2. Contractor shall provide and install software and licensing required to add devices and panels to the existing system.

B. Control Software:
1. Contractor shall provide all software required for a fully functional security/access system.
2. Software shall be installed and fully configured by the Contractor.
3. Contractor shall schedule meetings with the Owner prior to installation to determine the working of the security/access system.
4. Configuration of the security software shall include but not be limited to the following:
a. Number each door and any input and outputs associated with that door and associate it with a standard door name for easy review.
b. Meet with the owner to determine how they will use the system. Take information from them that will allow all custom settings of the software system. This shall include but not be limited to:
1) User groups based on building and administrative group
2) Access levels based on groups and times.
3) Door Groups for access and locking and unlocking schedules.
4) Building locking and unlocking schedules for each building
5) Administrative levels and super administrators
6) Building arming and disarming schedules of door contacts
7) Alarm level setting for different doors based on time of day and day of week.
8) Lockdown and Normal locking schedules. Configure the system to lock all doors upon going into lockdown mode through the button or through the software system.
9) Snow-Day override schedule that shall change when doors unlock and lock and which users or user groups are allowed to access the building during a snow day. Snow day shall revert back to regular scheduling afer 11 PM that day.
10) Setup all user logins to allow specific viewing of portions of the system based on login ID.
A) Detail in the setup that persons rights in working in the system.
c. Lockdowns and Secure
1) Create different locking schedules and processes for Lockdowns and Secure situations.
2) Work with the owner to determine what doors are locked or unlocked in a lockdown or secure situation.
3) Make all settings and groups required for each situation.
d. Set all alarm levels and outgoing outcalls for SMS and email alerts.
1) Add users and all those that are to be notified on a building basis.
2) Set levels for all door contacts such that the owner is notified of a door open when the system is armed but is not alerted during the day unless they ask for this type of configuration.
e. Generate customized maps for each building.
1) Create maps from the owner that have multiple levels such as entire building and then subdivided into different areas.
2) The maps shall show icons for each door. The icons shall be green or red based on open or closed door.
3) Setup all icons to allow the owner to click on a door and then have direct access to lock or unlock or pulse the lock on a door.

3.06 CREDENTIALS
A. All Physical Credentials and users are existing in the sytem
1. Associate new door devices with the owners existing groups of people
2. Configure specific new door devices with individuals as directed by the owner.
3. Work with the owner to apply system privileges and door access to each individual user.

3.07 DOOR LOCKING CONNECTIVITY

A. Latch Retraction device. “LR” on drawings
   1. The Latch Retraction devices shall be provided by the door hardware supplier.
   2. Power supplies shall be located in the comm room. Provide and install power supplies. Connect power supplies to the controller panel.
   3. Install all cables required to be connect this power supply to the security system and to the actual Latch Retraction lock at the door.
   4. Review door hardware specifications to determine if a wiring harness is being provide by the door hardware supplier.
      a. Install cables from the controller panel and power supply to the wiring harness. Connect to harness
      b. Install harness from door hardware LR to the hinge, through the hinge and to the connection point above the door.
      c. Wire from connection point above door to the power supply and then to the security panel.
      d. If no harness is provided, then wire from LR device, thru the hinge, to the power supply controller and finally to the security panel.

3.08 READER INSTALLATION

A. Card Readers “CR” on drawings
   1. Card readers shall be installed at locations shown on the drawings.
   2. Review site and drawings and coordinate the wall mounted readers and frame mounted readers. Order the correct reader for each location.
      a. Conduct a site visit prior to ordering card readers.
      b. If the wrong reader is ordered then the contractor shall provide the correct reader.
   3. Coordinate installation of all card readers with the doors and walls.
   4. Where the reader is mounted on the door, coordinate the installation with the installation of the door to allow all cable for security/access.
   5. Locate all card readers at ADA compliant heights and locations.
   6. Wire and configure the card readers so that when the lock is engaged the light on the reader is red and when the door is unlocked the light is green.
   7. Garage Doors and Pedestals: At the garage doors and at pedestals the card readers shall be installed with a box that has a cover for the top of the card reader.

3.09 DEVICES AT THE DOOR

A. Door Contacts “DC”
   1. Install contacts where shown on the drawings. For mandoor contacts, install them at the top of the door.
   2. Work with door provider and installer on timing of door contact installation.
   3. Install raceways to allow installation of the door contacts if no raceway is provided inside the wall.
   4. Drill into the door frame and door to allow installation of the door contact and the associated cable. No cable shall be visible after installation.
   5. Where door frames are filled, they shall be drilled out to allow installation of the door contact. Surface mount contacts are not allowed unless specifically noted on the drawings.
   6. Wire back to the PACS panel and connect as an input.
   7. Install and Coil second cable from each DC at the wall for a future alarm system.

B. Request to Exit Devices “RX” on drawings
   1. When the RX is shown, wire from this device in the lock/pushbar, back to the controller in the comm room.
   2. Set this up to shunts the door contact when triggered.
   3. Where there is an intrusion detection system the contractor shall provide cabling from the PACS panel to the Intrusion panel for each RX and MX and pass thru the signal to the Intrusion panel.

3.10 ASSISTED OPENER FOR ADA

A. Assisted Opener: “AO” and assisted button “AB” on drawings
   1. Where an assisted opener is shown the contractor shall wire to this opener and associated opener buttons (“AB”) to work as noted on the drawings and as below:
   2. Operation sequence when the doors are locked entering from outside -valid id card
      a. If the person presents a valid card then the latch shall retract inside the exterior door.
      b. The door shall hold unlocked for 15 seconds.
      c. The control board shall allow the exterior push button to be energized. Once the push button is energized then the exterior door shall be opened if the button is pushed.
   3. Operation sequence when the doors are unlocked entering from outside
      a. Push the ADA button Exterior door opens
   4. Operation sequence when the doors are locked entering from outside -no card or invalid card
      a. If the person pushes the exterior opener button, then the auto opener shall not engage because the opener button is not energized.
      b. The exterior opener button is not energized unless the PACS notes that the door is unlocked.
   5. Operation sequence when the doors are locked, exiting from interior
      a. When a person pushes the interior opener button then that shall communicate with the interior auto opener and open that door.
      b. The control board of the auto opener shall communicate with the access control system and instruct it to retract the latch on the interior door.
   6. Operation sequence when the doors are locked, exiting from vestibule
      a. When a person pushes the vestibule opener button then that shall communicate with the exterior auto opener and open that door.
      b. The control board of the exterior auto opener shall communicate with the access control system and instruct it to retract the latch on the exterior door.

3.11 INTERCOMS AT THE DOORS

A. IP Intercoms
   1. Intercom at the door shall be installed based on the type chosen and specified in specs and drawings.
   2. Where the Intercom is surface mounted.
      a. Surface mounted units shall be connected to the interior of the building with a conduit and steel backbox.
      b. Where possible route the cables through the door or wall framing and extend to the intercom.
      c. Install raceway from bottom of intercom to lower pushbutton.
      d. Ensure installation of lower button to meet ADA requirements
   3. Flush-mounted intercoms
      a. Provide and install the custom backbox at the intercom location.
      b. Provide notice to electrician to allow them to install conduits to accessible ceiling.
      c. Review and ensure raceway from bottom of intercom to lower pushbutton is installed.
      d. Ensure installation of lower button to meet ADA requirements
   4. Wire the lower pushbutton to the intercom to support initiation of an intercom call
   5. The intercom device shall be located at a place where it is accessible and where it can be mounted to see the person calling.
      a. Camera shall be positioned to cover the maximum area possible.
      b. Install a connection cable from the exterior interface to the interior unit and door lock.

c. Install any baluns, adapters, or other devices required to send the signal from the exterior intercom to the network.
d. Provide CAT-6 patch cables

6. IP Programmable Relay.
   a. This device shall be mounted in the main communications room.
   b. Connect to the Ethernet network with appropriate CAT-6 cabling
   c. Connect to the controllers to allow the base station to unlock the associated door.
   d. Integrate so that the base station only controls the door that the call was initiated from.
7. Base stations shall be located as shown on the drawings.
   a. The devices shall be configured to allow the Owner to unlock the door when a person calls in and is determined to be acceptable for entry.
   b. The master control devices shall interface with the access control system through the IP Programmable relay to interrupt any alarms and momentarily unlock the door.
   c. Configure they device to allow the user to determine which door the call is coming from and then unlock only that door.
   d. Provide all cabling and other equipment required to connect the base station to the Ethernet network. CAT-6 cable, Plenum Rated.

END OF SECTION

SECTION 28 3600 – SECURITY RECORDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes parts and equipment required for installation and configuration of a video security system. This system shall be referred to as the “security system” throughout these specifications.

1.02 SYSTEM DESCRIPTION

A. The security system shall be supplied and installed by a Contractor able to show examples of similar projects and installations within the last 3 years.
B. The video security system shall serve the building(s) shown and be able to be expanded to support other buildings attached to the data network
C. New cameras shall be IP cameras with direct connection to Ethernet Switches.
D. Software and hardware shall allow for monitoring from any PC attached to the data network.
E. Software and hardware shall allow for monitoring from any Smartphone or Wireless tablet device. Provide hardware and software to accomplish this.

1.03 COORDINATION

A. Coordinate with the network contractor. Provide IP addresses and ports the cameras are connected to in an excel spreadsheet to the network contractor for VLAN configuration
B. Coordinate with data cabling contractor. Walk the site and identify all camera locations and make the cabling contractor aware of all camera locations.

1.04 PROJECT PLAN

A. The contractor shall provide a project plan to the owner and contractor that describes the system and its capabilities and the possible configurations.
B. Provide a project approach which describes the installation and implementation plan and schedule and all sequencing.
C. Meet with the owner numerous times to determine how the system should work and how it should be monitored. Configure the system prior to installation to meet these requirements. Demonstrate the system use to the owner prior to installation and obtain approval to move forward with the installation.
D. Provide shop drawings showing all configuration and connectivity of the system.
E. Generate a testing plan and have that plan approved by the owner and engineer prior to installing the system.

1.05 RELATED STANDARDS

A. The security system shall conform to the following international and national standards:
    1. FCC Rules and Regulations
    2. UL 294 Access Control Systems
    3. UL 1076 Line Supervision
    4. 21 CFR part 11
    5. Part 15, Radio Frequency Devices
    6. National Electrical Manufacturers Association (NEMA)
    7. Applicable Federal, State and Local laws, regulations, codes
    8. Americans with Disabilities Act (ADA)
    9. National Electrical Code (NEC)

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved vendor for video security camera recording software is:
  1. Digital Watchdog
  2. No others are allowed

2.02 VIDEO SECURITY HARDWARE
- A. Network Video Recorder (NVR):
  1. This is existing at the Creekside data Center. Digital Watchdog is the software.
  2. Provide additional licenses to existing system to support new server.

2.03 VIDEO MANAGEMENT SOFTWARE (VMS)
- A. The VMS shall be Digital Watchdog.
  1. Provide additional licenses to existing system to support new server.

PART 3 - EXECUTION

3.01 EXAMINATION
- A. Review site and note locations of cameras, conduits and cables prior to installation.
- B. Review all ceiling styles on the reflected ceiling plans. Provide mounts as required based on the ceiling style.

3.02 INSTALLATION
- A. The Network Video Recorder (NVR) is existing in the Creekside Data Center
- B. Fully configure the Video Recording and Control Software.
  1. The Contractor shall meet with the Owner prior to installation of the system to discuss all aspects and abilities of the NVR and VMS and the attached cameras.
  2. The Contractor shall present all configuration options to the Owner to get their input and let them choose how the system is to be used and configured.
  3. The Contractor shall take information from the meeting and record that in meeting minutes. Provide copies of these minutes to the Owner and Designer
  4. The Contractor shall configure and install the system as requested by the Owner and as shown on the drawings and specifications.
  5. The servers and storage shall be configured based on the manufacturer’s recommendations.
     a. Discuss drive array and recording processes with the owner and manufacturer prior to installation of the system
     b. Discuss recording block size with the manufacturer prior to installation.
     c. Meet with the owner and discuss the server(s) setup and present a document from the NVR software and server manufacturer to demonstrate how the system will be configured.
     d. Evenly distribute cameras and recordings across all servers.
  6. Configuration of the system shall include but not be limited to the following.
     a. Labeling of all cameras in the system to match the owner approved labeling scheme as well as their chosen specific descriptive name.
     b. Video blanking of any areas on each camera if there are areas that are not to be seen or recorded by the NVR system.
     c. Passwords and logins for users and administrators. Include in this a list of all the users and their access levels.
     d. Recording Frames per second, resolution and long term recording resolution.

e. Generation and configuration of any presets for PTZ cameras including tours and timing.
f. Specialized recording times for each camera including additional FPS or resolution at times of the day.
g. Backup times and all data to be backed up. Configure scheduled backups
h. Aiming, focusing and framing of all camera images.
A) Sit with the owner and review each camera's view and custom set the aiming, framing and focus of each camera.
B) Have someone at the camera while reviewing that is able to move and aim and focus the camera.
C) Download an image from the camera as the owner wishes it to be aimed
D) Create a spreadsheet with each camera and have the owner sign off on the aiming of each camera.
i. Generation of custom views for all user software. Meet with each person that is allowed to view the cameras and help them generate a custom view of the cameras they wish to see.

7. Contractor shall fully load and match all maps to the video security system. Install all maps and load all camera locations and hot buttons to the maps to allow quick connect to the cameras based on clicking on the camera location on the map.
a. Each camera button shall show the camera number.
8. Recorded images and offloaded images shall be able to be time-stamped with the date, camera number and exact time down to the second when the video was recorded.
a. This shall be able to be seen on the viewing station and shall be attached to the video when it is offloaded and viewed on an outside player.
b. Setup the server and software to obtain time from the national standard time.

C. Connect the storage to the new NVR servers and the rest of the servers.
1. Configure the storage to provide service to all users and all storage requirements.
2. Meet with the owner prior to installation and present all options to the owner in regards to the configuration options. Assist the owner in deciding which options best meet their needs.
3. Publish a plan and configuration parameters of the storage and ensure that everyone agrees with the plan.
4. Install the storage and connect to all servers.

D. Analytics Configuration.
1. Analytics may be in the VMS or at the camera. Contractor shall setup each camera that is able to provide analytics. Shall be setup on the camera and the VMS
2. Setup the system to support alerts and search of recorded video based on metadata collected thru the analytic.
3. Include time in the contract to work with the owner to determine which analytics shall be setup and on which cameras the analytic shall be setup.
4. Identify each camera and what analytics shall be setup.
5. Create a document that details the available analytics and on which cameras they are available.
6. Setup the analytic to alert the owner thru the VMS when a threshold setup is exceeded.
7. Setup the VMS to support search using metadata captured by the analytic.
8. Test the analytic at each camera and throughout the entire VMS for live and recorded video.

E. Ethernet systems configuration shall be coordinated with the IT department. The owner will work with their contractor to switch the network to a security VLAN and other QOS parameters as required by the security system.
1. Meetings shall be scheduled with the Owner to discuss the configurations of all electronics and the capabilities of the system.

2. The owner shall be made aware of all the capabilities of the video security system and all possible configurations and shall be able to decide all aspects of the programming and configuration.
3. The Contractor shall generate a report on the requirements of the owner and shall work with the owner to help determine the configuration of all the data electronics to meet the security systems needs.
4. From the meetings the owner and contractor shall generate a plan for all configuration issues of the data network including but not limited to:
    a. IP Numbering Scheme
    b. VLAN settings
    c. Quality of Service (QoS) settings
    d. Network Prioritization
    e. New data connections.
    f. Wireless connectivity for Visitors, Students and Administrators.
    g. Wireless Security
5. The network electronics shall be configured to synchronize internal clocks to a designated internal NTP server.
6. The network electronics shall be configured with the same time zone settings and said time zone shall be the local time zone.

END OF SECTION

SECTION 28 3700 – SECURITY CAMERAS

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. This section includes parts, equipment and cabling required for installation of the video surveillance cameras.
- B. This shall include new IP video cameras and their cabling/termination equipment as shown on the drawings and detailed in the specifications.

1.02 COORDINATION
- A. All cables shall be coordinated with the installation of the raceways.
- B. All cameras shall be installed in the ceilings in relation to the lights and other obstructions.

1.03 DESCRIPTON
- A. Provide new IP cameras for video surveillance. See the detailed security drawings for location and quantities.
- B. Cameras shall be pure IP cameras without the use of external encoders/decoders where possible.
- C. Power for interior and exterior cameras shall be provided via the POE switch or via a centralized power supply in the communications room.
  1. The switches installed provide standard Type 3 PoE (15.4 watts) on each port. If a camera requires additional power above Type 3 PoE then the contractor shall provide that power supply and any additional required power cables.
- D. PTZ cameras that require additional power above that provided from a Type 3 PoE connections shall be provided with a power supply.
  1. Provide any and all camera, power and control cables required for complete system connectivity and functionality.
- E. It shall be the Contractor’s responsibility to provide all power to cameras based on the above methods. Take into account the Manufacturers recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved Manufacturers for IP cameras:
  1. Digital Watchdog

2.02 CAMERAS GENERAL REQUIREMENTS
- A. Cameras shall provide full color images and some shall change to black and white in low light.
- B. Cameras shall support text overlay of image in viewing to allow naming/numbering of each camera on the screen and when video is offloaded.
- C. The Contractor shall review the site with the Owner prior to ordering the lens for each camera.
  1. Finalize the needs of the Owner with the camera position to ensure that the correct lens is purchased for the camera.
  2. Review actual installation location prior to ordering cameras. Purchase correct mount for camera. All cameras in drop ceilings or hard ceilings shall be installed with recessed camera mounts.
- D. Where noted on the drawings, provide a vandal resistant dome to the camera.
- E. Where cameras require more power than PoE 802.af then the contractor shall provide power to the camera from a centralized power supply in the comm. room.
- F. External Cameras
  1. Each exterior camera shall be equipped with a heater/blower or other device to keep camera functional and keep lens/casing from fogging or condensation from forming.

2. Provide mounts for exterior cameras based on their installation location. Provide fully enclosed mounts. See drawings and conduct a field survey prior to ordering to ensure that he correct mounts are provided.
    a. Exterior mounts shall allow cable entry to the dome via the support. No cables shall be exterior to the mount or dome.

2.03 CAMERA -4K 180 DEGREE BULLET STYLE CAMERA -OUTDOOR
- A. MEGApix Ai 4K Ultra-Wide Angle Pano Bullet camera
- B. Shall include all mounts and hardware for indoor or outdoor installation
- C. Camera shall include:
    1. Star-Light Plus, 2.3mm ultra wide lens,
    2. AI Deep Learning,
    3. 1/1.8 Image Sensor,
    4. Triple Codecs (H.265, H.264, MJPEG),
    5. True Wide Dynamic Range,
    6. 100ft Smart Infrared
    7. Two Way Audio,
    8. Micro SD/SDHCC/SDXC class 10 card slot(card not included),
    9. PoE and 12Vdc power
    10. Shall be ONVIF Profile S and NDAA/TAA Compliant,
    11. Shall include a 5 Year manufacturer Warranty.
    12. Camera shall be Digital Watchdog # DWC-XSBC08Bi
        a. Exterior cameras shall be equipped with a heater and correct mount.

2.04 CAMERA -4K 180 DEGREE BULLET STYLE CAMERA -INDOOR
- A. MEGApix Ai 4K Ultra Wide Angle Wall Mount Pano wall mount, indoor camera
- B. Shall include all mounts and hardware for indoor installation
- C. Camera shall include:
    1. Star-Light Plus, 2.3mm ultra wide lens,
    2. AI Deep Learning,
    3. 1/1.8 Image Sensor,
    4. Triple Codecs (H.265, H.264, MJPEG),
    5. True Wide Dynamic Range,
    6. 100ft Smart IR,
    7. Two Way Audio,
    8. Micro SD/SDHCC/SDXC class 10 card slot(card not included),
    9. PoE and 12Vdc power
    10. ONVIF Profile S and NDAA/TAA Compliant,
    11. Shall include a 5 Year manufacturer Warranty.
    12. Camera shall be Digital Watchdog # DWC-XSWA08Bi

2.05 CAMERAS 360 DEGREE -SINGLE SENSOR, INDOOR/OUTDOOR
- A. MEGApix Fisheye Indoor/Outdoor Vandal Dome,
- B. Shall include all mounts and hardware for indoor or outdoor installation
- C. Camera shall include:
    1. Star-Light Plus,
    2. 9 Megapixel, 360 and 180-degree Panoramic view with Edge to Edge Clarity,
    3. 1/1.7 Image Sensor at 30fps ,
    4. Multi Codecs (H.265, H.264, MJPEG) with Simultaneous Dual Streams,
    5. 80ft Smart IR,
    6. True Wide Dynamic Range with Mechanical IR Cut Filter,
    7. Two Way Audio,
    8. Auto Gain Control (AGC), Auto White Balance (AWB), Motion Detection,
    9. Micro SD/SDHC Class 10 Card Slot (card not included),
    10. OnVIF Profile S, and NDAA compliant
    11. IP66, IK9 rated

12. POE and DC12V,
13. Shall include a 5 Year manufacturer Warranty.
14. Camera shall be Digital Watchdog # DWC-PVF9Di2TW

2.06 CEILING OR WALL MOUNTED DOME 4K INDOOR/OUTDOOR CAMER

A. MEGApix IVA Indoor/Outdoor Vandal Dome Camera,
B. Shall include all mounts and hardware for indoor or outdoor installation
C. Camera shall include:
   1. Star-Light Plus, 4K ,
   2. Star-Light Plus, 2952x2320 @ 30fps,
   3. 2.8 Fixed Lens,
   4. Ai Deep Learning
   5. 100ft Smart IR,
   6. True Wide Dynamic Rante
   7. Triple Codecs (H.265, H.264, MJPEG) with Simultaneous Streaming,
   8. Two Way Audio,
   9. PoE Class 3 and DC12V power
   10. OnVIF and NDAA Compliant,
   11. Micro SD/SDHC/SDXC class 10 card slot (card not included)
   12. IP66, IK10 rated
   13. Shall include a 5 Year manufacturer Warranty.
   14. Camera shall be Digital Watchdog # DWC-XSDE08Mi

2.07 CAMERA ACCESSORIES

A. Camera Mounts:
   1. The Contractor shall provide all appropriate camera mounts. Refer to the drawings and conduct a site survey to determine each camera mounting type required.
      a. Complete this prior to ordering cameras.
   2. Exterior cameras shall be mounted to the wall of the building in most cases.
      a. Where the camera is to look along the wall of a building the contractor shall provide an arm/pendant mount that mounts the camera parallel to the ground.
      b. Mount shall extend the camera out from the building a few inches to allow viewing in 360 horizontal degrees
      c. Corner mounts shall be installed where the camera is shown to be corner mounted.
         1) Provide flexible raceway to extend cable from the building or backbox and into the
   3. The security cameras shall be mounted to building structure where shown on the drawings.
      a. Contractor shall provide a mount that best corresponds to the structure and can be securely mounted.
      b. Mount the camera at a height as shown on the drawings or at the optimum height to allow the best field of view and future service via extension ladder.
         1) Unless specified the cameras on the exterior of a building should not be installed more than 15’ above grade.
      c. When mounting the cameras, take into account the light and mount the camera so that it does not block light.
      d. The camera mount shall provide a route for cables extending from the raceway to the camera. Cables shall not be installed outside the camera dome or camera mount.
      e. The Contractor shall install a conduit to allow cable installation to the camera.
         1) This shall include installing conduits from the inside of the building to the outside of the building to support exterior cameras.
         2) Core through the outside of the building. Coordinate location with owner and architect prior to drilling.
         3) Install ¾ conduit or sized as per the mount.

4) Except for corner and parapet mounts no conduits shall be visible after installation.
5) At no time shall a cable be visible. Install flexible conduit and seal appropriately around holes made in the building
6) Repair wall after installation.
7) No cable shall be visible after camera installation.

4. Dome-type cameras interior to a building may be installed in the lay-in ceiling.
   a. Provide supports so that the camera's weight is supported from the "T" bars of the drop ceiling.
   b. Provide a backbox and escutcheon to make a tight fit from the dome to the drop ceiling tile.
   c. Locate the cameras to cover the area required by the Owner. Work with the Owner prior to installation.
5. Dome-type cameras interior to a building may be installed as a pendant mount from the building structure.
   a. Provide a backbox at the building structure. Install a downpipe and camera mount to attach the camera to the downpipe. Size the pipe as required.
   b. The camera mount shall keep the camera level and shall extend down to a level of no more than 11' AFF.
   c. Locate the cameras to cover the area required by the Owner. Work with the Owner prior to installation.
6. Dome-type cameras interior to the building may be required to be mounted to a wall.
   a. Where there is a wall mount requirement, the Contractor shall install a wall-mount. Ensure that it is securely mounted.
   b. Route the cable through the wall and through the mount to connect to the camera.

B. Camera accessories.
   1. Contractor shall provide and install any and all accessories required for complete mounting, configuration and power delivery.

2.08 CAMERA INSTALLATION ACCESSORIES

A. Firestopping shall be completed inside and around all conduits after cable installation. Contractor shall install the best firestop for each individual installation.
   1. Firestop shall be installed with regard to local and national building codes.
   2. The firestop shall be a putty-like substance that expands under heat and will not allow flame to pass for a designated period of time.
   3. Firestop shall conform to all NEC, NFPA, and UL requirements.
   4. Some wall pass-thru's are shown on the drawings. The Contractor shall utilize these where possible.
   5. Where the contractor must install cables through a wall where there is no pass-thru already provided, the Contractor shall be responsible for installing a fire-rated pass-thru and fire-stopping the conduit after cable installation.

B. Weatherproofing shall be completed inside and around all conduits supporting exterior cameras after cable installation. Contractor shall install the best weatherproof for each individual installation.
   1. Weatherproof around all conduits that extend through the building to the cameras on the exterior wall or soffit.
   2. Seal all cameras so that all camera housing does not allow water into the conduit or into the building.
   3. Seal so there is no infiltration of water or condensate.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine all pathways prior to installation of all cables.
B. Identify locations of all user conduits and backboxes prior to cable installation.
C. Review site and note locations of cameras and conduits prior to installation.

3.02 PREPARATION

A. Visit each camera installation location to verify the type of mount prior to ordering the cameras.
B. If another contractor is installing the CAT-6 cabling then the contractor shall coordinate cable location with that contractor.
C. Green Tape walk thru.
    1. Contractor shall walk the entire site with the owner and identify each camera location with the owner prior to installation.
    2. Discuss the type of camera and its proposed field of view.
    3. Make adjustments as required by the owner and by the building structure to minimize interference and blocking of the camera image.
    4. Install a piece of green tape on the wall or ceiling at each camera location after agreement on the location is reached.
    5. Remove green tape after installation of cameras
D. Camera naming spreadsheet.
    1. Create an Excel spreadsheet showing the following:
        a. Camera number
        b. Camera part number
        c. IP address
        d. MAC address
        e. Owners chosen camera name
        f. Provide to the owner and designer.

3.03 INSTALLATION

A. Each camera shall be installed to provide maximum field of view and security.
B. Exterior cameras shall be mounted securely to the structure and shall be sealed to prevent water or any other environmental condition to enter the camera.
    1. Provide the correct mount for the location of each exterior camera.
    2. Where the mount is to the outside of a building then the contractor shall install a conduit from the exterior camera to the inside of the building for the camera cable(s).
    3. Review mounting location to determine optimum height of camera to cover all areas and provide the clearest pictures. Mount at appropriate height.
    4. Work with the Owner to focus and align all cameras for maximum coverage.
    5. Contractor shall change lenses for different focal lengths based on the actual installation location of the cameras and the requirements of the Owner.
    6. Seal around all conduit openings and the camera mount to seal from water and air infiltration.
    7. Install patch cable through the conduit and connect to the CAT-6 cable on the interior of the building.
C. Interior cameras shall be mounted in the lay-in ceiling, supported from the open ceiling or to the wall with a structural mount.
    1. The Contractor shall work with the Owner to determine the location of all the cameras.
    2. Work with the Owner to determine the direction of the lens and its focal length.
    3. Ensure that the camera is mounted securely to the drop ceiling and is supported from the T-bar.
    4. Where interior cameras are mounted to the wall, the Contractor shall provide a mount that will allow all cables to route through the mount. Cables shall not be “free-floating” from the wall to the camera.
    5. When a camera is pendant mounted the contractor shall install a down-pipe and conduit support to mount the camera at the correct height as determined by the owner.
D. Camera obstructions

1. Prior to camera installation review the site and make sure to install cameras so there are no obstructions such as lights, ducts, EXIT signs etc. that will obstruct the camera view.
2. Provide additional pipe and threaded rod as required to mount camera so there is no obstruction of the view.
3. Install at height or location so that the camera sees the entire field of view.

E. Contractor shall focus and aim all cameras
1. Camera aiming and focusing shall be a process where the owner has input at each stage.
2. The process for aiming and focusing shall be as follows:
   a. Meet with the owner and determine the desired view of each camera. Determine where images shall overlap and what they are focusing etc.
      1) Add this information to the camera naming spreadsheet.
   b. Install the cameras and aim as per the meeting notes.
   c. Meet with the owner and review each camera view on the monitor. Make notes of any changes required.
   d. Schedule a time to make all changes.
      1) Changes shall be made while the owner is reviewing the live image through the VMS Software. The contractor shall have a person at the camera that can aim and focus the camera.
      2) Once the owner agrees on the image aim and focus generate a still picture of that image and keep it in a file.
      3) Print the aimed view and provide as part of the submittal at project substantial completion.

F. Camera naming
1. The contractor shall work with the owner and engineer to determine the naming and numbering convention for the cameras.
2. Determine the naming and then apply that to each camera. Enter the designation of the camera into the video security system.
3. On all cameras the contractor shall affix a label with the camera number to the exterior case of the camera. This shall be visible when standing near the camera.

END OF SECTION

SECTION 28 5350 – CLASSROOM AUDIO

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. This section provides specific project and Contractor requirements for audio systems in the classrooms and other general spaces
- B. Parts and labor required for installation and testing of classroom audio and video components and cabling.

1.02 COORDINATION
- A. Coordinate the location of all speakers and the projector with the existing equipment in the ceiling. Take into account the lights and the other equipment when locating the speakers. Meet with the owner or their representative on placement of equipment in each room prior to installation.
- B. Speakers shall be installed in the ceiling to cover the most area. Speakers shall not be mounted to the outside edge of the room or near the edge of the room.

PART 2 - PRODUCTS

2.01 MATERIALS
- A. The contractor shall provide equipment as required for a complete audio/video classroom teaching installation.
- B. Any and all baluns, patch cords, interface cords splitters and other equipment shall be provided and installed to provide complete connectivity.

2.02 CLASSROOM AUDIO COMBO MIC AND AMPLIFIER SYSTEM
- A. The system must have specifications including but not limited to the following:
  1. Access (1.9GHz DECT Type) Technology wireless communication
  2. Wireless transmission range: up to 200 ft. (600m) open field
  3. Up to two microphones for whole room instruction, team-teaching or student sharing.
     a. Equip with one (1) microphone and neck lanyard.
  4. Pendant-style classroom microphone with audio input utilizing Access Technology (1.9 GHz) for transmission.
  5. Three (3) stereo audio inputs with master volume control
  6. One line level audio output with level control
  7. Two speaker outputs to power a total of 1-4 speakers
- B. The system shall carry a standard warranty equivalent from the manufacturer of no less than 3-years.
- C. Amplifier/mixer
  1. Wireless communication: Access (DECT Type) Technology
  2. Wireless transmission range: up to 200 ft (60m) open field
  3. Power output: 40 Watts Total (20 W / Channel)
  4. Frequency response: 20 Hz to 20 kHz amplifier
  5. Automatic power on when Microphone is powered on and linked
  6. Controls:
     a. (1) Power button
     b. (1) Microphone volume control
     c. (1) Audio input volume controls
     d. (1) Audio output level control
     e. Tone control
- D. Pendant-Style Microphone and transmitter
  1. The pendant-style microphone/transmitter shall contain microphone volume control on the unit allowing users to adjust volume level from anywhere in the classroom.

2. Shall be capable of being worn around a teacher's neck as a hands-free microphone via the lavaliere cord (provided by contractor) or to be used as a handheld student pass-around microphone.
3. Must be rechargeable via wall charger, computer, or Charging Station
4. Lanyard: adjustable length with magnetic clasp
5. Wireless communication: Access (Dect) Technology
6. Transmission range: up to 200 ft (60m)
7. Integrated microphone type: uni-directional electret
8. Audio input: 3.5mm
9. Earbud output: 3.5mm
10. Volume control: +/- 6dB (total range = 12 dB)
11. Power: on/off/mute button
12. Battery run time: 8 hours (fully charged)

E. Audio System Shall be Lightspeed #Cascadia T25 or equal.
1. Equip with one Lightspeed Clearmike or equal
2. Equip with Clearmike Charging cradle and adjustable lanyard

2.03 AUDIO SPEAKERS

A. The Contractor shall conduct a field evaluation of each classroom prior to ordering the equipment and shall order and install the correct type of speakers based on the actual ceiling in each classroom Select one speaker choice from below:

B. Drop Ceiling Speakers
1. Ceiling Speaker (Provide four in each classroom)
a. Two-way speaker system
b. Driver Size: 6.5" driver; 1" tweeter
c. Frequency Response: 40 Hz – 20 kHz ± 6dB
d. Impedance: 8 Ω with Power Handling: 30 W
e. Tile Support: 20-gauge metal tile bridge
f. Lightspeed #DRQ or equal.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Location of the audio components shall be finalized in each classroom prior to installation beginning.

3.02 PREPARATION

A. The contractor shall meet with the owner to determine the installation schedule for the project. The owner will provide the contractor with dates when work can be completed in each building.

B. Coordinate with the electrical contractor to ensure that they install the power outlet in the ceiling at the projector mount. This shall be identified in each room prior to installation.

3.03 SITE REVIEW AND PLANNING

A. Classrooms have drop ceilings or open ceilings. Install the correct speaker type based on the ceiling of each room.

B. All speaker cables shall route back to the teacher faceplate.

C. The contractor shall visit each classroom where the Audio/Video systems are to be installed and shall also note any potential issues in each classroom that might impede the installation of the audio/video components.

3.04 AUDIO ELECTRONICS INSTALLATION

A. The audio system shall be installed at the location shown on the drawings.

B. The system includes cabling, speakers, microphone and the mixer/amplifier,
C. Review the layout of the room and the existing lights and other items in the ceiling. Locate the speakers to provide the best coverage of the room with audio.
D. Speaker cables shall be connected in series. One cable shall be used to connect the mixer/amplifier to the first speaker and then to the other speakers as per the drawing. Contact the manufacturer with questions about speaker and speaker cable connectivity.
E. Connect speaker wires and all audio inputs to the mixer/amplifier. Adjust all inputs, outputs and audio controls to provide even sound between each input. Tune the system to provide clear audio without feedback. Speakers shall be placed with the idea of limiting feedback.
F. When connecting speakers to the amplifiers, ensure the correct polarity throughout the system.
G. Contractor shall label the volume control for each input. Labels shall be self-adhesive and shall be laser printed. Provide a sample label to the owner for approval prior to installation... All labels shall specify the device that dial controls. Handwritten labels are not allowed.
H. After connection of the system, the Contractor shall configure all components to ensure the best sound possible.
I. Contractor shall test each and every input and output of the system. Contractor shall have the Owner present for final testing and system checkout.
J. Connect the control system to the main output of the amplifier.
K. Mark the mixer for the optimal level and location each level control.

3.05 SPEAKER INSTALLATION

A. Prior to ordering all speakers, field verify the ceiling type in each classroom. Order the correct speakers for drop ceiling rooms and hard ceiling rooms etc.
    1. Review ceiling types on architectural drawings or walk the site if the building is existing.
B. Ceiling speakers shall be mounted flush with the ceiling.
    1. Ceiling speakers shall be installed into the existing ceiling tiles. Contractor shall cut each ceiling tile and install the speaker with the tile bridge.
    2. Contractor shall work with the Owner to locate all speakers where other equipment will not impede the installation.
    3. Where the manufacturer provides a T-bar support for the speaker, the Contractor shall install the support in drop ceiling installations.
    4. Speaker wire shall not lie on the ceiling. All speaker wire shall route through J-hooks.
    5. The Contractor shall leave a coil of speaker wire in the ceiling to allow lowering of the speaker for maintenance and removal.
    6. The Contractor shall work with the manufacturer to determine the best layout of the speakers, and shall submit that layout for review prior to installation.
    7. After installation, the entire system shall be tested, and it shall be demonstrated that each speaker is connected and in good working order.
    8. It shall be further demonstrated that all audio can be easily heard throughout each room where speakers have been installed.

3.06 MICROPHONE INSTALLATION

A. Wireless microphones shall be installed to serve the entire room areas where they are installed.
    1. Locate the antennae for all wireless microphones so that the signal will be picked up from anywhere in the room that the microphone serves.
    2. Coordinate all outside and interior signals with any wireless microphone channels so that there is no interference.
    3. Connect the wireless microphone base receiver to the input on the amplifier/mixer.

3.07 AUDIO System

A. The entire audio systems shall be configured to be a complete working system.

B. The Contractor shall label each speaker cable at each end with a wraparound label that has been laser printed.
   1. The Contractor shall give each speaker wire a separate designator. The Engineer shall approve the proposed numbering prior to printing the labels.
C. Each component shall be labeled for what it does and what it provides. Labels shall be laser printed, and shall be attached to the front of each unit.
   1. For example, the amplifier in a cabinet may be marked “Microphone Amplifier-First Floor Hallway.”
D. It is extremely important that each microphone cable be labeled at each end with a laser printed wrap around label. This will allow the Owner to know exactly which microphone is being connected.
   1. Where microphones are terminated, the Contractor shall provide a minimum of 3 feet of spare cable for future movements.
   2. The Contractor shall provide the proposed labeling of the microphone cables prior to the actual installation of the labels.
E. All speakers shall be set so that every area in the room where persons may stand or sit is covered with sound.

END OF SECTION

SECTION 28 5401 – FLAT PANEL VIDEO DISPLAYS

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. Parts and equipment required for transmitting, switching, generating and viewing video images.
- B. The words LCD, Display and Flat Panel display shall be used interchangeably and shall refer to a flat panel display that has LED or OLED lighting or is a direct view LED display.

1.02 SYSTEM DESCRIPTION
- A. Each LCD Display, or projector shall be installed so that users can easily view the picture being presented.
- B. The video systems shall be installed to provide the easiest user interface possible.

1.03 COORDINATION
- A. Coordinate the location of all LCD Displays, and projectors with the Owner and other trades prior to final installation.
- B. Coordinate with other Contractors who are doing work in the ceiling space. Coordinate the installation of all cables, projectors, monitors, etc., with the locations of other services.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved vendors for video displays are:
  1. Newline
- B. LCD Touch panel. Interactive display
  1. LCD Display shall be installed as shown on the drawings.
  2. Displays shall be 16:9 and shall include speakers
     a. Speakers shall be 25 watt
  3. Display shall be an LCD screen
  4. Display shall be 3840 x 2160
  5. Video/audio input shall be a minimum of:
     a. Front side:
        1) HDMI in
        2) 1-USB-A Touch
        3) 2-USB-C 3.2
        4) 1-Mic In
     b. Rear side:
        1) 2-HDMI In
        2) 1-USB-C
        3) 1-USB-C Video out
        4) 2-USB-A
        5) 3 USB-A Touch
        6) 1-HDMI Out
        7) 1-S.PDIF Out
        8) 1- Line Out
        9) 1-RS-232
        10) 1 LAN In
        11) 1 LAN Out
  6. Control
     a. Shall have an RS-232 input/output for control.
     b. Shall be equipped with Ethernet 10/100Mbps connection

c. USB for connection of interactive PC
7. Equipped with VESA compatible mounting holes
8. Display shall be no thicker than 4-1/2 inches.
9. Each display shall include a remote control.
10. Shall include WIFI Module
11. Display shall be an interactive touch panel that includes at a minimum:
    a. Shall work with Windows PC's and Apple IOS an Android 15
    b. Touch technology shall be IR Blocking or equal
    c. Shall allow up to 50 points of contact
    d. Shall be adaptive to work with finger touch or mfg. pens
    e. Include interactive software that on the display and that can be loaded on the PC or Apple device
12. Touch panel display shall be NEWLINE. Include minimum 3-year manufacturer warranty
    a. 86" Diagonal shall be Newline #TT-8625QELT

2.02 FLAT PANEL MOUNTS

A. Flat panel Mounts
1. All supports for LCD panels and monitors shall be appropriately sized and chosen for the exact model display to be supported.
2. Contractor shall match the weight of the display to the recommended weight rating of the support.
3. Contractor shall review the location where the support is to be mounted. Match the surface to which the display is to be mounted with the best attachment hardware available for the support.
4. All supports shall be by Chief Corporation or equal. Contractor shall submit each support for review by the Owner and Engineer prior to installation.
5. Wall Mount swing out
    a. Wall Mount swing-out mount shall be
        1) Chief #PNRUB
        2) Install based on manufacturers recommendations, based on size of Display.

B. Flat Panel accessories.
1. Component Storage Panel behind display
    a. At each display where there are devices to be installed behind the flat panel display, install a component storage panel.
    b. Hide panel and all components behind the display.
    c. Shall be Chief #CSMP0X12 or equal.

2.03 HDMI TO UTP TRANSCEIVERS

A. HDMI and USB-C to UTP transmitter and receiver. Includes USB-C
1. Systems shall transmit HDMI 2.0 and USB 2.0 via CAT-6A cable.
2. Supports distances of up to 230 ft (70 m) for 1080p output or up to 130 ft (40 m) for 4K60Hz HDMI and 4K30Hz USB output.
3. Shall be HDCP 2.2 compliance ensures secure connections between source and display.
4. Transmitter shall support HDMI and USB-C input on a faceplate for single-gang backbox
    a. Shall include an input choice button on the plate
    b. USB-C port shall support 4K 30Hz video transmission via DP Alt Mode (v1.2a) and USB 2.0 data transfer
5. Shall support bi-directional RS-232 via Captive Screw connector
6. Receiver shall be mounted behind the display and shall support
7. Two (2) USB-A ports with up to 5V/1.4A output, accommodating high-bandwidth devices like cameras.

8. HDBase-T shall be via RJ-45 at faceplate and receiver.
9. Install plenum rated, CAT-6A cable to connect between transmitter and receiver
10. Power transmitter from the display end



11.
12. HDBaseT Extender faceplate and receiver shall be C2G # C2G31029 or equal

PART 3 - EXECUTION

3.01 EXAMINATION

A. Location of the video mounts shall be finalized throughout the building prior to installation.
B. Locate all equipment to be installed and make certain that space is available for maintenance and service during the life of the system.
C. If any changes from the drawings are required, the Contractor shall submit a proposed layout of the displays to the Engineer for approval prior to installation.

3.02 PREPARATION

A. Ensure that the wall where a display will be mounted can support the weight of the mount and the display.
    1. Work with other contractors to ensure they are installing Blocking in the walls for the LCD's
    2. Where no blocking is available, provide and install metal stud anchor kits from display mount contractor.
B. Coordinate with the Lighting Contractor on location of all displays. Ensure that lighting will not impede the viewing of the image.
C. Coordination with other Trades:
    1. The Contractor shall meet with the Electrical Contractor prior to installation of the security conduits and boxes to ensure that the boxes to be installed by the Electrical Contractor meet the requirements of the security camera system.
    2. Coordinate power requirements in the communications room with other trades that will be installing equipment in the communications room.
    3. It is the responsibility of the Contractor to install additional pass-thru's if required for the installation of their work. Fire-stop each pass-thru according to code requirements.

3.03 GENERAL VIDEO INSTALLATION

A. The entire video system shall be configured to be a complete working system.
    1. Each cable shall pass the required video and audio signals.
    2. Each display device shall be fully connected to all inputs and control cables.
    3. Each display and signal processor and video source shall be set to maximize the video transmission and image quality so that they match the resolution.
    4. Test each input on each display.
B. Provide all hardware and installation materials to support the video display devices.

1. Install custom unistrut and custom threaded rod from building structure to support all display devices

C. Each component shall be labeled for what it does and what it provides. Labels shall be laser-printed, and shall be attached to the front of each unit.

D. LCD Display mounts:
1. Each display that is to be ceiling or wall mounted shall have a UL listed mount.
2. Contractor shall match the display with the manufacturers recommended mount.
3. Verify that the mount is rated to support the weight of the display.
4. Install all mounts so that the display is not located in a main traffic way where persons might injure themselves by running into the mount or display.
5. Ensure that the mount can support the weight of the display, and that the wall can support the combined weight of the display and the mount. Secure to the wall using appropriate supporting screws and lugs.
6. Where attaching to a drywall wall, attach through or into the stud and not just through the drywall.
7. When ceiling mounting an LCD, provide the required length of pipe extension to meet the desired height of the display.
8. Contractor shall ensure the safety of all persons by securely installing the correct mounts for each display.

3.04 FLAT PANEL DISPLAY INSTALLATION

A. Flat panel display installation:
1. Displays shall be installed where shown on the drawings. Contractor shall field verify the location of all displays prior to final installation.
2. When mounting the displays to the wall, the Contractor shall verify that the mount is the correct size, and will support the weight of the display.
3. When mounting the display from a drywall wall, the Contractor shall connect into or through the wall studs. Attachment just into the drywall is not acceptable.
4. When mounting the displays to the wall, locate them to minimize the possibility that they will be in the path of persons walking near the unit.
5. Contractor shall verify ADA compliance with the installation of all projectors and displays.
6. The display shall be connected to the source via patch cables. The Contractor shall provide and install all patch cables required.
7. Contractor shall test that the display works with the inputs, and that the remote control (if applicable) has batteries and works with the system.
8. Contractor shall set up the display so that the picture is clear and set the correct color, brightness, contrast, etc. Install all display items so that glare from natural or manmade light is minimized for all those that will view the display.
9. When mounting the display, the Contractor shall ensure that it is installed and secured to minimize the chance of falling and causing possible injuries.
10. Contractor shall set up a time to review the installation with the Owner and Engineer. During the review, the Contractor shall demonstrate that each display works and is installed safely and securely.
11. When LCD is controlled with a control system provide all cables and test all control of the display.

B. Interactive flat panel installation
1. Mount the LCD to the Mount and to the wall.
2. Connect to all inputs and outputs
3. Provide additional hardware and supports to mount all equipment noted to be mounted behind the LCD.
4. Connect the LCD to the power and USB and HDMI cable to the display.
   a. Connect the Ethernet network cable with a patch cable if the LCD is so equipped.
   b. Identify the cable and the port it is connected to in the Ethernet switch.

c. Enter this data into a spreadsheet and provide to owner or network contractor for configuration of the Ethernet ports.
d. Provide and install patch cables at flat panel and at the comm room.

5. Set the contact points on the display for the interactive portion of the screen. Set all points and configure the “pens”
6. Load all interactive software on the teacher’s PC.

3.05 UTP AUDIO AND VIDEO TRANSMITTERS AND RECEIVERS.

A. The UTP devices shall be used to transmit the signals for the various displays.
B. Install all cables required to transmit signals from source to display output. Provide all patch cables for complete connectivity.
C. The transmitter shall be connected to the source device as shown on the drawings. The contractor shall make all audio and video connections.
D. At each display the contractor shall configure the receiver to compensate for any skew of the signal.
E. Connect the audio and video outputs of the receivers to the video displays.

3.06 TESTING (PRE-COMMISSIONING)

A. All systems shall be initially adjusted and set by the contractor, unless otherwise specified, in writing, by the Consultant or the architect.
B. A complete mechanical and electronic inspection to verify proper installation and operation shall be made, including mountings, interconnection, video scaling and sizing. Test procedures and documentation of results shall be provided with the system documentation.

3.07 COMMISSIONING

A. The video Contractor will provide a technician to assist the Consultant during the commissioning of the system. The technician will be ready and available to make any necessary adjustments or repairs to the system that the Consultant finds in error of the specification.
B. The Video Contractor will have on hand all installation documentation and equipment manuals. The Contractor will have the necessary tools available for any adjustment or repairs. Once the system is commissioned, the Contractor will provide final As-built documents to the Consultant for review.

END OF SECTION

SECTION 28 7200 – TECHNOLOGY SUBMITTALS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section provides the Contractor with requirements regarding Product Data Sheets, Shop Drawings and Product Samples collectively referred to as “Submittals”.

B. This section provides the Contractor requirements regarding As-Built Documentation after installation and prior to Final Completion and Final Payment

C. The requirements of this section deal only with those submittals that are required to be provided by the chosen contractor after bid award. No submittals in this section are required to be provided with the Bid Response.

D. The requirements contained herein should be considered bound and apply to all technology and security specification sections per this contract.

1.02 PRE-INSTALLATION SUBMITTALS

A. The contractor shall provide material submittals to the Construction Manager or directly to the designer, whichever is managing the project.

B. Prior to beginning work, the chosen Contractor shall provide PDF files of all material submittals.

1. Highlight the part number of each item specifically. Submittals that are not highlighted will be rejected and sent back immediately.
2. Match camera submittals with the camera type on the drawings. see Security Equipment Schedule on TC501. Provide marking on the PDF File detailing which camera type is being submitted.
3. Provide the PDF with the following file names
    a. Site - Spec Section - Description
    b. In Example: K**ent City 28 1600: Data Cabling submittal**

1.03 AS-BUILT DOCUMENTATION

A. The contractor shall provide As-Built documentation to the Construction Manager or directly to the designer, whichever is managing the project.

B. Provide the As-Builts in hard and soft copy

1. Hard Copy shall include all Red-lined Drawings showing what was actually installed and where it was installed.
2. Soft copy on USB Drives (PDF or Microsoft Word or Excel) shall include all documents provided in the hard copy plus any configuration or data files. Include XLS files for all spreadsheets.

PART 2 - PRE-INSTALLATION SUBMITTALS

2.01 PRODUCT DATA SHEETS

A. Product data sheets shall consist of the manufacturers detailed specification sheets or “cut-sheets” for each product that is to be installed by the contractor or any subcontractors.

B. Product data sheets shall minimally include, but shall not be limited to:

1. Part Number
2. Manufacturer
3. Description of the product
4. Physical dimensions and characteristics of the product
5. Picture or manufacturers drawing of the item, where applicable
6. Electrical characteristics of the product including heat-load for active electronics.
7. Optical characteristics of the product for Fiber-Optic equipment and cable.

C. Provide product data sheets for all equipment and cabling that is to be installed by the contractor
D. Provide a PDF of all the Equipment being submitted. Each actual part number shall be highlighted on the PDF in yellow.
   1. Group Product Data Sheets by:
      a. Data Cabling
      b. Fiber Optic cabling
      c. Access Control
      d. Video Security
      e. Audio and Video Systems

2.02 SHOP DRAWINGS
A. Shop Drawings shall consist of detailed drawings showing actual connectivity, equipment to be installed and cable types for the systems noted below:
   1. Access Control system connectivity
B. Shop drawings shall also be provided for systems that the contractor intends to connect differently than what is shown on the contract drawings or where no connectivity is shown.

2.03 PRODUCT SAMPLES
A. Product Samples shall consist of a sample of the actual product that is to be installed.
B. Samples shall be tagged with the part number and specification section to which it pertains.
C. Product Samples shall be provided for the following:
   1. None at this time.

2.04 SUBMITTAL DOCUMENTS
A. The Contractor shall provide all Submittals to the Construction Manager or the designer
B. The Contractor shall provide PDF Files for all Product Data Sheets.
   1. All Product Data sheets shall be PDF files grouped as shown in 2.01/D
   2. The Contractor shall highlight the actual part number on the sheet of the component that they are submitting.
   3. If no part number is highlighted or marked with an arrow, then the entire submittal package will be rejected and sent back for re-submission.
C. The Contractor shall provide 1 set of PDF of Shop Drawings.
   1. Shop drawings shall be marked for the specification section of the bid documents to which they pertain. Mark the Detail (TCXXX/Y) to which the Shop Drawing refers.
   2. All shop drawings that are required to be drawn on the building background shall be provided on full-size drawings the same scale as those in the bid documents.
   3. All lines on the shop drawings shall be highlighted or completed in ink that is not the same color as that provided in the bid documents.
   4. The contractor shall provide a drawing legend detailing all symbols used in creation of the shop drawings.
D. The Contractor shall provide one of each product sample required to be submitted.
   1. Provide a cutsheet with each product sample detailing the specifics of the product and what it is proposed to be used for.

2.05 SUBMITTAL REQUIREMENTS
A. Submittals shall be provided for approval prior to installation of the work.
B. Any equipment installed that does not have an approved submittal associated with it can and will be removed from the project and replaced with other equipment as defined by the Designer. All replacement costs shall be the responsibility of the Contractor.
C. It shall be the responsibility of the Contractor to provide the submittals for review in sufficient time to not delay the installation. Work with the Construction manager on the schedule.
D. It shall be the responsibility of the contractor to ensure they have provided and have on hand “Reviewed” or “Furnish as Corrected” submittals for all equipment they install.

E. When reviewing submittals marked “Furnish as Corrected” take into account the comments and incorporate the comments into the products and installation of the systems.

PART 3 - AS-BUILT DOCUMENTATION

3.01 MATERIALS

A. The Contractor shall provide the following to the Designer prior to the issuance of the final payment.
   1. Approved submittals and equipment user manuals.
   2. As-Built Documentation as detailed below.
   3. All spare parts and cover plates for all components of the systems
   4. Manufacturer warranty cards for all components.

3.02 AS-BUILT PROCESS

A. The Contractor shall provide all project as-builts to the designer at substantial completion.
   1. Provide them to the designer for review
   2. Make any required changes the designer requests
   3. Re-submit at the time of Final Completion / final payment. Final Payment is not possible without a complete post installation deliverable package

3.03 PREPARATION

A. All documents for As-Builts and test results shall be neat and clearly labeled with listing of the project and documents included in each binder.
B. Quantity:
   1. Submit Red Lined, As-Built floorplans for the Systems detailed in 3.04/D.
      a. Provide one set of physical documents, full size,
      b. Provide PDF Scans of the As Built Floorplans.
   2. Submit Electronic files for As-Built Documentation
      a. Provide PDF Files. Provide a Coversheet that details:
         A) Client name.
         B) Project name.
         C) Manual title (e.g., “Project Close-out Manual for security system upgrade”).
         D) Date; date format: <month> <day>, <year> (e.g., “January 1, 20xx”).
         E) Installer and General Contractor names and contact information
         F) Warranty contacts for all systems.
      b. Submit Electronic files to Owner, Designer and Construction Manager via email or dropbox or directly through USB Drives.
   3. Submit (2) USB Drives with all As-Built documentation and software configurations.
      a. Software configurations shall be provided for:
         A) Video security NVR and camera/user database
         B) Access control system configuration and database

3.04 PROJECT DELIVERABLES

A. Provide a copy of all submittals and manuals and pamphlets.
B. Provide a copy of all Warranty documents and contact numbers for Warranty requests.
C. The contractor shall provide one set of full sized as-built prints. Provide a PDF of the as-built prints on the USB drives or via Email or Dropbox.
   1. Provide a clean set of the latest drawings with red lines marked for all field changes or bulletins. See above for systems to be included on the As-Built prints
D. The As-Built drawings shall include:
   1. Changes to be reflected on the drawings for Video Security Systems shall include:
      a. Camera locations

b. Cabling Paths
c. Camera numbers
d. Comm room where camera connects to.

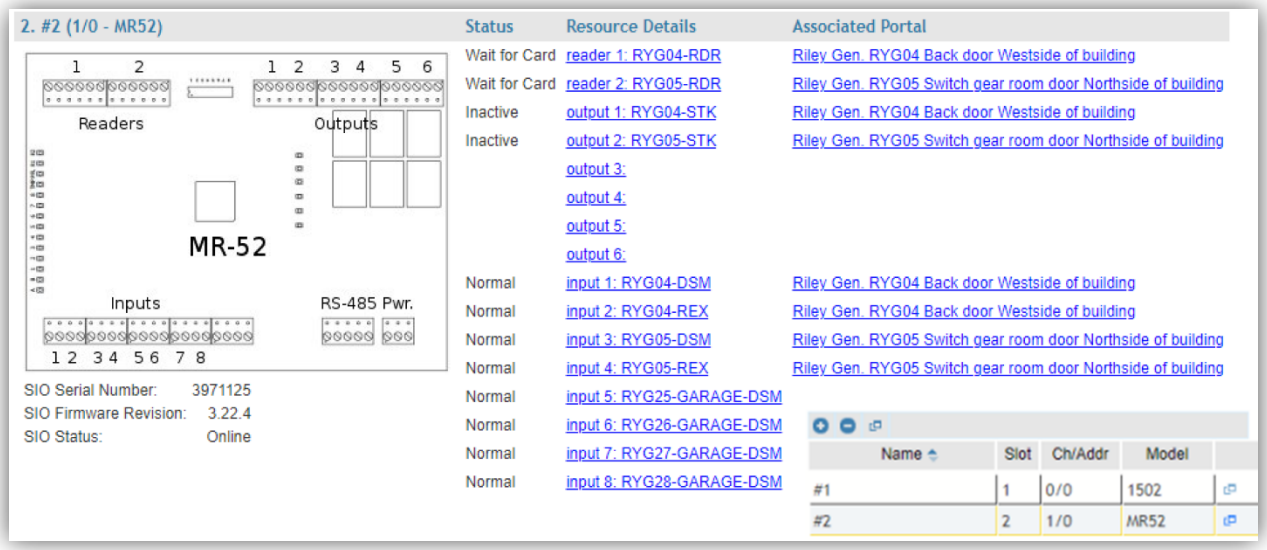
2. Changes to be reflected on the drawings for Access Control/Alarm Systems shall include:
   a. Changes to hardware installed at each door. Update each door for all devices installed and connected
   b. Changes to the panel locations
   c. Door numbers
   d. Changes to the schematic connectivity of any system shown on the drawings.
3. Changes to be reflected on the drawings for Audio and Video Systems shall include:
   a. Microphone/speaker faceplate locations and labels.
   b. Rack/cabinet locations.
   c. Speaker and microphone locations.
   d. Rack layout of all components in each rack.
   e. Changes to the schematic connectivity of any system shown on the drawings.
   f. Ceiling/wall mounted projector locations
   g. Label designation of all cables, including system interconnection cables.
4. Changes to be reflected on the drawings for Cabling Systems shall include:
   a. Route of exterior conduits and exterior cabling
   b. Route of backbone cabling, fiber and copper
   c. Route of major cable paths from outlet to comm room.
   d. Rack/cabinet locations.
   e. Faceplate locations
   f. Rack layout of all components in each rack.
   g. Changes to the schematic connectivity of any system shown on the drawings.
   h. Cable numbering for each faceplate.
5. Changes to be reflected on the drawings for Paging and Clock System shall include:
   a. Clock Locations
   b. Microphone and audio input faceplate locations and labels.
   c. Rack/cabinet locations.
   d. Speaker locations and associated zone information for each speaker
   e. Primary cable routing paths
   f. Call button locations
   g. Label designation of all cables, including system interconnection cables.

E. Documentation for the specific systems shall include. Provide the following for each system:
1. Contractor warranty dates based on Substantial completion date and contact information for warranty work.
2. Data cabling
   a. Testing Documentation for copper and fiber cabling
      A) Include software to read the test results.
      B) Testing Documentation; This shall include actual cable test results. Tabbed Sections in the binder:
         1) Telecommunication Horizontal Cabling Detailed cable test reports
         2) Telecommunications Fiber backbone cabling
         3) Summary report
   b. Signed Cabling Warranty from manufacturer
3. Video Security
   a. Picture of focused and approved camera image labeled with the camera number and IP address
   b. Master user password list
   c. Spreadsheet of each camera that shall include:
      A) Camera Part number
      B) Firmware revision
      C) IP address

D) MAC Address
E) Camera Name
F) Building where it is located

d. Training “Cheat Sheet”
e. Manufacturers Camera Warranty
f. Server/NVR Warranty
g. Manufacturer contact information for warranty work
h. Software Upgrade Protection (SUP) warranty including end date
i. Warranty certificate for all PC’s

4. Access Control
   a. Part list/diagram for each access control panel. To include
      A) Panel name and IP address (if applicable)
      B) Doors which are connected to this panel
      C) Panel location. Building and room number
   b. Diagram showing which devices and doors that are attached to each panel. Diagram shall be something like below. Group in PDF document per panel. Label the document with building and panel number. Ensure panel in the field has corresponding panel number



c. Training “Cheat Sheet”
d. Server Warranty
e. Software Upgrade Protection (SUP) warranty including end date
f. Warranty certificate for all PC’s

5. Audio / Video Systems
   a. Warranty certificate for LCD Monitors
   b. Warranty certificate for projectors

F. Training sign-in sheets detailing what was trained, who was trained and their time in training.

END OF SECTION

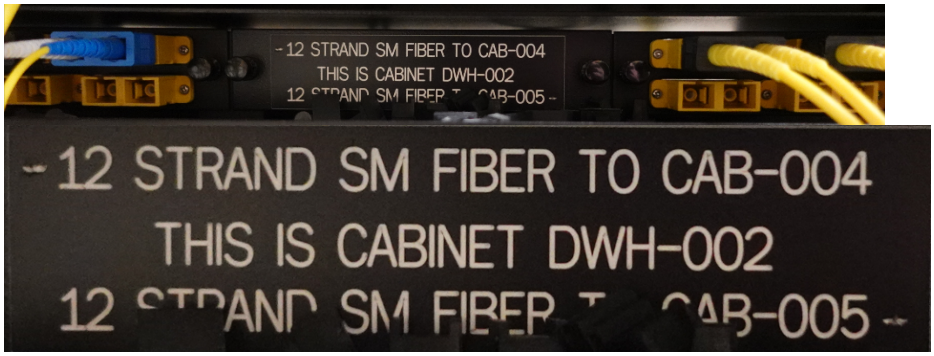
SECTION 28 7600 – TECHNOLOGY LABELING

PART 1 - GENERAL

1.01 WORK INCLUDED
- A. This section provides direction on labeling of cables and devices.

PART 2 - PRODUCTS

2.01 CABLE LABELING PRODUCTS INTERIOR
- A. UTP/STP, access control and audio / video cabling
  1. Laser-printed, self-adhesive wrap around shall be Brady LAT-18-361 or equivalent.
  2. Label shall be 1.00-inch width x 1.33 inch high.
  3. Labels shall come on a sheet with 7 labels per row with a white and transparent matte finish.
  4. Sheet size shall be 8-1/2 inch x 11 inch.
  5. Printable area shall be a minimum of 1.00-inch width x 0.50 inch high.
  6. All labels shall be printed through a laser printer using labeling software.
  7. The Contractor shall submit a proposal for the labeling scheme for all audio and video wiring. The Engineer shall approve of the scheme prior to all labeling.
- B. Wireless Access Point Cables in drop ceilings
  1. Install a yellow adhesive sticker to the drop ceiling grid at all WAP cables where the cable is coiled above a drop ceilng.
  2. Size to fit on the ceiling grid. Shall be yellow with black words. See below:
  3. **WAP CABLE ABOVE**
- C. Audio and Video Components in a cabinet or rack or teacher desk/lectern.
  1. Each of the audio and video components shall be labeled.
  2. The labels shall have a white background with black, laser printed letters.
  3. Each label shall be large enough for 2 lines of text and wide enough to detail what each dial and component is for.
  4. Each input and output control point on the amplifiers and other equipment shall be labeled for the device to which it connects.
  5. Mark each volume or level control for the optimum setting.
     a. Put a mark at the nominal input and output level for each control. This shall be useful for a new person to reset the system to work as designed if someone else has changed the settings.
- D. Fiber Cable labeling.
  1. Laser-printed, self-adhesive wrap around labels for and fiber cables in the comm rooms and ay the back of the patch panels shall be Brady LAT-19-361 or equivalent.
     a. Label shall be 1.00-inch-wide x 3.167 inch high.
     b. Labels shall come on a sheet with 7 labels per row with a white and transparent matte finish.
     c. Sheet size shall be 8-1/2-inch x 11 inch.
     d. Printable area shall be 1.00-inch-wide x 0.97 inch high.
     e. All labels shall be printed through a laser printer using labeling software.
     f. Install on fiber cable at the patch panel as it enters and at the coil of fiber on the wall or in the cable ladder
  2. Fiber panel labels
     a. All fiber optic patch panels shall be equipped with an adhesive, engraved lamacoid label that shows the type of fiber cable, quantity of strands and far end termination point.
     b. Label shall also detail which comm room the fiber originates in.
     c. Example is below:

d. 

e.

f. Where required, provide a blank SFP module to mount the label.

3. Interior exposed fiber cable and fiber cable inside inner duct shall be labeled every 100 feet, label shall be Panduit No. PST-FO.
   a. Label shall be covered with a clear laminate to protect the legend of the label.
   b. Attachments for tie wraps shall be available on the label to attach it to the cable or inner duct.

E. Faceplate Labels
1. Laser-printed, paper labels shall be used to label user faceplates.
2. Individual paper labels shall be installed behind the clear plastic strips of all user faceplates and surface mount housings.
   a. The labels shall show the location identifier number and letter of each individual cable.
3. Where a faceplate or surface mount box does not have a clear plastic strip the contractor shall install an adhesive label on the plate or surface mount box showing the cable number of each cable in the plate.

F. CAT-6/6A patch panels in comm rooms
1. Laser-printed, labels shall be used to label Cat-6 Patch panels
2. Label the side of the patch panel for the panel number in the comm room. “Panel A” etc. label on two spot on each panel
3. The panels shall be labeled 1-24. Use factory numbering or paper numbering if no factory numbering is provided.

G. Rack and Cabinet labels
1. Provide and install Engraved, lamacoid labels at the top of each rack or cabinet installed. Shall be black label with white engraved letters
2. Shall be 1” high minimum.
3. Coordinate rack number and comm room number prior to ordering
4. Sample:

a. **COMM RM A1- RACK 01**

H. Custom Faceplates
1. Engraved labels shall be installed at locations including but not limited to:
   a. Audio and Video special input plates. Detail each input and output
2. Size the phenolic labels for their individual uses. Provide a sample to the Engineer for approval prior to ordering or installation.

2.02 SECURTY CAMERA LABELING
A. Laser-printed, labels shall be used to label all Security Cameras
1. Label the camera with a White or Clear label with black lettering.
2. Label shall include the camera number.
3. May include the IP address. Consult with owner to determine if this is required
4. Label shall be a minimum of 3/4 inch tall and legible when standing beneath or near the camera as long as camera is not above 15; AFF

2.03 NETWORK AND WIRELESS LABELING PRODUCTS

A. Laser-printed, labels shall be used to label all Access Points and Ethernet Switches
B. Ethernet switches
    1. Label the front panel or on patch panel just above the switch if there is no room on the face of the switch
    2. Label shall include the switch name and IP address
    3. Label shall be a minimum of 1/2 inch tall
    4. White label with black numbers
C. Wireless Access Points
    1. Label the WAP with a White or Clear label with black lettering.
    2. Label shall include the WAP number/name.
    3. May include the IP address. Consult with owner to determine if this is required
    4. Label shall be a minimum of 3/4 inch tall

2.04 ACCESS CONTROL PANEL LABELING
A. Label the front of each access control panel to detail the doors that are connected to the panel.
    1. Label the front panel and detail each door number
    2. Label shall include the panel name and IP address
    3. Text shall be a minimum of 3/8 inch tall
    4. White label with black numbers

PART 3 - EXECUTION

3.01 PREPARATION
A. Terminate all cables in proper color code sequence.
B. Clean any surfaces where an adhesive label is to be installed.
C. Prior to beginning the work, the contractor shall submit to the engineer a plan for labeling all the cables. This shall take into account to what components each cable is connected.

3.02 GENERAL LABELING
A. Everything shall be labeled as per the specs and drawings.
B. All labels shall be installed to more easily identify the cables and ports on all panels. If there are any questions regarding labeling, contact the Engineer prior to installation.
C. Engraved lamacoid labels shall be provided and installed whenever there is no location for paper inserts on faceplates, power poles, poke thru's, floor boxes, modular furniture and surface raceway.
    1. Engraved lamacoid labels shall provide the same labeling as the paper inserts, but they shall be self-adhesive.
    2. These labels shall be adhered to the location closest to the modular jack.
    3. Individual letters shall be provided for each cable. An overall location identifier can be provided for all the cables at that faceplate or floor box.
    4. Engraved labels for rack shall be at least 1-1/2 inch high with letters 1 inch high.
    5. These labels shall be affixed to the top and front of each rack or cabinet. Verify that the label will fit the rack or cabinet prior to purchasing.

3.03 DATA CABLING LABELING EXECUTION
A. Cable labels for CAT-6 user cables from the faceplate to the patch panel shall be installed within 4 inches of the end of the cable sheath.
    1. The location identifier is made up of 3 fields, and a sample might look like this:

        A-X-YY

        The A stands for the communications room where the cables are terminated.
        The X represents that the Patch panel in that comm. room.
        The YY represents the cables number in that panel 01-48.

This system of identification provides the Owner with an easy way to keep track of cables, and where they are located or terminated.

2. The cable label shall be similar to the label below:

A-X-YY
A-X-YY
A-X-YY

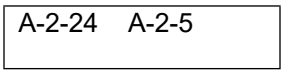
3. Provide a sample label to the Engineer for approval prior to installation of all labels.
4. Labels shall be installed at each end of each cable. Shall be within 4” of the termination.
5. Shall be at a uniform distance from termination on the patch panels. See pic below:



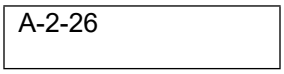




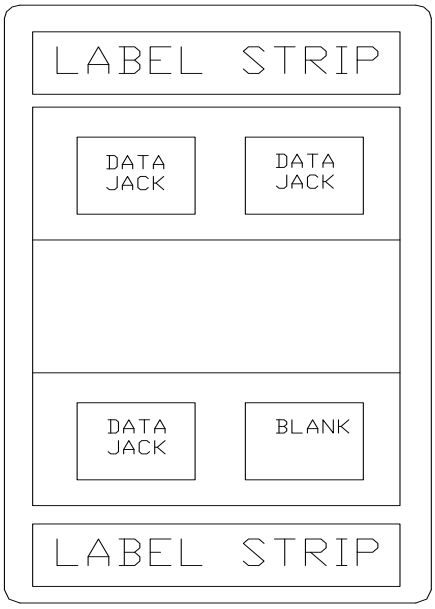
B. Paper inserts shall be supplied for all faceplates and patch panels labels.
   1. Paper inserts for the faceplate shall detail the exact location identifier for each cable.
   2. They shall fully cover the background of the insert space on the faceplate, but all numbers and letters of the identifier shall be visible after installation of the plastic cover plate.
   3. The paper insert for a standard faceplate will look like this:



Top Label Strip



Bottom Label Strip



   4. Provide a sample label to the Engineer for approval prior to installation of all labels.

C. CAT-6 Patch panels shall be labeled for the panel they are numbered in the comm room and for the cameras (1-24 or 1-48)

1. See below diagram:

a. Install labels at each end detailing the panel number.

Panel A	01	02	03	04	05	06	07	08	09	10	11	Panel A

D. CAT-6 Patch panels for Wireless Access Points shall be labeled for the WAP number

1. See below diagram:

a. Install labels below each outlet on the patch panel detailing the WAP number

b. Meet with the owner and obtain the WAP number and label the panel with that WAP number. Install .laser printed label

c. Example below shows WAP number of BU (for Butler building)-0XX etc.

Panel A	01	02	03	04	05	06	07	08	09	10	11	Panel A
	BU-021	BU-022	BU-023	BU-024	BU-025	BU-026	BU-027	BU-028	BU-029	BU-030	BU-031	

TYPICAL PANEL LABELING



3.04 FIBER OPTIC CABLING LABELING EXECUTION

A. Fiber optic cables shall have a wrap around label at each end that details the 2 buildings and/or closets where the cables terminate.

1. A fiber cable with 12MM strands terminates in White Hall Room 012 and Green Hall Room 243. The wrap around label shall look like this:

12MM
WT 012-GR 243

2. The wrap around labels shall be installed within 12 inches of the end of the sheath of the copper and fiber cables.
3. Provide a sample label to the Engineer for approval prior to installation of all labels.

B. Label the fiber optic stowage ring with the information on the fiber cable
1. Provide a laminated label in the center of the fiber optic stowage ring that details each fiber cable and its fiber type, strand count and far-end termination of each fiber cable.

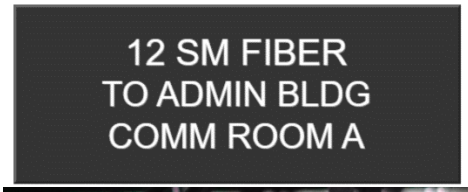
C. Fiber Panel labeling shall be done for the front of each fiber optic patch panel.
1. The figure below demonstrates the layout of the fiber panel label. Each label shall be customized for each individual panel. The figure below is for the 72 port panel.
2. Contact the Engineer with questions on the correct labeling prior to installation.

12 SM TO HIGH SCHOOL						12 MM TO COMM RM “B”						12 SM TO COMM RM “C”					
01	03	05	07	09	11	01	03	05	07	09	11	01	03	05	07	09	11
02	04	06	08	10	12	02	04	06	08	10	12	02	04	06	08	10	12

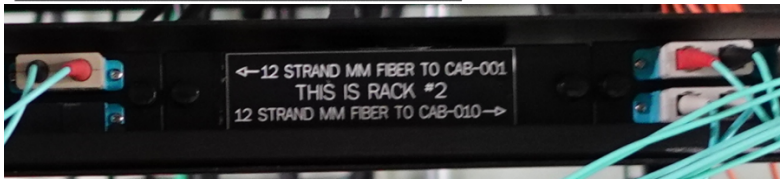
Figure A – Label for 36 Port Fiber Patch Panel

D. Fiber panel labeling shall be completed with an engraved plastic labels.
1. Labels shall detail the fiber type, quantity of strand and far end termination building and comm room
2. Sample:

a.



b.



3.05 VIDEO SECURITY LABELING

A. Cameras shall be labeled with the camera number in a visible location.
1. Affix a label to the camera housing that details the camera number
2. Shall be in a location that is visible from a standing position.

3. Shall be laser printed.
4. Label the camera cable patch panel to include the number of each camera connected to that cable. This camera cable label at the patch panel shall be by video security contractor
   a. Install an adhesive sticker below the cable in the patch panel as the factory number (1-24) is most likely on top of the panel.

B. Label the CAT-6 Patch Panel for security Cameras in each comm room
1. Install an adhesive label on each port on the patch panel that attached so the security camera cable.

DDD = the camera number within that building

C. CAT-6 Patch panels for security cameras shall be labeled for the camera number
1. See below diagram:
   a. Install labels at each end detailing the panel number.

Panel A	01	02	03	04	05	06	07	08	09	10	11	Panel A
	101	102	107	108	201	105	208	145	146	147	174	

D. All labels shall be installed to more easily identify the cables and ports on all panels. If there are any questions regarding labeling, contact the Engineer prior to installation.

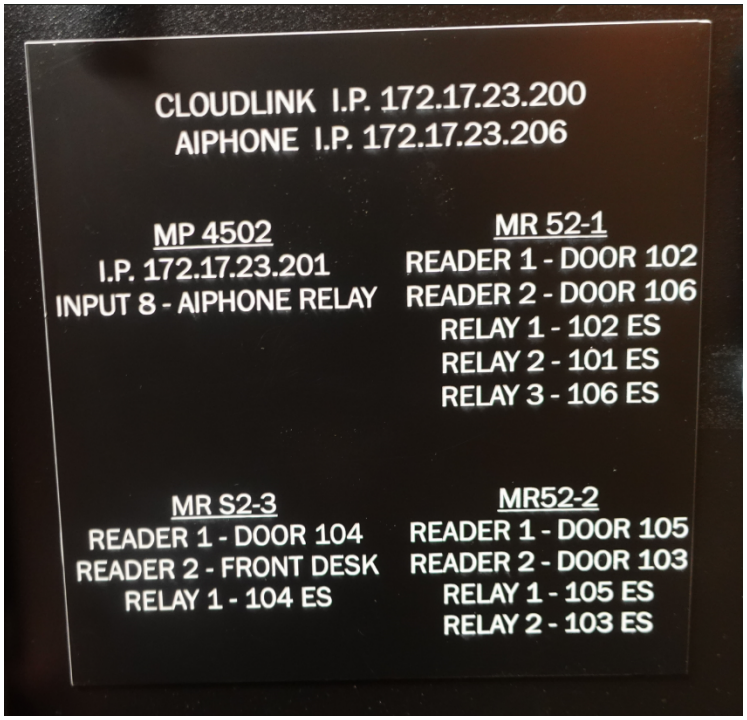
3.06 ACCESS CONTROL SECURITY LABELING

A. Security Panels shall be labeled on the outside to indicate panel number and communications room number

Security panel	IP address 111.111.10.112
Panel 04	Comm room XXX

1. Install a label on the inside of the panel that details:
   a. Door numbers that are connected to this panel
   b. Diagram of panel showing where each door is connected to the panel.
   c. Panel name as shown in the access control system
   d. IP address of the panel

e.



B. Access Control cables shall be labeled.
   1. The cables at the door devices shall be labeled where they connect to the device at the door
   2. The cables at the panels in the communications rooms shall be labeled with the door number
   3. Cable labels shall be installed within 3 inches of the end of the cable sheath.
      a. The cable label shall be similar to the label below:

125A-DC
125A-DC
125A-DC

      b. Provide a sample label to the Engineer for approval prior to installation of all labels.

         125A-DC

         The 125A stands for the Door Number.
         The DC stands for Door Contact. This could be any of the field devices: RX,ES, EL, MX, KP etc.

3.07 AUDIO/VIDEO LABELING

A. The Contractor shall make up a spreadsheet listing each audio and video cable that extends from the cabinet/rack to a location within the building.
   1. The spreadsheet shall detail the number of the cable, the room it is located in, and the cabinet to which it routes.

2. One line on the sheet shall show the results of the test. After being tested for continuity, and being tested that the cable delivers the required signal, the Contractor shall enter “PASS” into the result column.
3. There shall be spaces for the name of the person doing the test, the date, and the company name.
4. All information on the sheet shall be printed by a printer except the name of the person performing the tests, the date, and the “PASS” column.
5. This spreadsheet shall be submitted to the Engineer and Owner prior to project completion.

B. Each control, audio, video, speaker, and microphone cable shall be labeled with a self-laminating, laser printed label at each end. This includes all interconnection cables.
1. The cables shall be labeled for the equipment that the cable connects Consult with the Engineer prior to labeling.
2. All speaker cables shall be marked according to their location in each room. Consult with the Engineer prior to labeling.
3. Each video cable shall be labeled according to the equipment it connects to.
4. The cable label shall be similar to the label below:

SPKR-1
SPKR-1
SPKR-1

a. The above label details that this cable is the first speaker cable for the audio system. The same rationale will be used for speakers, video cables, etc. The Contractor shall mark all as-built drawings to show the microphone location or speaker that the label refers to. There shall be continuity between all labels and as-built prints.
b. Provide a sample label to the Engineer for approval prior to installation of all labels.

C. Once the system is set up and running, many different people will be using the system. The Contractor shall label each audio and video component for what it does.
1. In example, the mixers shall detail what microphones they mix. Do this by labeling each gain control dial on the mixer. The mixer would be labeled as “Microphone-Mixer in Incident room” or other similar label.
2. For the description of all the components, consult with the Engineer. All labels shall be laser printed.
3. The Contractor shall identify each item on the as-built connectivity drawings. Use the same identification as you do on the labels.

END OF SECTION

SECTION 28 7700 – TECHNOLOGY TESTING

PART 1 - GENERAL

1.01 WORK INCLUDED
- A. This section provides direction on
  1. Testing of copper and fiber cable,
  2. Testing and commissioning of the technology systems

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Approved vendors for cable testers are:
  1. Fluke or equal

2.02 TESTING PRODUCTS
- A. Category 6/6A cable shall be tested.
  1. Cable tester shall support Cat 6 channel and permanent link certification.
  2. Tester shall provide accuracy beyond TIA level III requirements traceable to laboratory reference standards.
  3. Through add on fiber optic probes, the tester shall be able to test multimode and single mode fiber cable.
  4. Test results shall be able to be stored on internal or removable compact flash memory cards.
  5. Tester shall have optional talk set for discussions over the cable being tested.
  6. Tester shall support a frequency range of 1-350 MHz with accuracy to the current proposed TIA Level III.
  7. Tester shall support the following tests:
     a. Near end crosstalk (NEXT).
     b. Attenuation.
     c. Equal level far end crosstalk (ELFEXT).
     d. Return loss.
     e. Ambiant noise.
     f. Wire map shall identify miswires, shorts, opens, reversals, and split pairs.
     g. Shall measure cable length and distance to faults (if any).
     h. Propagation delay.
     i. Loop resistance.
  8. Tester shall support the following test standards:
     a. TIA Cat 6/6A and ISO Class E.
     b. TIA Cat 5.
     c. TIA TSB-95.
     d. TIA Cat 3, 4 and 5 per TIA TSB-67.
     e. UTP, STP, SCTP coaxial and twinax cabling.
     f. IEEE: all Ethernet 802.3UTP and fiber PMD interfaces including 1000BASE-T; other 802.x PMD interfaces including token ring and demand priority.
     g. ATM: All UTP and fiber PMD interfaces.
  9. Tester shall have all required probes and accessories required to perform CAT-6 tests and “Network Tests.”
  10. Tester shall have been recently calibrated (within 4 months), and shall be utilizing the latest software.
- B. Fiber Optic Tester:
  1. Fiber cable shall be tested with a light power meter.

a. Multimode at 850nm and 1300nm, and single mode at 1310nm and 1550nm shall be tested by the light meter.
b. Power meter testing shall have a range of +20 dBm.
c. Testing at both wavelengths shall appear on the readout at one time for both multimode and single mode.
d. All connector types shall be available for testing.
e. Resolution of testing shall be to 1 foot.

2. All fibers shall be tested prior to any splice (other than pigtails) being closed and secured.

2.03 PUNCHLIST PROCESS

A. The contractor shall be required to go through a punchlist process prior to substantial completion and final completion/payment of each project
B. Contractor shall be responsible for reviewing their own work and checking to ensure it has met the project requirements.
C. The contractor shall:
1. Review your work in each room
2. Review the specifications and drawing and review their work to ensure it meets requirements
3. Create a punchlist document showing what work is not yet done and what as-builts are yet to be completed. Send document to designer.
a. Provide a date when contractor punchlist work will be completed.
4. Schedule a punchlist and substantial completion meeting with designer.
5. Present updated punchlist document to the owner
6. Walk the site with the contractor and demonstrate all systems and review the work completed. Demonstrate how all work is completed
D. Designer will create an “Owner Punchlist” document
1. This will be provided to the contractor
2. Contractor shall review the list, fix/upgrade/replace all equipment and cabling and finish work on the punchlist
3. Return punchlist to the designer showing when the work was fixed/completed and a signature on the sheet showing that the contractor has reviewed each item.
E. Meet onsite with the designer to review the finished work.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Testing shall be completed after fiber is installed inside the fiber patch panel and the fiber panel has been put together.
B. All cables and panels where cables terminate shall be labeled with the cable label or name of each individual cable. Identify how each cable and panel will be labeled.

3.02 CATEGORY UTP/STP CABLE TESTING

A. Cable tests for CAT 6 cables shall be provided for each user CAT-6 cable.
1. Prior to beginning the testing, the Contractor shall provide the Engineer with a notice that testing will begin. Written notice shall be given at least 3 business days prior to testing beginning.
2. Tester shall be calibrated each day with manufacturer provided calibration cable.
3. Tests shall be saved under each cables unique location identifier.
4. Contractor shall provide the correct cables and probes specifically for the cable and modular jacks that are being tested.
5. During the test the tester shall be set to check all “Network Tests.”

6. Test results shall be provided in hard copy and soft copy. Along with the soft copy, provide a copy of the software required to read the test results.
7. Contractor shall supply 2 copies of the paper results and 2 copies of the file results.
8. Provide all paper results in 3-ring binders. Binders shall have a cover that shows the job name, job number, building and closet where the cables were tested, and the range in the location identifiers of the cables tests provided.
9. Tester shall be set to match the cable being tested.
10. Contractor is responsible for ensuring that all cables pass the tests. Any cable found not to pass shall be removed and replaced at the Contractor's expense.

B. Multipair cables shall be tested for continuity, miswires, shorts, opens reversals, and split pairs.
1. Provide the test results in the multiple pair cable Test Sheet

3.03 FIBER CABLE TESTING

A. Fiber cable shall be tested with a light meter for end-to-end tests.
1. Prior to beginning the testing, the Contractor shall provide the Engineer with a notice that testing will begin. Written notice shall be given at least 1 week prior to testing beginning.
2. Light meter tester shall be calibrated at the beginning of each day.
3. Light meter test results shall be provided in a spreadsheet format.
4. Contractor shall supply 2 copies of the paper results and 2 copies of the file results.
5. Provide all paper results in 3-ring binders. Binders shall have a cover that shows the job name, job number, building and closet where the cables were tested, and the range in the location identifiers of the cables tests provided. Test reports shall include the following information for each cabling element tested:
   a. Actual measured and maximum allowable attenuation (loss) at the specified wavelengths per Part 2, Section 3 and the margin. An individual test that fails the link criteria shall be marked as FAIL.
   b. Reference method.
   c. Number of mated connectors and number of splices (if any).
   d. Actual length and maximum allowable length per Part 2, Section 3. Any individual test that fails the link length criteria shall be marked as FAIL.
   e. Group refractive index (GRI) for the type of fiber tested, if length was optically measured.
   f. Tester manufacturer, model, serial number, and software version.
   g. Circuit ID number and project/job name.
   h. Link criteria (autotest) used.
   i. Overall pass/fail indication.
   j. Date and time of test.
6. Contractor shall test all user fiber cables to the following limits:
   a. Link attenuation shall be tested in accordance with ANSI/TIA/EIA-526-14A. Reference measurements shall be made in accordance with Method B or equivalent
   b. Multimode loss shall be no more than .6dB per mated connector and shall be no more than 3dB/km at 850nm and 1dB/km at 1300 nm.
   c. Singlemode loss shall be no more than .6dB per mated connector and shall be no more than .5dB/km at 1310 nm and .4dB at 1550 nm.
   d. If the measured loss is above the limits, the Contractor shall take action to fix the cables and get the tests to be below the loss limits.
7. Contractor is responsible for ensuring that all cables pass the tests. Any cable found not to pass shall be removed and replaced at the Contractor's expense.
8. Testing shall be of the optical link. An optical fiber link is defined as the passive cabling network between 2 optical cross connects (patch panels or outlets). This includes cable, connectors, and splices but does not include active components. The link test contains the representative connector loss at the patch panel associated with the

mating of patch cords but does not include the performance of the connector at the equipment interface.

3.04 SECURITY SYSTEM COMMISSIONING

A. After all Work is completed, and prior to requesting the Acceptance test, Contractor shall conduct a final inspection, and pre-test all equipment and system features. Contractor shall correct any deficiencies discovered as the result of the inspection and pre-test.

B. Contractor shall submit a request for the Acceptance test in writing to the owner no less than fourteen days prior to the requested test date. The request for Acceptance test shall be accompanied by a certification from Contractor that all Work is complete and has been pre-tested, and that all corrections have been made.

C. During Acceptance test, Contractor shall demonstrate all equipment and system features to the owner. Contractor shall remove covers, open wiring connections, operate equipment, and perform other reasonable work as requested by the owner.

D. If the contractor has submitted all necessary paperwork and the system seems to be in working order according to the engineer then the system can be considered Substantially Complete after the engineer puts that in writing.

E. Security System Substantial Completion.

1. The access control system shall be considered substantially complete as soon as:
    a. All doors are connected, configured in the system and are working as required.
    b. All security devices are connected and have been tested and shown to be fully functional. All cables are labeled at each end.
    c. Intercoms are functioning and able to release lock on a door.
    d. All users are entered into the system and all cards/fobs have been distributed.
    e. All locking and unlocking schedules are defined and are working.
    f. User accounts are setup
    g. As-built drawings have been updated to reflect any changes in the connectivity.
    h. All manufacturer literature has been turned over to the Owner.
    i. Maps are setup and populated in the system.
    j. Training has been completed.
    k. Copy of the system configuration has been provided to the owner via a CD or thumb drive.
2. The video security system shall be considered substantially complete as soon as:
    a. All cameras are connected and functional.
    b. The system is fully configured and recording images as required.
    c. User accounts are setup
    d. As-built drawings have been updated to reflect any changes in the connectivity.
    e. All manufacturer literature has been turned over to the Owner.
    f. Maps are setup and populated in the system.
    g. Training has been completed.
3. The contractor shall schedule a substantial completion meeting where all security systems shall be demonstrated and shown to be in working order and configured as per the specs and the owner’s requirements.
    a. If the system is deemed to be in working order then the engineer shall sign a letter stating that the systems are Substantially Complete. The system is not Substantially Complete until a letter is provided to the contractor and owner.
4. After substantial completion the systems shall be in good working order for a period of 30 days.
    a. In the event that the system or systems should fail or not work as required during the 30-day period, the Contractor shall be on site the same day to fix and configure the system to make it work as designed.
    b. A new 30-day period will begin as soon as the system has been demonstrated to be in good working order and the engineer acknowledges in writing that the system has been fixed and is again considered substantially complete.

5. Once the system has been considered Substantially Complete and has been working for 30 consecutive days with no interruption in service, the system shall be thought of as “Finally Complete.”
6. Warranty shall begin immediately after the system is deemed Finally Complete.

3.05 PAGING SYSTEM TESTING

A. Paging system testing:
   1. The Contractor shall make up a spreadsheet that will be used for testing the equipment and connectivity in each room.
      a. List each room that has a separate zone. Room # and Zone extension #
      b. List each group zone and speakers in that zone.
   2. Note each input to the system and an area for testing of that input.
      a. Telephone system integration with talkback if so equipped
      b. Music Integration for music player
      c. Desktop paging phone system
      d. Desktop Microphone
   3. The spreadsheet shall also list each zone and input and shall contain a space to note that each audio speaker was tested and that it passed the test.
   4. Spreadsheet shall include space for noting who tested the speaker and the date of the test. All information on the sheet shall be printed by a printer except the name of the person performing the tests, the date, and the “PASS” column.
   5. This spreadsheet shall be submitted to the Designer and Owner prior to project completion. Shall be submitted showing that each piece was tested.
   6. Test Telephone interface to the paging system.
      a. Call into each separate classroom or paging zone and test audio
      b. Test talkback thru the telephone system.
      c. Document all zone numbers and call extensions.
   7. Test music
      a. Play music in certain zones
      b. Play music during passing time
   8. Test Bells
      a. Demonstrate bell tones. Change if the owner requests a change.
      b. Test that the bells are played through the speakers.
      c. If the system is deemed to be in working order then the engineer shall sign a letter stating that the systems are Substantially Complete. The system is not Substantially Complete until a letter is provided to the contractor and owner.

B. After substantial completion the systems shall be in good working order for a period of 30 days.
   1. In the event that the system or systems should fail or not work as required during the 30-day period, the Contractor shall be on site the same day to fix and configure the system to make it work as designed.
   2. A new 30-day period will begin as soon as the system has been demonstrated to be in good working order and the engineer acknowledges in writing that the system has been fixed and is again considered substantially complete.
   3. Once the system has been considered Substantially Complete and has been working for 30 consecutive days with no interruption in service, the system shall be thought of as “Finally Complete.”
   4. Warranty shall begin immediately after the system is deemed Finally Complete

3.06 CLASSROOM AV SYSTEMS

A. Classroom AV system testing:
   1. The Contractor shall make up a spreadsheet that will be used for testing the equipment and connectivity in each room. There shall be a separate piece of paper for each room.

2. The spreadsheet shall include a list of the equipment in each room and the cables in each room. The contractor shall note the serial number of each of the active components on the spreadsheet.
3. The spreadsheet shall also list each connectivity point and shall contain a space to note that each audio and video connection was tested and that it passed the test.
4. Spreadsheet shall include space for noting who tested the connections and the date of the test. All information on the sheet shall be printed by a printer except the name of the person performing the tests, the date, and the “PASS” column.
5. This spreadsheet shall be submitted to the Engineer and Owner prior to project completion. Shall be submitted showing that each piece was tested.
6. After installation of all cables and components, the contractor shall test each cable and device to ensure that it works as intended.
    a. Test that the remote works for the projector.
    b. Test that the VCR, DVD and PC video images are able to be seen on the projector and on the projection screen.
    c. Test that the audio from each device is played through the speakers.
    d. If so equipped, connect and demonstrate the document camera.
    e. Pull down the projection screen and note that the image from the projector fully fills the screen.
    f. If the system is deemed to be in working order then the engineer shall sign a letter stating that the systems are Substantially Complete. The system is not Substantially Complete until a letter is provided to the contractor and owner.

B. After substantial completion the systems shall be in good working order for a period of 30 days.
1. In the event that the system or systems should fail or not work as required during the 30-day period, the Contractor shall be on site the same day to fix and configure the system to make it work as designed.
2. A new 30-day period will begin as soon as the system has been demonstrated to be in good working order and the engineer acknowledges in writing that the system has been fixed and is again considered substantially complete.
3. Once the system has been considered Substantially Complete and has been working for 30 consecutive days with no interruption in service, the system shall be thought of as “Finally Complete.”
4. Warranty shall begin immediately after the system is deemed Finally Complete.

END OF SECTION

SECTION 28 7750 – TECHNOLOGY TRAINING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. This section includes directions for the Contractor regarding training for technology and security systems.

1.02 SYSTEM DESCRIPTION

A. The Contractor shall provide training on all the installed systems.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.01 GENERAL TRAINING REQUIREMENTS

A. The Contractor shall provide training on all systems installed or upgraded as part of the contract.
   1. The Contractor shall involve the personnel from the Owner's office in the implementation and configuration of the systems.
   2. Prior to the cutover of the system, the Contractor shall work with the Owner on the training that will be provided. The Owner and the Contractor shall schedule the training at a time beneficial to both.
   3. Each system is to have training provided as part of the installation.
   4. Each training session shall include.
      a. This training will give an overview of the capabilities of each system, and the methods to be employed in utilizing the system.
      b. The Contractor shall provide a syllabus detailing what will be discussed at the training, and notes for the Owner to refer to during the life of the system. The notes shall list directions for general use of the system and possible fixes to general issues that could occur.
      c. Training shall include as-built diagrams of the connectivity, a walk-thru of the system, a demonstration of actual user interface with the system, and directions on its general use.
      d. This training is only meant to give an overview of each system. In depth training shall be provided for an in-depth analysis of certain systems as described below.
   5. For all training, the Contractor shall pay all expenses.

B. Create cheat sheets for all systems that the users can keep after the training.
   1. Cheat sheet shall include details on how to use the system.
   2. A copy of the cheat sheet shall be laminated and installed at the system location.
   3. For individual training the contractor shall provide a cheat sheet for each person being trained.
   4. Cheat sheet shall be laminated.
   5. Provide a cheat sheet in each classroom or conference room.
   6. Submit these for approval to the designer and owner prior to training. Have the cheat sheets at the training.

3.02 CLASSROOMAUDIO/VIDEO SYSTEM TRAINING

A. Training on the classroom audio/video distribution system shall be as follows:
   1. Contractor shall provide a minimum of eight (8) -1 hour, in depth training classes on the connectivity and use of the classroom audio/video system. Each class shall be capable of having 12 teachers in the class.
   2. Training class shall be on-site utilizing the actual equipment installed as part of the system.
   3. Demonstrate all uses of the system and how it works.
   4. The Contractor shall provide handouts at the meeting detailing all aspects of the use of the system. It shall include directions on how to best utilize all components, as well as a checklist of items to go through if something is not working properly.
   5. The Owner and Contractor shall meet and decide on the syllabus prior to training.
   6. Generate a laminated sheet detailing the sequence and how to use each system in each room. Leave that behind in the room. Provide extra paper copies to the owner.

3.03 PAGING/BELL SYSTEM TRAINING

A. The Contractor shall furnish pre-acceptance and post-acceptance training on the paging/bell system.
   1. The first training shall occur during the on-site system configuration. 1 or 2 Owner's Representatives shall be present when the technician is setting up the system and doing the programming of all the extension numbers and different call groups.
   2. Formal training shall be done with Owner's Representatives after installation and configuration of the system. The training shall include:
      a. Copies of all pertinent paperwork and system booklets that come with the paging/sound masking system.
      b. A spreadsheet listing all the speaker groups and their corresponding rooms and a drawing graphically representing the speaker groups.
      c. The Contractor shall provide a short booklet detailing the steps required to perform all the general functions of the paging system.
      d. A complete overview of the capabilities of the paging system and a demonstration of calling through the telephone system and desktop microphone shall be completed as part of the training.
      e. At the end of the training, the administrators shall be able to fully configure and control all aspects of the paging systems.
      f. All training shall take place on the Owner's site with the Owner's system.

END OF SECTION

SECTION 28 7800 – TECHNOLOGY WARRANTY

PART 1 - GENERAL

1.01 SECTION INCLUDES
- A. This section includes directions for the Contractor regarding system and equipment warranties.

1.02 SYSTEM DESCRIPTION
- A. The project is not complete until all paperwork has been provided.

1.03 COORDINATION
- A. Coordinate as-built drawings and records with the Engineer and Owner.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
- A. Provide manufacturer's warranty for all equipment installed
- B. Provide contractor warranty for workmanship and equipment
- C. Provide software upgrade protection (SUP) warranty as detailed in the specifications.

2.02 MATERIALS
- A. The Contractor shall provide the following to the owner/designer at Substantial Completion and any updates prior to the issuance of the final payment
  1. Manuals and pamphlets on all electronic equipment.
  2. All spare parts and cover plates for all components of the network.
  3. Red lined set of as-built drawings for the entire project.
- B. Updated hard copy and soft copy of the As-Built Documentation. See associated spec section.

PART 3 - EXECUTION

3.01 EXAMINATION
- A. Contractor shall fully examine all components of the system to make sure that all manuals and paperwork are included in the final submittal.
- B. Examine all equipment and cabling to ensure that it is labeled as per the drawings and specifications.

3.02 GENERAL WARRANTY
- A. Warranty Period shall be 1 year after a signed copy of Substantial Completion. This shall be the Warranty Period.
- B. See further specifications for additional warranty requirements that may be longer for certain systems.
  1. Contractor shall be responsible for generating and submitting the Substantial Completion document to the designer for review and signature.
- C. Warranty shall include each and every part, cable or software system provided as part of this project. This includes cabling, Networking, Wireless, Audio/Video systems and Access Control and Video Security systems.
  1. During the Warranty Period:

a. If any part is broken due to a manufacturing defect or installation defect, the Contractor shall fix and/or replace the broken item at their own expense.
b. If any equipment loses connectivity or fails for any reason the contractor shall be onsite to diagnose and fix or replace equipment and upgrades software.
c. The Contractor shall also supply all configuration and programming necessary to keep all electronic equipment to the latest revision of software during the warranty period.
d. If the “system” goes down, and needs configuration to be brought back up, the Contractor shall be liable for any programming or reconfiguration.
e. During the warranty period, the Contractor shall make the Owner aware of any software upgrades that are available.
f. Contractor shall install all software upgrades for that warranty period or as detailed below for specific systems.
g. If the system does not run well during the warranty period the contractor shall be onsite to diagnose and fix the system.

D. The contractor shall be onsite within 24 hours after a call from the owner or designer regarding system or equipment issues.

3.03 EXTENDED CABLING WARRANTY

A. The Contractor shall provide to the Owner a “Link Warranty” on all the components of the voice/data cabling system. This includes all components from the faceplate, through the jacks, cable, and back to the patch panels, not including patch cords.
1. This shall include Fiber Optic cabling and termination equipment.
B. Cable shall be installed that is covered as part of the complete warranty on the data cabling system. Cable that cannot be covered under the warranty shall not be installed.
C. The warranty shall be provided through the manufacturer of the faceplate, jacks, and patch panels. All components shall be by the same manufacturer.
D. The warranty shall guarantee that if any part or piece of the “Link” is found to be defective for a period of no less than 15 years, then that part or piece shall be replaced or fixed at no cost to the Owner.
E. The Contractor shall be responsible for installing the system in such a manner that the manufacturer will provide this warranty to the Owner.
F. The Contractor is responsible for compiling and submitting all the paperwork required to receive the warranty. This includes gathering all the information, completing any required forms, and submitting these forms and any other records to the manufacturer as required.
G. It shall be the Contractor’s responsibility to receive the approved warranty notification from the manufacturer and provide that and all the associated paperwork to the Owner.
H. The installation shall not be considered finally complete until the Owner has received notification, from the manufacturer, that the entire cabling system is covered by their warranty

3.04 CAMERA WARRANTY

A. All cameras shall be warranteed by the manufacturer for 5 years.
B. If camera fails during general warranty period than the contractor shall be onsite and replace camera with a new model. Install replacement camera.
C. After general warranty period the manufacturer shall replace or repair the camera if it fails.

3.05 VIDEO SECURITY SOFTWARE WARRANTY

A. As part of the project the contractor shall provide a three-year (3) video security recording system and security camera warranty that provides for all software updates during the years after Substantial Completion.
1. Contractor shall be required to install all software and firmware updates during the three years.

3.06 ACCESS CONTROL SOFTWARE WARRANTY

A. As part of the project the contractor shall provide a three-year (3) access control system software warranty that provides for all software updates during the years after Substantial Completion.

1. Contractor shall be required to install all software and firmware updates during the three years.

END OF SECTION

SECTION 31 1000 - SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Protecting existing vegetation to remain.
   2. Removing above- and below-grade site improvements.
   3. Temporary erosion and sedimentation control.

1.02 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.03 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises where directed by Owner. Refer to plans for irrigation components to be salvaged to Owner.

C. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

PART 2 - PRODUCTS (not used)

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 01 5639 "Temporary Tree and Plant Protection."

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.

3.03 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction.

3.04 EXISTING UTILITIES

A. Locate, identify, and protect all site utilities.

3.05 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 4-inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.06 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Sawcut existing pavements at removal limits, or further as required for stable edge condition matching existing jointing. Protect sawcut edges after removals or, if damaged, provide new sawcut immediately prior to installation of new work.

3.07 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 1000

SECTION 31 2000 - EARTH MOVING

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. Excavating and backfilling.

1.03 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

B. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

C. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
   1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.
   3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

D. Fill: Soil materials used to raise existing grades.

E. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
   1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch-wide, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curling force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.
   2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

G. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to ASTM D 1557.

B. Shop Drawings: Location and dimensions of Contractor's proposed bore pits.

C. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, which might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.05 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Utility Locator Service: Notify "Miss Dig" for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 31 1000 "Site Clearing," are in place.

D. Do not commence earth moving operations until plant-protection measures specified in Section 01 5639 "Temporary Tree and Plant Protection" are in place.

E. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Engineered Fill: MDOT Class II granular material

E. Bituminous Pavement Sub-base: MDOT Class II granular material

F. Bituminous Pavement Base: MDOT 21AA Limestone

G. Concrete Pavement Base: MDOT 21AA Limestone

2.02 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Survivability: As follows:
      a. Grab Tensile Strength: 157 lbf; ASTM D 4632.
      b. Sewn Seam Strength: 142 lbf; ASTM D 4632.
      c. Tear Strength: 56 lbf; ASTM D 4533.
      d. Puncture Strength: 56 lbf; ASTM D 4833.
   3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
   4. Permittivity: 0.5 per second, minimum; ASTM D 4491.
   5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
   1. Survivability: Class 2; AASHTO M 288.
   2. Survivability: As follows:
      a. Grab Tensile Strength: 247 lbf; ASTM D 4632.
      b. Sewn Seam Strength: 222 lbf; ASTM D 4632.
      c. Tear Strength: 90 lbf; ASTM D 4533.
      d. Puncture Strength: 90 lbf; ASTM D 4833.
   3. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
   4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
   5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

C. Geogrid
   1. Between the Aggregate Base and Granular Base:

a. Tensar NX 750 or equivalent
2. Between the Granular Base and Compacted Subgrade:
a. Tensar NX 850 or equivalent

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.02 DEWATERING

A. Groundwater and surface water which is free of contamination and sediment may be discharged to a storm drain. Drains must be protected from sediment by using filter fabric or silt sacks. However, if field indicators indicate possible contamination the water cannot be discharged. Note: suspect contaminated groundwater may exhibit chemical or unusual odors, unusual coloring, sheen, and/or contain man-made debris.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

3.03 EXPLOSIVES

A. Explosives: Do not use explosives.

3.04 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction.

B. Suspect Contaminated Soil, Groundwater, or other Unknown Material:
1. During work activities if suspect contaminated soil, groundwater, or other unknown material is encountered contact the Owner immediately. Suspect contaminated soil may exhibit chemical or unusual odors, staining, unusual coloring, and/or contain man-made

debris. Suspect contaminated groundwater may exhibit chemical or unusual odors, unusual coloring, and/or sheen.

2. Immediately cease all excavation, dewatering, transport, or disturbance of the suspect material until given direction by the Owner.

3.05 BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Backfill voids with satisfactory soil while removing shoring and bracing.

C. Place and compact backfill of subbase material, free of particles larger than 1 inch in any dimension, in maximum 4-inch lifts.

D. Place and compact final backfill of 6-inch topsoil lift to final subgrade elevation.

3.06 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.07 COMPACTION OF BACKFILLS

A. Place backfill and fill soil materials in layers not more than 6 inchesin loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, foundations and building slabs, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 98 percent.
2. Under paved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

D. Compact base materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, foundations and building slabs, compact each layer of base material in maximum 6-inch lefts at 98 percent.
2. Under paved areas, compact each layer of base material in maximum 6-inch lefts at 98 percent.

3.08 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.

2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.09 GEOGRID INSTALLATION

A. Place geogrid promptly according to manufacturer's written instructions. Overlap longitudinal and transverse joints per manufacturer’s recommendations.

B. Do not let geogrid be exposed to sunlight for more than 500 hours prior to burying.

3.10 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.11 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.12 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including topsoil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 2000

SECTION 32 1216 - ASPHALT PAVING

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. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.

B. Related Requirements:
1. Section 31 1000 "Site Clearing" for demolition and removal of existing asphalt pavement.
2. Section 31 2000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 32 1373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
3. Job-Mix Designs: For each job mix proposed for the Work.

B. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
1. Paving Fabric: 12 by 12 inches minimum.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and testing agency.

B. Material Certificates: For each paving material.

C. Material Test Reports: For each paving material, by a qualified testing agency.

D. Field quality-control reports.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by MDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of MDOT for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.06 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F.
   2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

PART 2 - PRODUCTS

2.01 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
   1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

D. Mineral Filler: ASTM D242/D242M, rock or slag dust, hydraulic cement, or other inert material.

2.02 ASPHALT MATERIALS

A. Asphalt Binder: ASTM D6373 binder designation PG 64-22.

B. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Water: Potable.

D. Undersealing Asphalt: ASTM D3141/D3141M; pumping consistency.

2.03 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material.

B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

C. Sand: ASTM D1073, Grade No. 2 or No. 3.

D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.

E. Joint Sealant: ASTM D6690, Type IV, hot-applied, single-component, polymer-modified bituminous sealant.

2.04 MIXES

A. Recycled Asphalt Content:
   1. May be permitted in percentages in accordance with MDOT guidelines and specifications for use in the surface course mix design.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by MDOT and complying with the following requirements:
   1. Leveling Course: MDOT 13A or MDOT 4EML
   2. Surface Course: MDOT 13A or MDOT 4EML

2.05 GEOGRID

A. Between the Aggregate Base and Granular Base:
   1. Tensar NX 750 or equivalent

B. Between the Granular Base and Compacted Subgrade:
   1. Tensar NX 850 or equivalent

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
   1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
   2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.03 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
   1. Mill to a depth as indicated on the drawings.

2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material according to approved waste management plan required in Section 01 7419 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.04 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
   1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
   2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd..
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

3.05 REPAIRS

A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch in existing pavements.
   1. Install leveling wedges in compacted lifts not exceeding 3 inches thick.

B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth as indicated on the drawings.
   1. Clean cracks and joints in existing hot-mix asphalt pavement.
   2. Use emulsified-asphalt slurry to seal cracks and joints less than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.
   3. Use hot-applied joint sealant to seal cracks and joints more than 1/4 inch wide. Fill flush with surface of existing pavement and remove excess.

3.06 SURFACE PREPARATION

A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
   1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.

C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd.. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
   1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
   2. Protect primed substrate from damage until ready to receive paving.

D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
   1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
   2. Protect primed substrate from damage until ready to receive paving.

E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd..
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.07 GEOGRID INSTALLATION

A. Place geogrid promptly according to manufacturer's written instructions. Overlap longitudinal and transverse joints per manufacturer’s recommendations.

B. Do not let geogrid be exposed to sunlight for more than 500 hours prior to burying.

3.08 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at a minimum temperature of 250 deg F.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.09 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.10 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
1. Average Density: 96 percent of reference laboratory density according to ASTM D6927 or AASHTO T 245, but not less than 94 percent or greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.11 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
   1. Base and Leveling Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Base and Leveling Course: 1/4 inch.
   2. Surface Course: 1/8 inch.
   3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.12 SURFACE TREATMENTS

A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.

B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D3910 and allow to cure.
   1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

3.13 FIELD QUALITY CONTROL

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

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D979/D979M or AASHTO T 168.
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D2041/D2041M, and compacted according to job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D1188 or ASTM D2726/D2726M.
      a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D2950 and correlated with ASTM D1188 or ASTM D2726/D2726M.

E. Replace and compact hot-mix asphalt where core tests were taken.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.14 WASTE HANDLING

A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 01 7419 "Construction Waste Management and Disposal."

END OF SECTION 32 1216

SECTION 32 1313 - CONCRETE PAVING

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. Concrete sidewalks and pavements.

B. Related Sections:
   1. Section 32 1373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, and ground granulated blast-furnace slag.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: As required in project documents.

C. Other Action Submittals:
   1. Design Mixtures: For each concrete paving and curb mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer.

B. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Applied finish materials.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.

C. Shop Drawings: For layout and cutting of Detectable Warning Tiles at each sidewalk ramp.

D. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. ACI Publications: Comply with ACI 301unless otherwise indicated.

1.07 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.02 STEEL REINFORCEMENT

A. Recycled Content: Postconsumer recycled content plus one-half of pre-consumer recycled content not less than 25 percent.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A, plain steel.

E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

F. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.

G. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.

H. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.

I. Plain-Steel Wire: ASTM A 82/A 82M, galvanized.

J. Deformed-Steel Wire: ASTM A 496/A 496M.

K. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, deformed.

L. Dowel Placement System: Speed Dowel by Sika Greenstreak, or approved equal.

M. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars; zinc coated (galvanized) after fabrication according to ASTM A 767/A 767M, Class I coating. Cut bars true to length with ends square and free of burrs.

N. Epoxy-Coated, Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain-steel bars.

O. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.

P. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

Q. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

R. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

S. Zinc Repair Material: ASTM A 780.

2.03 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:
1. Portland Cement: ASTM C 150, gray portland cement Type I/II. Mix designs may be supplemented with the following subject to Architect’s review and approval:
   a. Fly Ash: ASTM C 618, Class C or Class F.
   b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
2. Blended Hydraulic Cement: ASTM C 595, Type IP, portland-pozzolan cement.

B. Normal-Weight Aggregates: ASTM C 33, , uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
1. Maximum Coarse-Aggregate Size: 1 inchnominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2.04 FIBER REINFORCEMENT

A. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 incheslong.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Monofilament Fibers:
         1) Axim Italcementi Group, Inc.; FIBRASOL II P.
         2) Euclid Chemical Company (The), an RPM company; Fiberstrand 100, Fiberstrand 150.
         3) Grace, W. R. & Co. - Conn.; Grace MicroFiber.
         4) Metalcrete Industries; Polystrand 1000.
         5) QC Construction Products; QC FIBERS.

2.05 CURING MATERIALS

A. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.06 CONCRETE SEALER

A. Apply a 100% silane or siloxane, penetrating concrete sealer per manufacturer's recommendations. The concrete should be reasonably dry prior to the sealer application, to properly absorb the sealer. Ensure joints have been cleaned and sealed at the same time. Manufacturer products, or approved equal, include:
   1. MasterProtect H 1000, 200 sf/gal, BASF.
   2. Iso-Flex 618-100 RFS, 200 sf/gal, Lymtal.
   3. Protectosil BHN, 200 sf/gal, Evonik Corp.
   4. Sikagard 705:, 200 sf/gal, Sika.
   5. Sil-Act ATS-100LV, 200 sf/gal, ACT.

2.07 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.08 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:
   1. Compressive Strength (28 Days): 4000 psi
   2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
   3. Slump Limit: 4 inches plus or minus 1 inch

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.0 percent for 1-inch nominal maximum aggregate size.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

F. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301requirements as follows:
1. Fly Ash or Pozzolan: 25 percent.
2. Ground Granulated Blast-Furnace Slag: 50 percent.
3. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

2.09 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Test subgrades and subbase for specified compaction.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.03 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.04 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Reinforcement shall be held in place by chairs, spacers, or other devices commercially manufactured specifically for that purpose. Bricks, blocks, rocks, or use of other construction debris will not be accepted. Hooking or pulling reinforcement into place will not be allowed.

E. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.05 JOINTS

A. General: Form expansion, isolation, and control joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Expansion Joints: Set expansion joints at locations indicated on plans.
   1. Locate expansion joints as indicated on the drawings.
   2. Install dowel bars and support assemblies at joints where indicated. Use speed dowel assemblies to prevent concrete bonding to one side of joint.
   3. Extend joint fillers full width and depth of joint.
   4. Terminate joint filler at height indicated on plans to allow for installation of joint sealant.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate isolation joints as indicated on the drawings.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler at height indicated on plans to allow for installation of joint sealant.
   4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

D. Control Joints: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness, as follows:
   1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/8-inchradius. Repeat grooving of control joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inchradius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.06 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg F uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg Fand not more than 80 deg Fat point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

K. Hot-Weather Placement: Comply with ACI 301and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg Fat time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
   3. Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.07 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
   1. Medium-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.08 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft.before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound as follows:
   1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.09 CONCRETE WASHOUT

A. Do not discharge concrete washout into storm drains, catch basins or to the sanitary sewer system. Perform washing of concrete trucks in designated areas or an approved offsite location.
   1. Designated areas should be clearly labeled. They should be in a pit to prevent run-off of waste water. Place designated areas a minimum of 50 feet from storm drains, bodies of water and ditches. All designated areas should be lined to prevent seepage and should have a barrier.
   2. Alternative to a designated area: Provide a concrete box. If only a small amount of concrete washing is to occur, one option is to line a roll-off box. For very small projects this could be done with a drum.

B. Once concrete washout has hardened, break up and dispose of properly. Disposal of hardened concrete should occur on a regular basis.

C. Washout facilities must be cleaned, or new facilities provided once the washout area is 75% full.

3.10 FIELD QUALITY CONTROL

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

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each ready mix loador fraction thereof of each concrete mixture placed each day.
      a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
   2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg Fand below and when it is 80 deg Fand above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days and two specimens at 28 days.
      a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi

D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

3.12 WASTE MANAGEMENT

A. Separate and recycle waste materials, packaging, and all other materials in accordance with the Waste Management Plan and to the maximum extent possible, send to reuse or recycle centers.

B. Concrete Washout:
   1. Do not discharge concrete washout into storm drains, catch basins or to the sanitary sewer system. Perform washing of concrete trucks in designated areas or offsite.
      a. Designated areas should be clearly labeled. They should be in a pit to prevent run-off of waste water. Place designated areas a minimum of 50 feet from storm drains, bodies of water and ditches. All designated areas should be lined to prevent seepage and should have a barrier.
      b. Alternative to a designated area: Provide a concrete box. If only a small amount of concrete washing is to occur, one option is to line a roll-off box. For very small projects this could be done with a drum.
   2. Once concrete washout has hardened, break up and dispose of properly. Disposal of hardened concrete should occur on a regular basis.

C. Washout facilities must be cleaned, or new facilities provided once the washout area is 75% full.

END OF SECTION 32 1313

SECTION 32 1373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.01 SUMMARY

A. Section applies to areas outside building footprint and includes:
   1. Cold-applied joint sealants.
   2. Hot-applied joint sealants.

1.02 PRECONSTRUCTION TESTING

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers samples of materials that will contact or affect joint sealants. Use ASTM C 1087 manufacturer's standard test method to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.03 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each kind and color of joint sealant required.

C. Pavement-Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

D. Product certificates.

E. Product test reports.

F. Preconstruction compatibility and adhesion test reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.

B. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: To match color of new concrete and as selected by Architect from manufacturer's full range.

2.02 COLD-APPLIED JOINT SEALANTS

A. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

2.03 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

2.04 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.01 INSTALLATION

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.

C. Protection: Protect bluestone and other adjacent materials to prevent sealant spills, drips, strings, or other surface blemishes.

D. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

E. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
   1. Do not leave gaps between ends of joint-sealant backings.
   2. Do not stretch, twist, puncture, or tear joint-sealant backings.
   3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

F. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place joint sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
   1. Remove excess joint sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

H. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

I. Clean off excess joint sealant or sealant smears adjacent to joints as the Work progresses, by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 32 1373

SECTION 32 1816.13 - PLAYGROUND PROTECTIVE SURFACING

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. Unitary, seamless surfacing.

1.03 DEFINITIONS

A. Definitions in ASTM F2223 apply to Work of this Section.

B. SBR: Styrene-butadiene rubber.

C. Unitary Surfacing: A protective surfacing of one or more material components bound together to form a continuous surface; same as "unitary system" in ASTM F2223.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of protective surfacing.
   1. Include plans, sections, placement details, and attachment to substrates.
   2. Include patterns made by varying colors of surfacing.

C. Samples for Initial Selection: For each type of exposed finish.
   1. Include Samples of accessories involving color selection.

D. Samples for Verification: For each type of protective surfacing and exposed finish.
   1. Include Samples of accessories to verify color and finish selection.
   2. Unitary, Seamless Surfacing: Minimum 6 by 6 inches.

E. Product Schedule: For protective surfacing. Use same designations indicated on Drawings.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Product Certificates: For each type of unitary surfacing product.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Maintenance Data: For playground protective surfacing to include in maintenance manuals.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality standards for materials and execution.
   1. Build mockups for protective surfacing including accessories.
      a. Size: 48 inches by 48 inches.

   2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.08 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components of protective surfacing that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Reduction in impact attenuation as measured by reduction of critical fall height.
      b. Deterioration of protective surfacing and other materials beyond normal weathering.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Source Limitations: Obtain protective surfacing materials from single source from single manufacturer.
   1. Provide geosynthetic accessories of each type from source recommended by manufacturer of protective surfacing materials.

2.02 PERFORMANCE REQUIREMENTS

A. Impact Attenuation: Critical fall height tested according to ASTM F1292.

B. Accessibility Standard: Minimum surfacing performance according to ASTM F1951.

2.03 UNITARY, SINGLE-DENSITY, SEAMLESS SURFACING

A. Description: Manufacturer's standard, site-mixed and applied, single-layer material in thickness as required, tested for impact attenuation according to ASTM F1292 and for accessibility according to ASTM F1951.
   1. Manufacturer: Surface America, Inc. or approved equal.
      a. Contact: PO Box 157, Williamsville, NY 14231; Telephone: (800) 999-0555
   2. Product. Poured-in-place playground surfacing system, including the following:
      a. PlayBound Poured-In-Place Primer
         1) Material: Urethane.
      b. PlayBound Poured-In-Place Top Surface:
         1) Material: Blend of Virgin EPDM rubber or TPV Granule and aliphatic urethane binder.
         2) Thickness: Nominal ½” (12.7mm).

3) Color ‘A’: Bright Green.
4) Color ‘B’: Terra Cotta.
5) Color ‘C’: Pearl.
6) Dry Static Coefficient of Friction (ASTM D2047): 1.0.
7) Wet Static Coefficient of Friction (ASTM D2047): 0.9.
8) Dry Skid Resistance (ASTM E303): 89.
9) Wet Skid Resistance (ASTM E303): 57.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for subgrade elevations, slope, and drainage and for other conditions affecting performance of the Work.
   1. Verify that substrates are sound and without high spots, ridges, holes, and depressions.

B. Hard-Surface Substrates: Verify that substrates are satisfactory for unitary, protective surfacing installation and that substrate surfaces are dry, cured, and uniformly sloped to drain within recommended tolerances according to protective surfacing manufacturer's written requirements for cross-section profile.
   1. Asphalt Substrates: Verify that substrates are dry, sufficiently cured to bond with adhesive, and free from surface defects, dust, dirt, loose particles, grease, oil, and other contaminants incompatible with protective surfacing or that may interfere with adhesive bond.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates to receive surfacing products according to protective surfacing manufacturer's written instructions.

B. Hard-Surface Substrates: Clean surface free of laitance, efflorescence, curing compounds, and other contaminants incompatible with protective surfacing.
   1. Repair: Fill holes and depressions in unsatisfactory surfaces with leveling and patching material.
   2. Treatment: Mechanically abrade or otherwise prepare asphalt substrates according to protective surfacing manufacturer's written instructions to achieve adequate roughness.
   3. Terminal Edges: Formed concrete for terminal edges of protective surfacing.
   4. Treat control joints and other nonmoving substrate cracks to prevent telegraphing through protective surfacing.

3.03 INSTALLATION OF SEAMLESS SURFACING

A. Mix and apply components of seamless surfacing according to manufacturer's written instructions to produce uniform, monolithic, and impact-attenuating protective surfacing of required overall thickness.
   1. Substrate Primer: Apply over prepared substrate at manufacturer's standard spreading rate for type of substrate.
   2. Poured-In-Place Top Surface (Wearing) Layer: Spread over primed base course to form a uniform layer applied at manufacturer's standard spreading rate in one continuous operation and, except where color changes, with no cold joints. Finish surface to produce manufacturer's standard wearing-surface texture.

a. Design: Where graphic design is required, place colored, design material as soon as previously placed material is sufficiently cured, using primer or adhesive if required by manufacturer's written instructions.

3. Lacquer Topcoat: Spray or roller applied at manufacturer's standard coating rate in one continuous operation.
4. Edge Treatment: As indicated on Drawings. Fully adhere edges to substrate with full coverage of substrate. Maintain fully cushioned thickness required to comply with performance requirements.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests.

B. Perform the following tests with the assistance of a factory-authorized service representative:
1. Perform "Installed Surface Performance Test" according to ASTM F1292 for each protective surfacing type and thickness in each playground area.
2. Perform installed-surface-performance tests at no less than one series of tests for each 1000 sq. ft. Insert dimension of each type and thickness of in-place protective surfacing or part thereof.

C. Playground protective surfacing will be considered defective if it does not pass tests.

D. Prepare test reports.

3.05 PROTECTION

A. Prevent traffic over seamless surfacing for not less than 48 hours after installation.

END OF SECTION 32 1816.13

SECTION 32 3113 - CHAIN LINK FENCES AND GATES

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. Chain-link fences.
   2. Swing gates.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Fence and gate posts, rails, and fittings.
      b. Chain-link fabric, reinforcements, and attachments.

1.04 FIELD CONDITIONS

A. Field Measurements: Verify layout information for gate relocations shown on Drawings in relation to existing and proposed site improvements. Verify dimensions by field measurements and confirm with Owner and Architect.

1.05 WARRANTY

A. Special Warranty: Installer agrees to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to comply with performance requirements.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Faulty operation of relocated gates.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to ASCE/SEI 7.

B. Post Size: Determine according to ASTM F1043 for existing post spacing and gate sizes, for Material Group IA, ASTM F1043, Schedule 40 steel pipe.
   1. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.

2.02 CHAIN-LINK FENCE FABRIC

A. General: Salvage and reuse existing fence fabric. If new fabric is required due to damage, provide to match existing.
   1. Fabric Height:
      a. Outfield and Foul Line Fence: 48 inches.
   2. Steel Wire for Fabric: 9 gauge.
      a. Mesh Size: 2 inches.
      b. Polymer-Coated Fabric: ASTM F668, Class 2b over zinc-coated steel wire.
         1) Color: Black.
      c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
   3. Selvage: Knuckled at both selvages.

2.03 CHAIN-LINK FENCE FABRIC (BACK STOP)

A. General: Salvage and reuse existing fence fabric. If new fabric is required due to damage, provide to match existing.
   1. Fabric Height: 15 feet.
   2. Steel Wire for Fabric: 6gauge.
      a. Mesh Size: 2 inches.
      b. Polymer-Coated Fabric: ASTM F668, Class 2b over zinc-coated steel wire.
         1) Color: Black.
      c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
   3. Selvage: Knuckled at both selvages.

2.04 CHAIN-LINK FENCE FABRIC (SWING GATES)

A. General: Salvage and reuse existing fence fabric. If new fabric is required due to damage, provide to match existing.
   1. Fabric Height: 48 inches.
   2. Steel Wire for Fabric: 9 gauge.
      a. Mesh Size: 2 inches.
      b. Polymer-Coated Fabric: ASTM F668, Class 2b over zinc-coated steel wire.
         1) Color: Black.
      c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
   3. Selvage: Knuckled at both selvages.

2.05 FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
   1. Fence Height:
      a. Outfield and Foul Line Fence: 48 inches.
   2. Perimeter Fence Post Material: Light-Industrial-Strength Group IC-L, round steel pipe, electric-resistance-welded pipe.
      a. Line Post: 2 ½" (2.375) O.D.
      b. End/ Corner Post: 3" (2.875) O.D.
   3. Horizontal Framework Members: Top rails according to ASTM F1043.
      a. Top and Bottom Rail: 1 5/8" (1.625) O.D.
   4. Polymer-Coated: ASTM F934, over zinc-coated frame.
      a. Color: Black.

2.06 FENCE FRAMEWORK (BACKSTOP)

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F1043 or ASTM F1083 based on the following:
   1. Fence Height: 15 feet.
   2. Perimeter Fence Post Material: Light-Industrial-Strength Group IC-L, round steel pipe, electric-resistance-welded pipe.
      a. Line Post: 2 ½" (2.375) O.D.
      b. End/ Corner Post: 4" (3.5) O.D.
   3. Horizontal Framework Members: Top rails according to ASTM F1043.
      a. Top, Bottom and Intermediate Rail: 2" (1.875) O.D.
   4. Polymer-Coated: ASTM F934, over zinc-coated frame.
      a. Color: Black.

2.07 FENCE FRAMEWORK (SWING GATES)

A. General: ASTM F900 for gate posts and single swing gate types.
   1. Gate Leaf Width: 72 inches.

B. Pipe and Tubing:
   1. Zinc-Coated Steel: ASTM F1043 or ASTM F1083; protective coating and finish to match fence framework.
   2. Gate Height: 48 inches.
   3. Gate Post: 3" (2.875) O.D.
   4. Gate Frames and Bracing: 2" (1.875) O.D.
   5. Color: Black.

C. Frame Corner Construction: Welded.

D. Hardware:
   1. Hinges: 360-degree inward and outward swing.
   2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
   3. Padlock and Chain: Provided by Owner.

2.08 TENSION WIRE

A. Polymer-Coated Steel Wire: 0.177-inch-diameter, tension wire according to ASTM F1664, Class 2b over zinc-coated steel wire.
   1. Color: Black, according to ASTM F934.

2.09 FITTINGS

A. Provide fittings according to ASTM F626.

B. Post Caps: Provide for each post.
   1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:
   1. Top Rail Sleeves: Pressed-steel or round-steel tubing not less than 6 inches long.
   2. Rail Clamps: Line and corner boulevard clamps for connecting intermediate and bottom rails to posts.

E. Tension and Brace Bands: Pressed steel.

F. Tension Bars: Steel, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: According to ASTM F626.
   1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
      a. Hot-Dip Galvanized Steel: 0.148-inch-diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.

I. Finish:
   1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft. of zinc.
      a. Polymer coating over metallic coating.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
   1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.03 CHAIN-LINK FENCE INSTALLATION

A. Install chain-link fencing according to ASTM F567 and more stringent requirements specified.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated by Contractor's structural engineer, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
      a. Concealed Concrete: Place top of concrete 2 inches below grade to allow covering with surface material.

D. Tension Wire: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:

1. Extended along bottom of fence fabric. Install bottom tension wire within 4 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.

E. Top Rail: Install according to ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

F. Intermediate and Bottom Rails: Secure to posts with fittings.

G. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 1-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

H. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

I. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
   1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

3.04 GATE INSTALLATION

A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.05 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

END OF SECTION 32 3113

SECTION 32 3300 - SITE FURNISHINGS

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. Bollards.

B. Related Requirements:
   1. Section 31 2000 "Earth Moving" for excavation for installing concrete footings.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of applicable product.

1.04 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

PART 2 - PRODUCTS

2.01 BOLLARDS

A. Basis of Design Requirements: Subject to compliance with requirements, provide the product indicated below, or approved equal:
   1. Manufacturer: 1-800-BOLLARDS; Phone: 800.265.5273
   2. Product: 8” diameter Fixed Stainless Steel Bollard; 36” ht., type 304 stainless steel material; #4 satin finish; .322 inches wall thickness, standard flat cap.
   3. Model#: FSS08040
   4. Qty: 2.
   5. Installation: Per manufacturer’s recommendation.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

3.03 CLEANING

A. After completing site furnishing installation, inspect components. Remove spots, dirt, and debris. Repair damaged finishes to match original finish or replace component.

END OF SECTION 32 3300

SECTION 32 9113 - SOIL PREPARATION

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 planting soils for disturbed lawn areas.

B. Related Sections:
1. Division 32 Section 32 9200 ‘Turf and Grasses’ for topsoil/ seed bed preparation and seeding.

1.03 DEFINITIONS

A. Retain terms that remain after this Section has been edited for a project.

B. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

C. Imported Soil: Soil that is transported to Project site for use.

D. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

E. Topsoil: Imported soil; or manufactured soil that has been modified as specified with required soil amendments to produce a soil mixture best for turf growth.

F. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

G. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

H. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Submit a certified analysis of topsoil from all sources from an independent testing laboratory prior to placement. Topsoil shall meet criteria set fourth within the paragraph 2.1 deficiencies shall be corrected prior to placement of topsoil.

PART 2 - PRODUCTS

2.01 TOPSOIL

A. Planting-Soil for Lawns: Topsoil shall be imported, shred before spreading.
   1. Imported topsoil shall meet the following criteria, be confirmed through test results and submitted to the Project Engineer. Imported topsoil shall be weed-free and free of extraneous material (stones, sticks, etc.) larger than ½".
      a. pH range between 5.5 and 6.5
      b. Soluble salts content 500 ppm (parts per million) maximum
      c. Organic content between 5 and 30 percent
      d. Clay content between 5 and 25 percent

2.02 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
   1. Class: T, with a minimum of 99 percent passing through a sieve and a minimum of 75 percent passing through a sieve
   2. Class: O, with a minimum of 95 percent passing through a sieve and a minimum of 55 percent passing through a sieve.
   3. Form: Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a sieve and a maximum of 10 percent passing through a sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Sand: Clean, washed, natural or manufactured, free of toxic materials and according to ASTM C 33/C 33M.

PART 3 - EXECUTION

3.01 GENERAL

A. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in subsoil or topsoil.

3.02 PLACING TOPSOIL OVER DISTURBED LAWN AREAS

A. Remove 4" of existing topsoil within disturbed lawn areas.

B. Subgrade Preparation: Till subgrade to a minimum depth of Remove stones larger than in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Remove stones larger than in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

D. Spreading topsoil for Lawns: Spread topsoil to a minimum total depth of 4" but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.

E. Compaction: Compact each lift of planting soil to 85 percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place.

F. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.03 PROTECTION AND CLEANING

A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform seeding operations:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Vehicle traffic.
   4. Foot traffic.
   5. Erection of sheds or structures.
   6. Impoundment of water.
   7. Excavation or other digging unless otherwise indicated.

B. Remove surplus soils and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
   1. Dispose of excess existing subsoil, topsoil and unsuitable materials off site.

END OF SECTION 32 9113

SECTION 32 9200 - TURF AND GRASSES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Seed bed preparation, fertilization, seeding, sodding, mulching, maintenance and turf warranty.

B. Related Sections:
   1. Division 32 Section 32 9113 “Soil Preparation” for topsoil preparation and placement.

1.03 DEFINITIONS

A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

B. Weeds: includes dandelion, jimsonweed, quackgrass, horsetail, morning glory, rush grass, mustard, lambsquarter, chickweek, cress, crabgrass, Canadian thistle, nutgrass, poison oak, blackberry, tansy ragwort, Bermuda grass, Johnson grass, poison ivy, nut sedge, nible will, bindweed, bent grass, wild garlic, perennial sorrel and brome grass.

C. Topsoil: Use imported topsoil. See Section 32 9113 “Soil Preparation” and drawing designations for topsoil and seeding.

1.04 REFERENCES

A. Michigan Department of Transportation (MDOT) – 2012 Standard Specification for Construction.

1.05 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.

1.06 INFORMATIONAL SUBMITTALS

A. Certification of grass seed and sod.
   1. Certification of each seed mixture.

B. Product certificates and data.

C. Submit sample of mulch blanket.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

2. Pesticide Applicator: State licensed, commercial.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

PART 2 - PRODUCTS

2.01 SEED AND SOD

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed and Sod Species:
   1. Quality: Seed of grass species as listed below with not more than 0.5 percent weed seed:
   2. Supplier: Rhino Seed, 800.482.3130.
      a. Seed Blend: ‘School Lawn Mix’.
         1) Seeding Rate: 250 lbs./acre.
   3. Supplier: Stantec, 574.586.2412.
      a. Seed Blend: ‘Specialty Seed Mixes – Stormwater’
         1) Seeding Rate: 36.38 lbs./acre.

2.02 FERTILIZERS

A. Recommended starter fertilizer for grass with fifty percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil as indicated within topsoil analysis, and shall contain a minimum of 4% phosphorus acid, 2% soluble potash and sufficient nitrogen to provide one pound of actual nitrogen per 1000 square feet of lawn area.

2.03 MULCH BLANKET

A. Mulch Blanket: Shall be DS150 Double Net Straw Blanket as manufactured by North American Green, 248.596.4300, 866.960.4300.

2.04 PESTICIDES AND HERBICIDES

A. General: Pesticides and herbicides may only be used with written permission from Owner.

PART 3 - EXECUTION

3.01 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 9113 "Soil Preparation."

B. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

C. Before seeding, obtain Architect’s acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.02 PLANTING SEASON

A. April 1st through May 31st or August 16th through October 10th unless otherwise noted on plans or directed by Engineer.

3.03 FERTILIZING

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

B. Apply after smooth raking of topsoil.

C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.

D. Mix fertilizer thoroughly into upper two inches (2") of topsoil

3.04 MECHANICAL SEEDING

A. Sow seed with mechanical seeder.
   1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   2. Do not use wet seed or seed that is moldy or otherwise damaged.
   3. Do not seed immediately following rain, when ground is dry, or during windy periods.

B. Sow seed at a total rate of 250 lbs. per acre.

C. Rake seed lightly into top 1/8 inchof soil, roll lightly, and water with fine spray.

D. Within 24 hours of seeding, all areas shall be mulched using mulch blanket. Mulch blanket shall be spread evenly with extreme care so as to leave the seeded lawn surface with a minimal amount of damage. Stake mulch blanket per manufacturers instructions.

3.05 SODDING

A. Athletic Fields: If turf seeding can not be fully established prior to the specified substantial completion date, the contractor shall sod disturbed areas within the athletic play fields at no additional cost to Owner. Sod composition shall match the specified Athletic Field Repair seed mix.

3.06 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Establishment period will require multiple mowings.

3.07 SATISFACTORY TURF

A. Prior to acceptance, turf installations shall meet the following criteria as determined by Landscape Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory. Maintenance shall include mowing of seeded lawn areas and watering.

END OF SECTION 32 9200

SECTION 33 1100 - FACILITY WATER DISTRUBTION PIPING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. City of Dexter Engineering Standards

B. Latest revision of AWWA C600.

1.02 SUMMARY:

A. This Section includes water-distribution piping and related components outside the building for water service mains.

B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

1.03 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.

1.04 COORDINATION

A. Coordinate connection to water main with the City of Dexter.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Water main shall be class 54 ductile iron pipe to conform with the City of Dexter Engineering Standards.

2.02 GATE VALVES

A. Per City of Dexter Engineering Standards.

2.03 WATER METERS

A. Water meters may be furnished and/or purchased from the City of Dexter.

2.04 FIRE HYDRANTS

A. Fire Hydrants: Per City of Dexter Engineering Standards. EJIW Model 5BR or an approved equal conforming to AWWA C-502.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Refer to Section 31 2000 "Earth Moving" for excavating, trenching, and backfilling.

3.02 PIPING INSTALLATION

A. General: Per City of Dexter Engineering Standards and standard details.

B. Water-Main Lead Connection: Arrange with the City of Dexter to be present for transfers of water main lead changes at the appropriate locations indicated on water main plan sheets.

C. Water-Main Connection: Tap water main according to requirements of the City of Dexter.

D. Bury piping with depth of cover over top at least 5.5 feet deep.

E. Install underground piping with restrained joints at horizontal and vertical changes, use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports per the City of Dexter standard details.

3.03 JOINT CONSTRUCTION

A. Per City of Dexter Engineering Standards.

3.04 VALVE INSTALLATION

A. Per City of Dexter Engineering Standards.

3.05 FIRE HYDRANT INSTALLATION

A. Per City of Dexter Engineering Standards.

3.06 JACK AND BORE

A. Per City of Dexter Engineering Standards. Water main jacking or boring shall extend a minimum of ten feet outside the edges of the pavement.

3.07 CLEANING AND TESTING

B. Clean, test, and disinfect water-distribution piping Per City of Dexter Engineering Standards.

END OF SECTION 33 1100

SECTION 33 4200 - STORMWATER CONVEYANCE

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes:
1. Ductile-iron culvert pipe and fittings.
2. PE pipe and fittings.
3. PVC pipe and fittings.
4. Concrete pipe and fittings.
5. Non-pressure transition couplings.
6. Expansion joints.
7. Cleanouts.
8. Encasement for piping.
9. Manholes.
10. Polymer-concrete, channel drainage systems.
11. Catch basins.
12. Stormwater inlets.
13. Stormwater detention structures.
14. Pipe outlets.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Manholes: Include plans, elevations, sections, details, frames, and covers.
2. Catch basins and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.
3. Stormwater Detention Structures: Include plans, elevations, sections, details, frames, covers, design calculations, and concrete design-mix reports.

C. Product Certificates: For each type of cast-iron soil pipe and fitting.

D. Field quality-control reports.

1.03 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 CORRUGATED-PE PIPE AND FITTINGS

A. Corrugated-PE Drainage Pipe and Fittings NPS 3 to NPS 10: AASHTO M 252, Type S, with smooth waterway for coupling joints.

B. Corrugated-PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294, Type S, with smooth waterway for coupling joints.

C. Corrugated-PE Silttight Couplings: PE sleeve with ASTM D1056, Type 2, Class A, Grade 2 gasket material that mates with pipe and fittings.

D. Corrugated-PE Soiltight Couplings: AASHTO M 294, corrugated, matching pipe and fittings.

2.02 PVC PIPE AND FITTINGS

A. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

B. PVC Corrugated Sewer Piping:
1. Pipe: ASTM F949, PVC, corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F477, elastomeric seals.

2.03 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C76.
1. Bell-and-spigot or tongue-and-groove ends and gasketed joints with ASTM C443, rubber gaskets
2. Class IV.

2.04 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground nonpressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
1. For Concrete Pipes: ASTM C443, rubber.
2. For Cast-Iron Soil Pipes: ASTM C564, rubber.
3. For Fiberglass Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
4. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
5. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
1. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:
1. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:
1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.05 CLEANOUTS

A. PVC Cleanouts:
1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.06 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Diameter: 48 inches minimum unless otherwise indicated.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
   4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   5. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated, and top of cone of size that matches grade rings.
   7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
   8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
   9. Steps: Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
   10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
   11. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Frames and Grates
   1. EJ Group No. 1040 with Type B cover or as indicated on the plans.

2.07 CONCRETE

A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:
   1. Cement: ASTM C150/C150M, Type II.
   2. Fine Aggregate: ASTM C33/C33M, sand.
   3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
      a. Invert Slope: 1 percent through manhole.
   2. Benches: Concrete, sloped to drain into channel.
      a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A615/A615M, Grade 60 (420 MPa) deformed steel.

2.08 CATCH BASINS

A. Standard Precast Concrete Catch Basins:
   1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
   4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   5. Joint Sealant: ASTM C990, bitumen or butyl rubber.
   6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
   7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.
   8. Steps: Individual FRP steps; FRP ladder; or ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 60inches.
   9. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates
   1. Pavement edge or gutter line: EJ Group 5080 or as indicated on the plans.
   2. Paved areas other than edge gutter line: EJ Group 1040 Type M or as indicated on the plans.
   3. Yard areas: EJ Group 1040 Type N or as indicated on the plans.

2.09 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions in accordance with utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions in accordance with utility standards. Include heavy-duty frames and grates.

C. Combination Inlets: Made with vertical curb and horizontal gutter openings, of materials and dimensions in accordance with utility standards. Include heavy-duty frames and grates.

D. Frames and Grates
   1. Pavement edge or gutter line: EJ Group 5080 or as indicated on the plans.
   2. Paved areas other than edge gutter line: EJ Group 1040 Type M or as indicated on the plans.
   3. Yard areas: EJ Group 1040 Type N or as indicated on the plans.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 31 2000 "Earth Moving."

3.02 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping in accordance with the following:
   1. Install piping pitched down in direction of flow.
   2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   3. Install piping with 36-inch-minimum cover.
   4. Install hub-and-spigot, cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   5. Install hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   6. Install ductile-iron piping and special fittings in accordance with AWWA C600 or AWWA M41.
   7. Install PE corrugated sewer piping in accordance with ASTM D2321.
   8. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.
   9. Install nonreinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."
   10. Install reinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install corrosion-protection piping encasement over the following underground metal piping in accordance with ASTM A674 or AWWA C105/A21.5:
   1. Hub-and-spigot, cast-iron soil pipe and fittings.
   2. Hubless cast-iron soil pipe and fittings.
   3. Ductile-iron pipe and fittings.
   4. Expansion joints.

3.03 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
   1. Join hub-and-spigot, cast-iron soil piping with gasketed joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
   2. Join hub-and-spigot, cast-iron soil piping with caulked joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum caulked joints.
   3. Join hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
   4. Join ductile-iron culvert piping in accordance with AWWA C600 for push-on joints.
   5. Join ductile-iron piping and special fittings in accordance with AWWA C600 or AWWA M41.
   6. Join corrugated-PE piping in accordance with ASTM D3212 for push-on joints.
   7. Join PVC corrugated sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.
   8. Join nonreinforced-concrete sewer piping in accordance with ASTM C14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   9. Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   10. Join dissimilar pipe materials with nonpressure-type flexible couplings.

B. Join force-main pressure piping in accordance with the following:
   1. Join PVC pressure piping in accordance with AWWA M23 for gasketed joints.
   2. Join dissimilar pipe materials with pressure-type couplings.

3.04 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   1. Use Light-Duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification cleanouts in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification cleanouts in vehicle-traffic service areas.
   4. Use Extra-Heavy-Duty, top-loading classification cleanouts in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch(es above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.05 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 1 inch above finished surface elsewhere unless otherwise indicated.

3.06 CATCH BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.07 STORMWATER INLET INSTALLATION

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.08 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.09 CHANNEL DRAINAGE SYSTEM INSTALLATION

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in 4-inch-minimum concrete around bottom and sides.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

F. Embed channel sections in 4-inch-minimum concrete around bottom and sides.

3.10 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Section 22 1413 "Facility Storm Drainage Piping."

B. Connect force-main piping to building's storm drainage force mains specified in Section 22 1413 "Facility Storm Drainage Piping." Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.

3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, manhole, or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.
    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
4. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to sediment interceptors specified in Section 22 1323 "Sanitary Waste Interceptors."

E. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure-type flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    a. Unshielded or Shielded flexible couplings for same or minor difference OD pipes.
    b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
    c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.11 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
1. Remove manhole or structure and close open ends of remaining piping.
2. Remove top of manhole or structure down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade in accordance with Section 31 2000 "Earth Moving."

3.12 IDENTIFICATION

A. Materials and their installation are specified in Section 31 2000 "Earth Moving." Arrange for installation of green warning tape directly over piping and at outside edge of underground structures.
1. Use warning tape or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.13 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
   3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
   4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems in accordance with requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Gravity-Flow Storm Drainage Piping: Test in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Exception: Piping with soiltight joints unless required by authorities having jurisdiction.
      b. Option: Test plastic piping in accordance with ASTM F1417.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.14 CLEANING

A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 33 4200

SECTION 33 6113 - UNDERGROUND HYDRONIC DISTRIBUTION PIPING

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PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 20 Section “Mechanical General Requirements.”
2. Division 20 Section “Basic Mechanical Materials and Methods.”
3. Division 23 Section “Hydronic Piping.”
4. Division 23 Section “Snow Melting and Floor Heating.”

1.02 DEFINITIONS

A. HDPE: High density polyethylene plastic.

B. PE: Polyethylene plastic.

C. PEX: Crosslinked polyethylene plastic.

D. PVC: Polyvinyl chloride plastic.

1.03 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing hydronic piping systems with the following minimum working-pressure ratings:

1. Hot-Water Piping: 150 psig.

1.04 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cased piping.
2. Loose-fill insulation.

1.05 **INFORMATIONAL SUBMITTALS**

A. Shop Drawings: Signed and sealed by a qualified professional engineer.
1. Perform stress calculations in accordance with ANSI B31.1.
2. Calculate requirements for expansion compensation for underground piping.
3. Show expansion compensators, offsets, and loops with appropriate materials to allow piping movement in the required locations. Show anchors and guides that restrain piping movement with calculated loads, and show concrete thrust block dimensions.
4. Show pipe sizes, locations, and elevations. Show piping in trench, conduit, and cased pipe with details showing clearances between piping, and show insulation thickness.

B. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from hydronic distribution piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures. Show expansion loops and 90 degree fittings.

C. Profile Drawings: Show system piping in elevation. Draw profiles at horizontal scale of not less than 1 inch equals 50 feet and at vertical scale of not less than 1 inch equals 5 feet. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing hydronic distribution piping.

1.06 **CLOSEOUT SUBMITTALS**

A. Field quality-control test reports.

1.07 **QUALITY ASSURANCE**

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.

1.08 **PROJECT CONDITIONS**

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 no fewer than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

1.09 **COORDINATION**

A. Coordinate pipe-fitting pressure classes with products specified in related Sections.

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. Refer to Part 3 "Piping Application" Article for applications of pipes, tubes, fittings, and joining methods.

B. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.

2.03 **RIGID HDPE CASED PIPING**

A. Manufacturers:

1. Insul-Tek Piping Systems, Inc.
2. Rovanco Piping Systems, Inc.
3. Thermacor Process, L.P.

B. Description: Factory-fabricated piping with carrier pipe, insulation, and casing.

C. Carrier Pipe: Steel pipe complying with ASTM A 53/A 53M, Type E, Grade B with beveled ends for welded joints.

D. Carrier Pipe Insulation:

1. Polyurethane Foam Pipe Insulation: ASTM C 591, preformed, rigid, cellular.
   a. Thermal Conductivity (k-Value): 0.13 at 75 deg F.
   b. Service Temperature: Minus 250 to plus 200 deg F.
   c. Moisture Absorption: ASTM D 2842, maximum 0.054 percent by volume.
   d. Minimum 90 percent closed cell.
   e. Dry Density: 2 lb/cu. ft. maximum.
   f. Compressive Strength: 35 psig minimum at 5 percent deformation.
   g. Water-Vapor Transmission: 1.26 perm inches according to ASTM E 96.

E. Casing: High-density polyethylene.

F. Casing accessories include the following:

1. Joint Kit: Half-shell, pourable or split insulation, casing sleeve, and shrink-wrap sleeve.
2. Expansion Blanket: Elastomeric foam, formed to fit over piping.
3. End Seals: Shrink wrap the casing material to seal watertight around casing and carrier pipe.

G. Source Quality Control: Factory test the carrier pipe to 150 percent of the operating pressure of system. Furnish test certificates.

PART 3 EXECUTION

3.01 **EARTHWORK**

A. Refer to Division 31 Section "Earthwork" for excavating, trenching, and backfilling.

3.02 **PIPING APPLICATION**

A. Hot-Water Piping: Conduit piping with polyurethane carrier-pipe insulation.

3.03 **PIPING INSTALLATION**

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping. 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. Remove any standing water in the bottom of trench.

C. Bed the pipe on a minimum 6-inch layer of granular fill material with a minimum 6-inch clearance between the pipes.

D. Do not insulate piping or backfill piping trench until field quality-control testing has been completed and results approved.

E. Install piping at uniform grade of 0.2 percent upward in direction of flow or as indicated.

F. Install components with pressure rating equal to or greater than system operating pressure.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals through exterior building walls.

J. Secure anchors, where necessary, with concrete thrust blocks. Concrete is specified in Division 03 "Cast-in-Place Concrete."

K. Connect to hydronic piping where it passes through the building wall or floor. Hydronic piping inside the building is specified in Division 23 Section "Hydronic Piping."

3.04 **JOINT CONSTRUCTION**

A. Refer to Division 20 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Conduit and Cased Piping Joints: Assemble sections and finish joints with pourable or split insulation, exterior jacket sleeve, and apply shrink-wrap seals as required by manufacturer's written installation instructions.

3.05 **IDENTIFICATION**

A. Install continuous plastic underground warning tapes during back filling of trenches for underground hydronic distribution piping. Locate 6 to 8 inches below finished grade, directly over piping. Refer to Division 20 Section "Mechanical Identification" for warning-tape materials and devices and their installation.

3.06 **FIELD QUALITY CONTROL**

A. Prepare hydronic piping for testing according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Isolate equipment. Do not subject equipment to test pressure.
3. Install relief valve set at pressure no more than one-third higher than test pressure.
4. Fill system with water. Where there is risk of freezing, air or a safe, compatible liquid may be used.
5. Use vents installed at high points to release trapped air while filling system.

B. Test hydronic piping as follows:

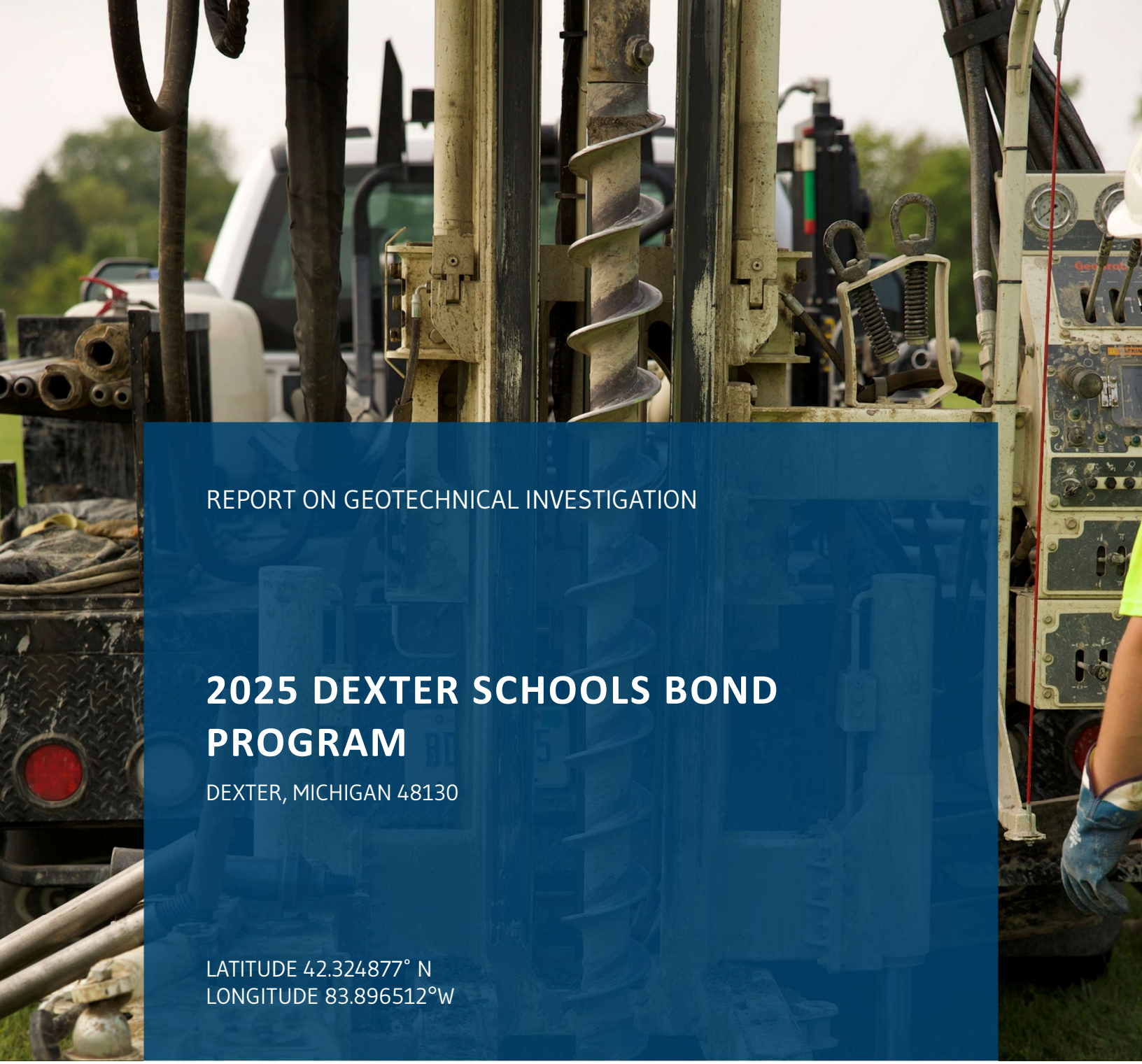
1. Subject hydronic piping to hydrostatic test pressure that is not less than 1.5 times the design pressure, but not less than 90 psig.
2. After hydrostatic test pressure has been applied for 10 minutes, examine joints for leakage. Remake leaking joints using new materials and repeat hydrostatic test until no leaks exist.

C. Test conduit as follows:

1. Seal vents and drains and subject conduit to 15 psig for 4 hours with no loss of pressure. Repair leaks and retest as required.

D. Prepare a written report of testing.

END OF SECTION



REPORT ON GEOTECHNICAL INVESTIGATION

2025 DEXTER SCHOOLS BOND PROGRAM

DEXTER, MICHIGAN 48130

LATITUDE 42.324877° N
LONGITUDE 83.896512°W

CONSULTING GROUP

Prepared for:

Granger Construction
6267 Aurelius Road
Lansing, Michigan 48911

G2 Project No. 253566
October 13, 2025

October 13, 2025

Mr. Greg Brand, P.E.
Senior Project Manager
Granger Construction
6267 Aurelius Road
Lansing, Michigan 48911

RE: Report on Geotechnical Investigation
2025 Dexter Schools Bond Program
Dexter, Michigan 48130
G2 Project No. 253566

Dear Mr. Brand:

We have completed the geotechnical investigation associated with the 2025 Dexter Schools Bond Program, which includes the construction of building additions at Dexter High School and Wylie Elementary School, as well as athletic improvements at Dexter High School and Creekside Intermediate School. This report presents the results of our observations and analyses, as well as recommendations related to earthwork, subgrade preparation, foundation design, and below-grade wall design, as well as related construction considerations.

We appreciate the opportunity to be of service to you 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

Tyler S. Hesse, P.E.
Project Manager

Jason B. Stoops, P.E.
Associate / Project Consultant

TSH/JBS/tsh

EXECUTIVE SUMMARY

We understand the project consists of the construction of two (2) building additions at Dexter High School and one (1) building addition at Wylie Elementary School. In addition, improvements will be made to the athletic facilities at the Dexter High School and Creekside Intermediate School campuses. The athletic improvements will consist of constructing bleachers, PCC stairs, entry structures, and pole mounted batting cages.

Approximately 4 inches of Portland cement concrete (PCC) or 2 to 5 inches of sand/clay topsoil are present at the ground surface at the soil boring locations. Very loose to medium compact granular and stiff to hard cohesive fill, with intermixed wood debris and organic matter content, underlie the PCC and/or topsoil within borings B-02, B-08, B-12, B-15 through B-17, and B-19, and extend to approximate depths ranging from 4 to 8-1/2 feet below existing grade. In general, alternating strata of native medium compact to very compact granular soil and stiff to hard cohesive soil underlie the PCC, fill, and topsoil extending to the explored depths ranging from 10 to 45 feet below existing grade. However, native very loose to loose granular soil and medium cohesive soil are present within borings B-02 through B-04, B-09, B-11, B-18, and B-20 at approximate depths ranging from 3 to 9 feet below existing grade. During drilling operations, groundwater was encountered at depths ranging from 6 to 24-1/2 feet below existing grade within soil borings B-01, B-03 through B-06, B-12, B-13, and B-17 through B-20. No measurable groundwater was observed within the remaining borings during drilling operations. Upon the completion of drilling operations, groundwater was measured at a depth of 22 feet below existing grade within boring B-01. No measurable groundwater was observed within the remaining borings upon the completion of drilling operations.

The granular and cohesive fill soils do not appear to have been placed in an engineered manner and are not suitable for support of foundations; however, the fill is marginally suitable for support of floor slabs following successful completion of a proof-roll/proof-compaction evaluation and provide differential floor slab settlement can be tolerated. Based on the reported depth of the lower-level floor slab for the Dexter High School entry addition, approximately 14 feet below grade, we anticipate that the fill will be removed during construction.

We recommend that the two (2) Dexter High School additions, the Wylie Elementary School addition, bleachers, and entry structures be supported by conventional shallow foundations. The proposed foundations must extend through any existing fill and bear within the underlying native stiff to hard cohesive soils or native medium compact to compact granular soils. Also, native medium consistency sandy clay is present within the footprint of the proposed Wylie Elementary School addition near soil boring B-20 between the approximate depths of 3 and 5-1/2 feet below the ground surface. We recommend the foundations extend through this layer of medium consistency sandy clay and bear within the underlying very stiff silty clay. Alternatively, the existing fill and medium consistency sandy clay can be removed from the influence of the proposed foundations and be replaced with engineered fill overlying native soils. We recommend that foundations bearing within the native stiff to hard cohesive soils, native medium compact to compact granular soils, or engineered fill be designed based on net allowable bearing capacity of 3,000 psf. We understand that the pole mounted batting cage will be supported by drilled pier foundations. We recommend that following soil parameter be used for the design of the drilled pier foundations:

Boring ID	Depth	Soil	Cohesion (psf)	Angle of Friction (°)	Unit Weight (pcf)	Soil Modulus (pci)
B-10	0 to 3-1/2 Feet	-	-	-	-	-
	3-1/2 to 4-1/2 Feet	Hard Silty Clay	4,500	0	130	700
	4-1/2 to 10 Feet	Medium Compact Sand	0	32	115	75

Do not consider this summary 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 the project consists of the construction of two (2) building additions at Dexter High School and one (1) building addition at Wylie Elementary School. In addition, we understand that improvements will be made throughout the athletic facilities at the Dexter High School and Creekside Intermediate School campuses.

We understand that two (2) additions will be constructed at the northwest and south sides of the existing Dexter High School building. The northwest addition will be utilized as an entryway and a fitness area, will be a single-story structure, and will have an approximate footprint of 12,000 square feet. Furthermore, we understand the northwest addition will include a below-grade level approximately 14 feet below the main level finished floor elevation (FFE). The southern addition will be utilized as Career and Technical Education (CTE) space, will be a single-story, slab-on-grade structure, with an approximate footprint of 5,200 square feet.

The proposed Wylie Elementary School addition will be constructed on the south side of the existing structure. The addition will be a single-story, slab-on-grade structure with an approximate footprint of 9,400 square feet.

Finally, several athletic improvements will be made throughout the Dexter High School and Creekside Intermediate School campuses. The athletic improvements at the Dexter High School campus will include construction of entryways, aluminum bleachers, and pole mounted batting cages. The athletic improvements at the Creekside Intermediate campus will include the construction of an entryway and staircase at the north side of the existing football stadium.

The original scope of the investigation included an athletic fieldhouse to be constructed within the Dexter High School campus. At the time of our investigation, the final location of the fieldhouse was undecided, and we were informed that a supplemental investigation would be required once the location was finalized. As such, recommendations related to construction of the fieldhouse are not included within this report.

If information related to existing/final site grades, structural loading conditions, and/or finished floor elevations change or become available, G2 Consulting Group, LLC (G2) should be notified to re-evaluate the recommendations provided herein, if necessary. The purpose of our exploration is to determine and evaluate the general subsurface conditions at the above-mentioned locations and to develop recommendations for earthwork, subgrade preparation, foundation design, and below-grade wall design, as well as related construction considerations as they relate to the geotechnical conditions on site.

SCOPE OF SERVICES

The field operations, laboratory testing, and engineering report preparation were performed under 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 performed a total of twenty (20) soil borings throughout the aforementioned areas. Soil borings B-01 through B-04 were performed within the influence of the northwestern addition at Dexter High School extending to a depth of 45 feet each. Soil borings B-05 and B-06 were performed within the influence of the southern addition at Dexter High School extending to a depth of 25 feet each. Soil borings B-07 through B-13 and B-14 through B-16 were performed within the vicinity of the athletic improvements at Dexter High School and Creekside Elementary School, respectively, extending to a depth of 10 feet each. Soil borings B-17 through B-20 were performed within the influence of the addition at the Wylie Elementary School extending to a depth of 25 feet each.

2. We performed laboratory testing on representative samples obtained from the soil borings. Laboratory testing included visual engineering classification, natural moisture content, organic matter content, and unconfined compressive strength determinations.

3. We prepared this engineering report. The report includes recommendations regarding earthwork, subgrade preparation, foundation design, and below-grade wall design, as well as construction considerations.

FIELD OPERATIONS

Granger Construction selected the number, depth, and location of the soil borings. The boring locations were located in the field by a G2 representative using GPS assisted mobile technology and by measuring from known surface features using conventional taping methods. The approximate soil boring locations are shown on the Soil Boring Location Plans, Plate Nos. 1 through 4. A topographic survey detailing existing surface grades at the soil boring locations was unavailable at the time of this report and as such, we were unable to interpolate ground surface elevations at the boring locations. We highly recommend the ground surface elevations at the boring locations be determined so that the encountered soil stratigraphy can be tied to elevation.

The soil borings were performed using a truck mounted drilling rig. Continuous 2-1/4-inch, inside-diameter, hollow-stem augers were used to extend the boreholes to the explored depths. Soil samples were collected at 2-1/2-foot intervals within the upper 10-feet and at 5-foot intervals thereafter. The samples were obtained using the Standard Penetration Test (SPT) method (ASTM D1586), 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 in three (3) 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 soil boring logs.

The soil samples were placed in sealed containers and brought to our laboratory for testing and classification. During field operations, the driller maintained logs of the subsurface conditions, including changes in stratigraphy and observed groundwater levels. The final boring logs are based on the field boring logs supplemented by laboratory soil classification and test results. The boreholes were backfilled with auger cuttings and topped with cold-patch asphalt, where necessary, upon completion of drilling operations.

LABORATORY TESTING

Representative soil samples were subjected to laboratory testing to determine soil parameters pertinent to subgrade preparation and foundation design. An experienced geotechnical engineer classified the samples in general conformance with the Unified Soil Classification System. Laboratory testing was conducted in conformance with the following ASTM Test Methods:

- "Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass" (ASTM D2216);
- "Standard Test Methods for Determining the Water (Moisture) Content, Ash Content, and Organic Material of Peat and Other Organic Soils" (ASTM D2974); and
- "Standard Test Method for Unconfined Compressive Strength of Cohesive Soil" (ASTM D2166).

The unconfined compressive strengths were determined by ASTM Test Method D 2166 and using a spring-loaded hand penetrometer. The hand penetrometer estimates the unconfined compressive strength to a maximum of 4-1/2 tons per square foot by measuring the resistance of the soil sample to the penetration of a spring-loaded cylinder.

The results of the moisture contents, organic matter contents, and unconfined compressive strengths are indicated on the Soil Boring Logs, Figure Nos. 1 through 20, at the depths the samples were obtained. The results of the unconfined compressive strengths determined in accordance with ASTM D2166 are presented graphically in the appendix as Figure No. 21.

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 to have the samples, please coordinate their pickup prior to the discard date.

SITE DESCRIPTION

Dexter High School

The Dexter High School campus is located at 2200 N. Parker Road in Dexter, Michigan. The existing school can be accessed via two access drives leading eastward into the parcel and via an access drive extending southward from Shield Road. The existing site grades appear to be the highest near the intersection of Shield and N. Parker Road and appear to gently slope downward as you approach the existing school. The site grades immediately surrounding the building appear to be at higher elevations at the northwest end of the building near the entrance of the school and lower toward to the southeast end of the building. We understand the existing building has a common finished slab elevation across its footprint that roughly corresponds to the grades surrounding the southern end of the building. The changes in elevation at the site result in a building configuration with a walk-out basement with the below grade walls located at the north end of the building.

The existing school building is a single to four-story structure with one-story partially below grade at the north end. The campus also includes several soccer field, two (2) baseball diamonds, ten (10) tennis courts, and a detention pond, as well as associated bituminous concrete service drives and parking areas, and Portland cement concrete (PCC) sidewalks. The remainder of the campus is covered in manicured lawn, includes several mature trees, and isolated areas of dense vegetation.

A topographic survey detailing existing surface grades throughout the campus was unavailable at the time of this report; however, based on our review of topographical information available in Google Earth Pro, existing surface grades throughout the campus range from elevation 856 to 893 feet. Site grades surrounding the existing highschool range from 863 feet at the western face, 866 feet on the southern face, 865 to 866 feet on the eastern face, and 880 feet at the northern face of the building.

Based on historical aerial imagery, the parcel appears to have been used for agricultural purposes prior to construction of the Dexter High School Campus leading up to 1998. Sometime between 1998 and 2005, the Dexter High School building and northern athletic facilities were constructed. We observe the southwestern wooded area was cleared and twin turf fields were constructed sometime around 2020. We observed crack sealing has been performed throughout the bituminous concrete areas since the original construction of the campus.



Historical Aerial Imagery (1998)



Historical Aerial Imagery (2005)

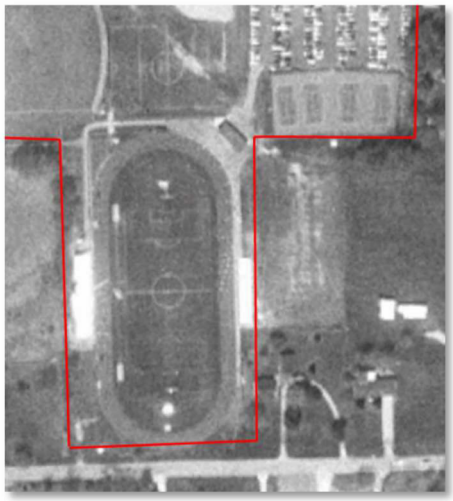


Aerial Imagery (2025)

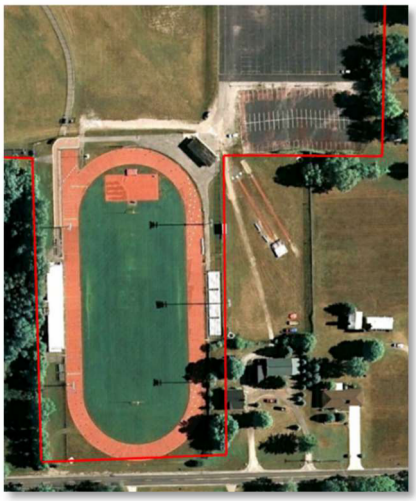
Creekside Intermediate School

The Creekside Intermediate School campus is located at 2615 Baker Road in Dexter, Michigan. The site can be accessed via several access drives leading westward from Baker Road into the parcel. The existing site grades appear to be their highest along Baker Road ranging from 870 feet to the north and 878 feet to the south. The existing buildings and nearby parking lots appear to be constructed at elevations near 870 feet. The site gently slopes downward to the west from Baker Road. Baseball fields at the northwest corner of the parcel are located at elevations near 865 feet. Another baseball field located at the southwest corner of the parcel appear to be at an elevation near 863 feet.

The southern football field, running track, bleacher structures, and maintenance building appear to have been constructed sometime prior to 1993. Then, sometime around 2007, the athletic fields north of the football field were demolished and replaced with bituminous concrete parking areas. It appears that the northern restroom/concessions building was constructed sometime between 2007 and 2013.



Historical Aerial Imagery (1993)



Historical Aerial Imagery (2007)



Historical Aerial Imagery (2013)



Aerial Imagery (2025)

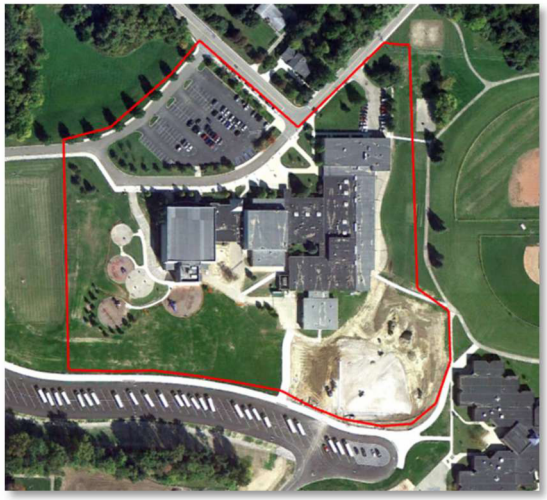
Wylie Elementary School

The Wylie Elementary School campus is located at 3060 Kensington Street in Dexter, Michigan where Grand Street terminates into Kensington Street. The existing site grades appear to be relatively flat immediately surrounding the building at an elevation of 615 feet. Site grades south and east of the existing building range from 926 feet at the east to an elevation of around 908 feet in the southwest. The existing baseball field located to the southeast of the building appears to be constructed at an elevation around 917 feet.

The campus consists of a single-story, slab-on-grade school building, with associated playground structures, a baseball diamond, bituminous concrete pavements, and PCC sidewalks. The remainder of the campus is grass covered and includes several mature trees.

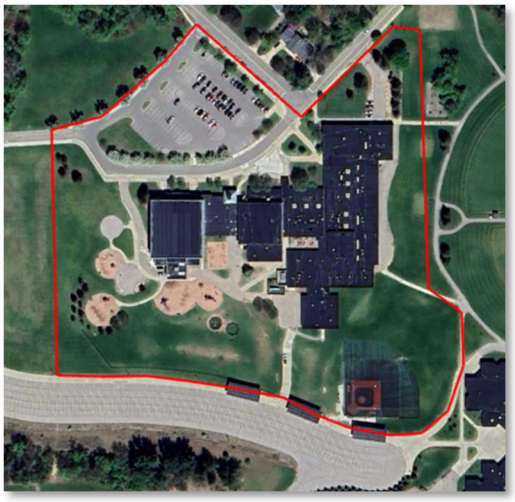


Historical Aerial Imagery (1993)



Historical Aerial Imagery (2011)

Based on historical aerial imagery, the Wylie Elementary School building was constructed sometime prior to 1993. Then, sometime around 2011, the southern bituminous concrete bus loop and baseball diamond were constructed. It appears that crack sealing has been performed throughout the pavement areas since the original construction of the campus.



Aerial Imagery (2025)

SOIL AND GROUNDWATER CONDITIONS

Soil Conditions

Dexter High School Additions (B-01 through B-06)

Approximately 4 inches of PCC and 2 to 5 inches of sand and/or clay topsoil is present at the ground surface at soil borings B-01 and B-02, and B-03 through B-06, respectively. Sand and sandy clay fill, with intermixed wood debris, underlie the PCC within boring B-02 and extends to an approximate depth of 6 feet below grade. Alternating strata of native granular and cohesive soils underlie the PCC within borings B-01, the fill soils within B-02, and the topsoil within borings B-03 through B-06, and extend to the explored depths ranging from 25 to 45 feet below existing grade.

The sandy clay fill soils are very stiff in consistency, with moisture contents ranging from 10 to 13 percent, and unconfined compressive strengths ranging from 4,500 to 6,500 psf. The native granular soils are medium compact to very compact in relative density with SPT N-values ranging from 11 to 80 blows per foot (bpf). However, loose granular soils are present within borings B-02 through B-04, with SPT N-values ranging from 1 to 5 bpf, at depths ranging from 6 to 8 feet. The native cohesive soils are stiff to hard in consistency, with natural moisture contents ranging from 5 to 20 percent, and unconfined compressive strengths ranging from 3,000 psf to more than 9,000 psf.

Dexter High School Athletic Improvements (B-07 through B-13)

Approximately 2 to 5 inches of sand/clay topsoil is present at the ground surface at soil borings B-07 through B-10, B-12, and B-13. Clayey sand and sandy clay fill underlie the topsoil within borings B-08 and B-12 and extend to an approximate depth of 4 to 8-1/2 feet. The sandy clay fill soils within boring B-12 have an organic matter content of 10.1 percent. Alternating strata of native granular and cohesive soils underlie the topsoil within borings B-07, B-09, B-10, and B-13, underlie the fill soils within borings B-08 and B-12, and are present at the ground surface at boring B-11, and extend to the explored depth of 10 feet below existing grade.

The clayey sand fill soils are very loose to medium compact in relative density, with SPT N-values ranging from 2 to 13 bpf. The sandy clay fill soils are very stiff in consistency, with a moisture content of 10 percent, and an unconfined compressive strength of 5,000 psf. The native granular soils are generally medium compact to very compact in relative density with SPT N-values ranging from 15 to 69 bpf. However, loose native granular soils, with SPT N-values ranging from 9 to 10 bpf, are present within borings B-09 and B-11, at approximate depths ranging from 3 to 9 feet. The native cohesive soils are very stiff to hard in consistency, with natural moisture contents ranging from 7 to 22 percent, and unconfined compressive strengths ranging from 5,000 psf to more than 9,000 psf.

Creekside Intermediate School Athletic Improvements (B-14 through B-16)

Approximately 2 inches of sand topsoil is present at the ground surface at soil borings B-14 through B-16. Sand and clayey sand fill underlies the topsoil within borings B-15 and B-16 and extend to an approximate depth of 6 feet below existing grade. Alternating strata of native granular and cohesive soils underlie the topsoil within boring B-14 and the fill soils within borings B-15 and B-16, and extend to the explored depth of 10 feet below existing grade.

The granular fill soils are loose in relative density with SPT N-values ranging from 6 to 10 bpf. The native granular soils are medium compact in relative density with SPT N-values ranging from 19 to 28 bpf. The native cohesive soils are very stiff to hard in consistency, with natural moisture contents ranging from 8 to 11 percent, and unconfined compressive strengths ranging from 4,500 psf to more than 9,000 psf.

Wylie Elementary School Addition (B-17 through B-20)

Approximately 2 to 5 inches of sand/clay topsoil is present at the ground surface at soil borings B-17 through B-20. Granular and cohesive fill soils consisting of clayey sand, silty clay, and sandy clay, with an organic matter content of 3.7 percent, underlie the topsoil within borings B-17 and B-19 and extend to an approximate depth of 7 feet below existing grade. Alternating strata of native granular and cohesive underlie the topsoil within borings B-18 and B-20, and the fill soils within borings B-17 and B-19 and extend to the explored depth of 25 feet below existing grade.

The granular fill soils are loose to medium compact in relative density, with SPT N-values ranging from 8 to 11 bpf. The cohesive fill soils are stiff to hard in consistency, with natural moisture contents ranging from 11 to 16 percent, and unconfined compressive strengths ranging from 2,500 psf to in excess of 9,000 psf. In general, the native granular soils are medium compact to very compact in relative density, with SPT N-values ranging from 14 to 66 bpf. However, very loose granular soils are present within borings B-18 and B-20, with an SPT N-value of 4 bpf, 7 to 9 feet and 1 to 3 feet, respectively. The native cohesive soils are generally stiff to hard in consistency, with natural moisture contents ranging from 9 to 17 percent, and unconfined compressive strengths ranging from 3,000 to in excess of 9,000 psf. However, medium consistency sandy clay is present within boring B-20, with a natural moisture content of 11 percent, a dry density of 116 pounds per cubic foot (pcf), and an unconfined compressive strength of 1,210 psf.

General

The stratification depths shown on the soil boring logs represent the soil conditions at the boring locations. Variations may occur between and away from the boring locations. Additionally, the stratigraphic lines represent the approximate boundaries between soil types. The transition may be more gradual than indicated. We have prepared the boring logs on the basis of the field log of the soil conditions encountered supplemented by laboratory classification and testing.

The Soil Boring Location Plans, Plate No. 1 through 4, and Soil Boring Logs, Figure No. 1 through 20, 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 soil boring logs and elsewhere in this report are presented on Figure No. 22.

Groundwater Conditions

Dexter High School Additions (B-01 through B-06)

During drilling operations, groundwater was encountered at approximate depths ranging from 12 to 20 feet below existing grade within soil borings B-01, and B-03 through B-06. No measurable groundwater was not present during drilling operations within boring B-02. Upon completion of drilling operations, we observed groundwater at a depth of 22 feet below existing grade within boring B-01. No measurable groundwater was observed within the remaining soil borings upon completion of drilling operations.

Dexter High School Athletic Improvements (B-07 through B-13)

During drilling operations, groundwater was encountered at approximate depths ranging from 6 to 7 feet below existing grade within borings B-12 and B-13. No measureable groundwater was observed during drilling operations within boring B-07 through B-11. No measurable groundwater was observed within borings B-07 through B-13 upon the completion of drilling operations.

Creekside Intermediate School Athletic Improvements (B-14 through B-16)

No measurable groundwater was observed during or upon the completion of drilling operations within borings B-14 through B-16.

Wylie Elementary School Addition (B-17 through B-20)

During drilling operations, groundwater was encountered at approximate depths ranging from 18 to 24-1/2 feet below existing grade within borings B-17 through B-20. No measurable groundwater was observed upon the completion of drilling operations within borings B-17 through B-20.

General

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 predominantly 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 PREPARATION RECOMMENDATIONS

Granular and cohesive fill soils are present within soil borings B-02, B-08, B-12, B-15 through B-17, and B-19 and extend to approximate depths ranging from 4 to 8-1/2 feet below existing grade. The fill soils contain intermixed wood debris, organic matter contents ranging from 3.7 to 10.1 percent, and do not appear to have been placed in an engineered manner. The fill soils are not suitable for support of foundations, and as such, we recommend that foundations either extend through the fill to bear within native soils, or the fill soils be completely removed and replaced with engineered fill.

Based on the reported depth of the lower-level floor slab for the northwest addition at Dexter High School, we anticipate that the fill soils will be removed during construction. The fill soils within the influence of the Wylie Elementary School addition are marginally suitable for support of the floor slab, following successful completion of a proof-roll evaluation and provided floor slab settlement can be tolerated. If floor slab settlement cannot be tolerated, we recommend the fill be completely removed and replaced with engineered fill.

Topographic surveys detailing existing surface grades throughout the three (3) campuses were unavailable at the time of this report. Similarly, grading plans detailing finished site grades and FFEs were unavailable at the time of this report. It was reported to us that the lower-level FFE for the northwest addition at Dexter High School will match the existing lower-level elevation, approximately 14 feet below the exterior sidewalk elevation. Similarly, the FFE for the southeast addition at Dexter High School will match the existing lower-level elevation, which is within one (1) foot of the adjacent exterior grade. The FFE for the Wylie Elementary School addition will match the existing building FFE, which is within approximately one (1) to two (2) feet of existing grade. If information related to existing/final site grades becomes available, G2 should be notified to re-evaluate the recommendations provided herein, if necessary. Furthermore, we highly recommend elevation be assigned to the soil borings so that the encountered soil stratigraphy can be tied to elevation.

We anticipate earthwork operations will consist of demolition of the existing PCC sidewalks and bituminous pavements within the influence of the building additions and site improvements, complete removal of topsoil, trees, and vegetation within the influence of the development areas, removal of any existing utilities within the influence of the building additions, removal of unsuitable fill soils within the influence of the building additions, evaluating the base of the resulting excavations and improving the conditions, as necessary, placing engineered fill to achieve design subgrade elevation, proof-rolling/proof-compacting the exposed subgrade, excavating for utilities and foundations, and preparing subgrade for floor slab and pavement support. We recommend all earthwork operations be performed in accordance with comprehensive specifications and be properly monitored in the field by qualified personnel under the direction of a licensed professional engineer.

At the start of earthwork operations, any existing topsoil, trees, or vegetation should be entirely removed within the proposed development areas. Any existing utilities and associated backfill within the structure footprint(s) should be completely removed and replaced with engineered fill. Where utilities lie outside the structures zone of influence, utilities to be abandoned can be filled with cementitious grout and left-in-place.

After site stripping, the exposed subgrade is expected to consist of granular/cohesive fill soils and/or native granular/cohesive soils. Where cohesive soils are encountered, soils should be proof-rolled with a fully loaded tandem-axle dump truck and be evaluated for stability. Unsuitable soils exhibiting excessive instability, such as severe rutting, should be improved with additional compaction or undercut to expose stable soils. Where granular soils are encountered, soils should be proof-compacted with a heavy smooth-drum vibratory roller and should be visually evaluated for instability and/or unsuitable soil conditions by a qualified geotechnical engineer or technician. We recommend 10 passes in two (2) perpendicular directions during the proof-compaction operations. We recommend that the vibratory setting be turned off when within 25 feet of any existing structures. Any resulting undercut excavations should be evaluated for stability, improved as necessary, and should be backfilled with engineered fill.

Engineered fill should be free of organic matter, frozen soil, clods, or harmful material. The fill should be placed in uniform horizontal layers not more than 9-inches in loose thickness. The engineered fill should be compacted to achieve a dry density corresponding with 95 percent of the maximum dry density as determined by the Modified Proctor Compaction test (ASTM D1557).

To economically conduct earthwork operations at the site, imported fill, adhering to the aforementioned requirements, should consist of low plasticity clays or well-graded aggregates. Low plasticity clays, having a plasticity index less than 20 percent, should be placed within +3 or -1 percent of the optimum moisture content as determined by the Modified Proctor Test. For well-graded aggregates, such as MDOT Class II sand, we recommend the engineered fill be placed at ±2 percent of the optimum moisture content as determined by ASTM D1557.

We recommend the use of free-draining granular soils, such as MDOT Class II sand, within utility trenches and to backfill around below-grade walls. We recommend the use of engineered fill with a sufficient amount of fines (material passing the No. 200 sieve) in order to facilitate trenching and excavation techniques for strip and spread footing foundations.

FOUNDATION RECOMMENDATIONS

Information regarding structural loading conditions associated with the building additions and athletic improvements were unavailable for our review at the time of this report. In the absence of such information, and for the purposes of this report, we have assumed that the structures will be lightly to moderately loaded. When information regarding structural loading conditions becomes available, G2 should be notified so that we may have an opportunity to review the loading conditions and revise the recommendations found in this report, if necessary.

Dexter High School Additions

Based on the reported depth of the lower-level floor slab being at depth of approximately 14 feet relative to the existing site grades on the north end of the building, we anticipate foundations for the northwest addition at Dexter High School will be supported by native very stiff to hard cohesive soils and/or medium compact granular soils. We recommend the addition be supported by conventional shallow spread and/or strip footings designed to bear within the native very stiff to hard cohesive and/or medium compact granular soils. We recommend a net allowable bearing capacity of 3,000 psf be used for foundations bearing within the above-mentioned soils.

We recommend the southeast addition at Dexter High be supported by conventional shallow spread and/or strip footings designed to bear at a conventional 3-1/2 foot depth within the native medium compact to compact granular soils. We recommend a net allowable bearing capacity of 3,500 psf for foundations bearing within the native medium compact to compact granular soils.

Dexter High School Athletic Improvements

We understand preliminary designs for the bleachers and entry structure indicate the use of shallow spread/strip footings and the pole mounted batting cage indicate the use of drilled pier foundations.

Clayey sand and sandy clay fill are present within borings B-08 and B-12 and extend to approximate depths ranging from 4 to 8-1/2 feet. The sandy clay fill within boring B-12 has an organic matter content of 10.1 percent. The fill soils are not suitable for support of foundations, and as such, we recommend foundations extend through the fill and bear within the underlying native granular/cohesive soils.

We recommend that the entry-way structure and bleachers be supported by conventional shallow spread and/or strip footing foundations designed to bear within the native very stiff to hard cohesive and/or medium compact to compact granular soils at approximate depths ranging from 3-1/2 to 8-1/2 feet below finished grade. We recommend a net allowable bearing capacity of 3,000 psf be used for foundations bearing within the above-mentioned native soils.

The design of drilled shaft requires an understanding of the axial, shear, and moment forces acting at the head of the drilled shaft. Once this information becomes available, please share it with us so that we may review and evaluate the suitability of the drilled shaft recommendations we present in this report and to evaluate the need for deeper borings.

We recommend drilled shafts be designed using the following soil parameters:

Boring ID	Depth	Soil	Cohesion (psf)	Angle of Friction (°)	Unit Weight (pcf)	Soil Modulus (pci)
B-10	0 to 3-1/2 Feet	-	-	-	-	-
	3-1/2 to 4-1/2 Feet	Hard Silty Clay	4,500	0	130	700
	4-1/2 to 10 Feet	Medium Compact Sand	0	32	115	75

Based on the anticipated embedment depth, we anticipate that foundations will bear within native medium compact granular soils. We recommend a net allowable bearing capacity of 3,000 psf be used for design of drilled pier bearing with the native medium compact granular soils.

Center-to-center pile spacing should not be less than three (3) pile diameters to avoid reduction in downward pile capacity due to group action. If the required drilled shaft depth extends below 10 feet, additional soils information may be required to finalize the foundation design.

Creekside Intermediate School Athletic Improvements

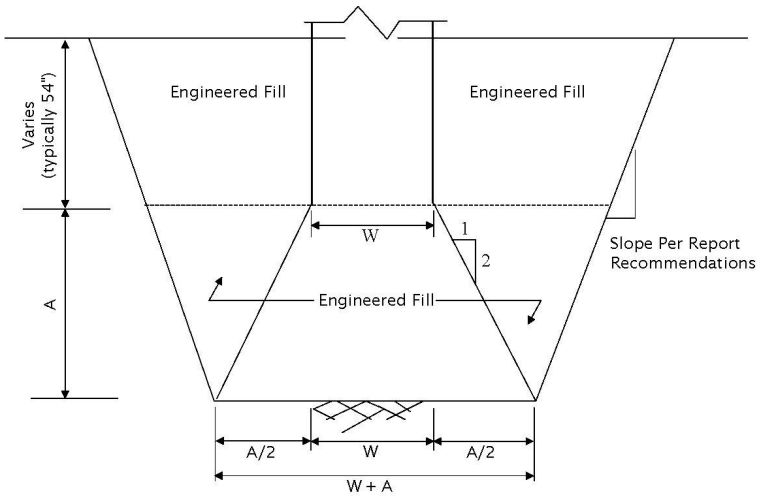
Granular fill soils are present within the vicinity of the proposed improvements at Creekside Intermediate School and extend to an approximate depth of 6 feet below existing grade. The fill soils are not suitable for the support of entryway or staircase foundations, and as such, we recommend that foundations extend through the fill and bear within the underlying native granular/cohesive soils found at depths ranging from 3-1/2 to 6 feet depending on the location.

We recommend that the entry-way structure and stairwell be supported by conventional shallow spread and/or strip footings designed to bear within the native granular/cohesive soils at depths ranging from 3-1/2 to 6 feet finished grade. We recommend a net allowable bearing capacity of 3,000 psf for foundations bearing within the native medium compact granular and/or very stiff to hard cohesive soils.

Wylie Elementary School Addition

Granular and cohesive fill soils are present within the influence of the Wylie Elementary School addition and extend to an approximate depth of 7 feet below existing grade. The fill soils have an organic matter content of 3.7 percent. These soils are unsuitable for the support of foundations and marginally suitable for the support of floor slabs. In addition, native medium consistency sandy clay is present at the bearing depth associated with conventional foundations near the southwest corner of the addition. The building foundations could bear within the medium sandy clay layer; however, this would result in a reduced net allowable bearing capacity. As such, we recommend the granular/cohesive fill soils and the native medium sandy clay be completely removed to expose the native granular/cohesive soils and be replaced with engineered fill within the influence of the building addition.

The influence beneath a foundation can be described as the zone of soil encompassed by a trapezoid projected outward from the base of the foundation at a ratio of 1 horizontal unit to 2 vertical units extending to the top of the native. At a minimum all of the existing fill soils and the native medium cohesive soils in this zone must be removed and replaced with engineered fill.



We recommend the addition be supported by conventional shallow spread and/or strip footings designed to bear at a conventional 3-1/2 foot depth within the native stiff to very stiff cohesive soils, medium compact granular soils, and/or engineered fill overlying native granular/cohesive soils. Foundations bearing within these soils may be designed using a net allowable bearing capacity of 3,000 psf.

General

Continuous wall or strip footings should be at least 18-inches in width and isolated spread footings should be at least 36-inches in their least dimension. Exterior foundations must bear at a minimum depth of 3-1/2 feet below finished grade for protection against frost heave. Interior footings may bear at shallower depths provided they extend through fill soils, suitable bearing materials are available for support, and foundations are continuously protected from frost penetration during construction.

Foundations installed immediately adjacent to the existing building foundations must bear at the same depth as the existing foundations. Under no circumstances shall excavations extend below adjacent foundations without proper underpinning. We do not know the bearing depth of the existing foundations; however, consideration could be given to excavating test pits adjacent to the building for the purpose of identifying the existing bearing soils and whether underpinning will be required or not.

To achieve a change in the level of a strip footing, the footing should be gradually stepped at a grade no steeper than two horizontal units to one vertical unit (2H:1V). If required to construct foundations at different levels, adjacent spread foundation 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. We recommend the new and existing building sections be structurally separated to allow for independent movements.

If the recommendations outlined in this report are adhered to, total and differential settlements for the completed structure should be within 1 inch and ½ inch, respectively. We expect settlements of these magnitudes are within tolerable limits for the type of structure proposed. We recommend all foundations be suitably reinforced to minimize the effects of differential settlements associated with local variations in subsoil conditions.

FLOOR SLAB RECOMMENDATIONS

The FFEs for the two (2) additions at Dexter High School and the addition at Wylie Elementary School were unavailable at the time of this report. It was reported to us that the floor slabs for the two (2) additions at Dexter High School will match the existing lower-level floor slab elevation and the floor slab for the Wylie Elementary School addition will match the existing building FFE. Once the exact FFEs are determined, G2 should be notified so that we may review the recommendations presented in this report and make changes, if necessary.

Following satisfactory completion of the subgrade preparation recommendations as described within the *SITE PREPARATION RECOMMENDATIONS* section of this report, a subgrade modulus (k) of 125 pounds per cubic inch (pci) may be used for design of floor slabs supported by native very stiff to hard and/or medium compact to compact granular soils.

As previously stated, the fill soils within the influence of the Wylie Elementary School addition are marginally suitable for support of floor slabs. Provided differential floor slab settlement can be tolerated and following satisfactory completion of the subgrade preparation recommendations as described within the *SITE PREPARATION RECOMMENDATIONS* section of this report, a subgrade modulus (k) of 100 pounds per cubic inch (pci) may be used for design of the Wylie Elementary School floor slab supported by native medium compact granular soils and/or engineered fill overlying the native granular/cohesive soils. If the existing fill is completely removed and replaced with engineered fill, a subgrade modulus (k) of 150 pounds per cubic inch (pci) may be used for design of the floor slab.

We recommend at least 4 inches of clean free-draining material, such as 2NS sand or 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 10-mil plastic sheeting, or equivalent, may be placed on the sand layer beneath floor slabs. However, additional floor slab curing techniques will be required especially if floor slab placement occurs in the winter months to prevent floor slab curling. The floor slab should be isolated from the foundation system to allow for independent movement.

BELOW-GRADE WALL RECOMMENDATIONS

We understand that the lower-level floor slab for the northwest addition at Dexter High School will be approximately 14 feet below the adjacent exterior grade. As such, we anticipate below-grade walls, up to 14 feet tall, will be constructed around the north, west, and eastern perimeter of the building addition.

Below-grade walls should be designed to withstand lateral earth pressures due to backfilled soils and adjacent surcharge loads. Below-grade walls considered to be fixed at the top should be designed on the basis of at-rest lateral earth pressures corresponding to an equivalent fluid pressure of 55 pounds per square foot per foot of depth for drained granular backfill soil.

Below-grade wall backfill should consist of MDOT Class II sand to improve the wall drainage. Lateral earth pressures are significantly influenced by the type and intensity of backfill compaction. We recommend thin lifts, approximately 6 inches in thickness, be placed and relatively small compaction equipment be used to compact backfill placed against below-grade walls.

We recommend a foundation drain system or weep holes be incorporated to maintain drained soil conditions. To prevent the development of hydrostatic pressures on below-grade foundation walls, a sub drain system should be installed at the foundation level. The perforated or slotted sub drains should be encased with at least 12-inches of clean gravel or pea gravel, and the gravel and pipe together should be wrapped with a suitable non-woven filter fabric, such as Mirafi 140N, to prevent the migration of surrounding soil fines into the gravel and drainpipe. The sub drain system should outlet water to the nearby catch basin.

CONSTRUCTION CONSIDERATIONS

Information regarding proposed utility inverts was unavailable at the time of this report; however, it is assumed that utilities will extend approximately 5 to 6 feet below finished grade. As described within this report, we anticipate foundation excavations will extend 3-1/2 to 8-1/2 feet below finished grade.

We anticipate caving and/or sloughing of the surficial granular soils during shallow foundation excavation operations. As such, the foundation contractor should come prepared to over-excavate and form foundation excavations. If earth formed foundations are utilized, we recommend foundation excavation and concrete placement operations be conducted on the same day to minimize potential for cave-ins or stormwater run-off into the open excavations.

In addition, we anticipate caving and/or sloughing of the granular soils during drilled shaft excavation operations. Therefore, the contractor should come to the site prepared to extend temporary telescopic steel casing to the bottom of the drilled shaft excavation to maintain a stable excavation during construction operations. Once drilling is completed to the design depth, reinforcing steel should be set and concrete placed until a positive head of concrete has been established within the casing. This positive concrete head should be maintained while pulling the casing to prevent sloughing of the granular soils into the fresh concrete. After concrete has been placed to an appropriate grade, the casing may be removed and concrete placement operations completed. The telescoped casing must be removed in the opposite order in which it is installed (i.e. – from the inside out).

To reduce lateral movement of the drilled pier foundation, the contractor must place the concrete for the pier in intimate contact with undisturbed soil. Fill any voids or enlargements in the drilled pier shaft excavation with concrete at the time of drilled pier concrete placement. We recommend using a concrete mix design with a slump of 5 to 7 inches for free fall placement to reduce the potential for concrete arching and provide a workable material.

We recommend using a short temporary top form, such as a sono tube, to form the top portion of the drilled pier. The use of this top form is a very beneficial aid to the correct placement and orientation of the anchor bolts.

In general, we do not anticipate significant accumulations of groundwater within the construction excavations anticipated for this project. However, groundwater intrusion may be encountered during excavation operations for the lower-level portion of the northwest addition at Dexter High School. We anticipate that any groundwater seepage or surface runoff can be controlled with a properly constructed system of sumps and pumps. If groundwater is required to be lowered more than 2 feet, we recommend that a system of shallow well-points be utilized.

We recommend maximum slope inclinations of 2H:1V within the very loose to loose cohesive soils, 1-1/2H:1V within the medium compact granular and medium cohesive soils, 1H:1V within the compact granular and stiff cohesive soils, and 3/4H:1V within the very stiff to hard cohesive soils for excavations extending below a depth of 5-feet. Where seepage from excavation cuts is observed, the slopes will need to be flattened sufficiently to achieve stability, but in no case left steeper than 3H:1V at and below the seepage level.

All excavations should be safely sheeted, shored, sloped, or braced in accordance with MI-OSHA requirements. If material is stored or equipment is operations near an excavation, lower angle slopes or stronger shoring must be used to resist the extra pressure due to the superimposed loads.

GENERAL COMMENTS

We have formulated the evaluations and recommendations presented in this report relative to site preparation and foundation construction on the basis of data provided to us relating to the project location and surface grade for the proposed site(s). 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 reviews the changes. G2 will then confirm the recommendations presented herein or make changes in writing.

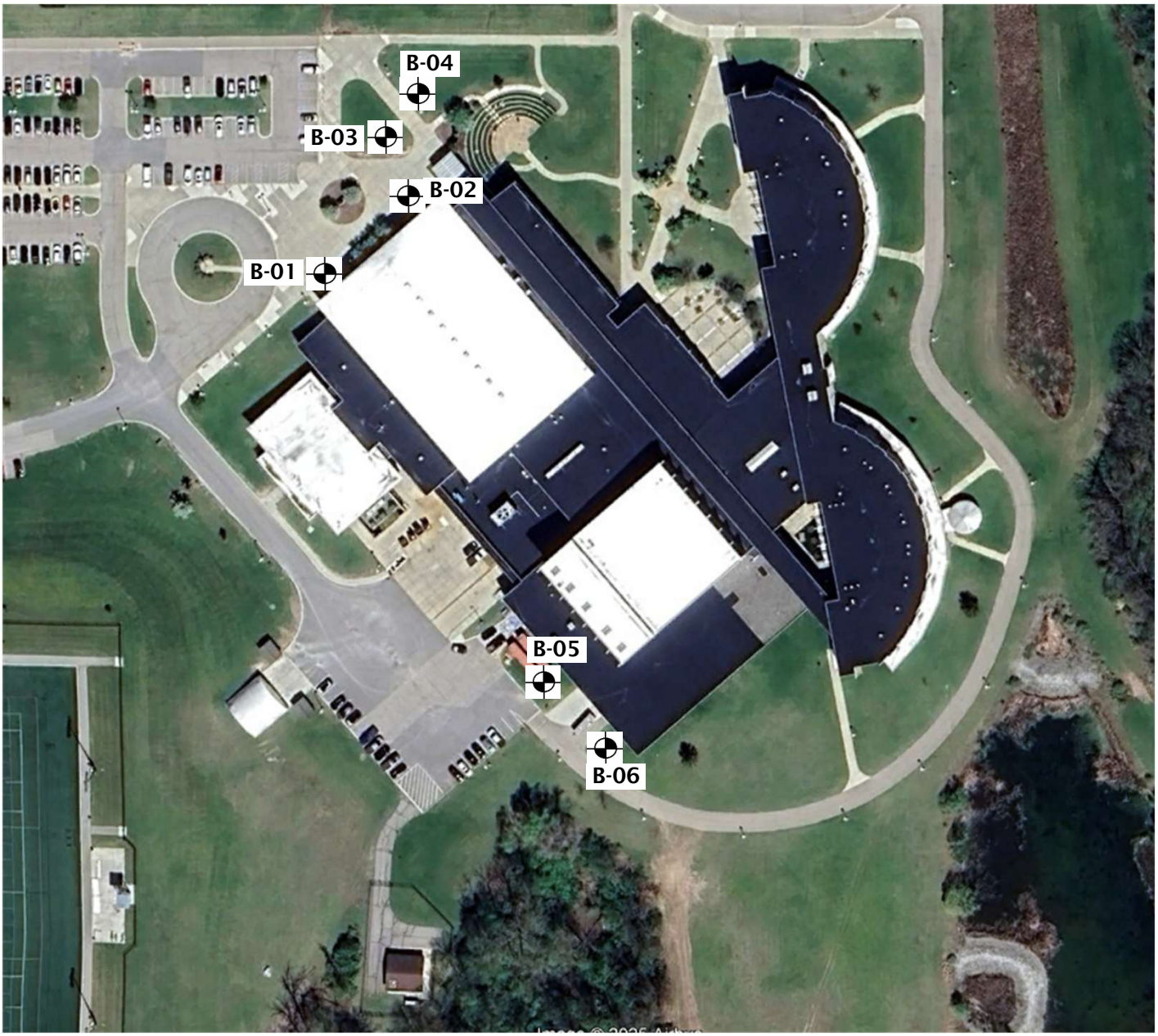
The scope of the present investigation was limited to evaluation of subsurface conditions for the support of proposed structures and other aspects of the proposed improvements. No chemical, environmental, or hydrogeological testing or analyses were included in the scope of this investigation.

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 Plans, Plate Nos. 1 through 4. This report does not reflect variations that may occur between the actual boring locations and the actual structure locations. 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 subgrade preparation, foundation construction, 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

SOIL BORING LOCATION PLANS	PLATE NOS. 1 THROUGH 4
SOIL BORING LOGS	FIGURE NOS. 1 THROUGH 20
UNCONFINED COMPRESSIVE STRENGTH TEST RESULTS	FIGURE NO. 21
GENERAL NOTES TERMINOLOGY	FIGURE NO. 22



Legend

Soil borings performed by 2G Drilling between August 26, 2025 and August 29, 2025

Notes

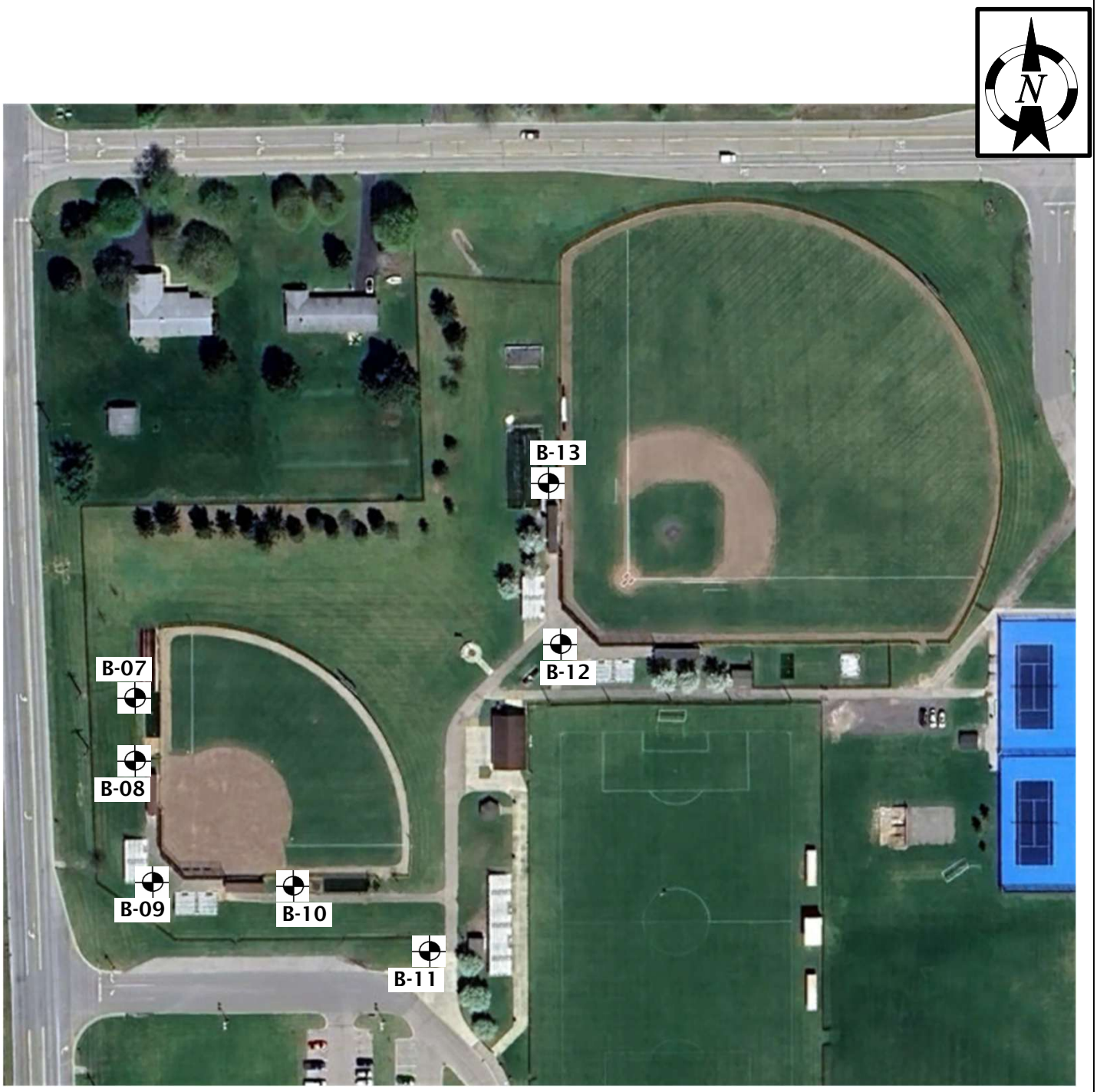
1. Soil borings B-01 through B-06 drilled to depths ranging from 25 to 45 feet.

Soil Boring Location Plan

2025 Dexter Bond Program
Dexter High School Additions
Dexter, Michigan 48130

2G CONSULTING GROUP

Project No. 253566	
Drawn by: TSH	
Date: 9/26/2025	Plate No. 1
Scale: NTS	



Legend

Soil borings performed by 2G Drilling between August 29, 2025 and September 9, 2025

Notes

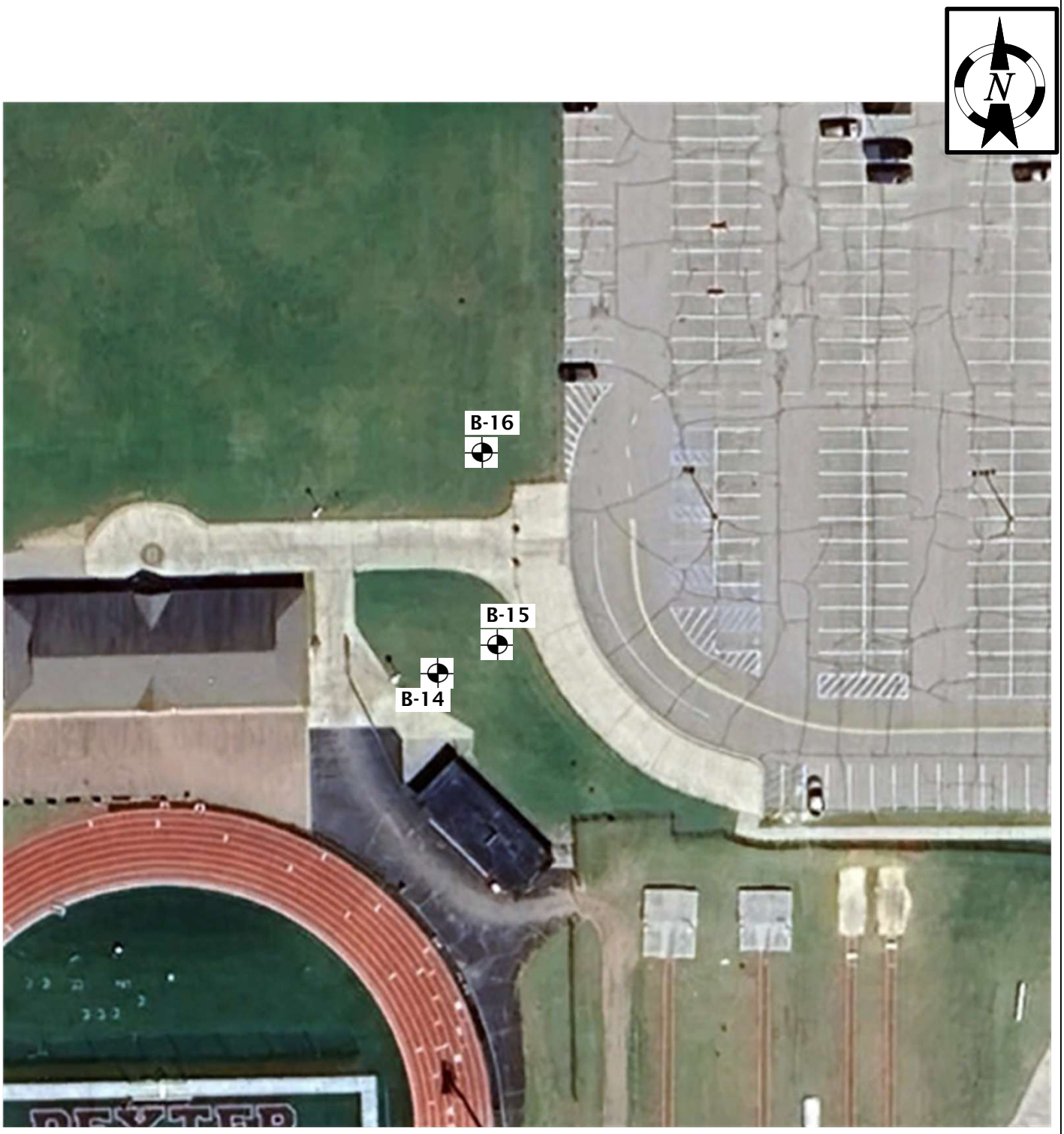
1. Soil borings B-07 through B-13 drilled to a depth of 10 feet each.

Soil Boring Location Plan

2025 Dexter Bond Program
Dexter High School Athletic Improvements
Dexter, Michigan 48130

2G CONSULTING GROUP

Project No. 253566	
Drawn by: TSH	
Date: 9/26/2025	Plate No. 2
Scale: NTS	



Legend

Soil borings performed by 2G Drilling on September 9, 2025

Notes

1. Soil borings B-14 through B-16 drilled to a depth of 10 feet each.

Soil Boring Location Plan

2025 Dexter Bond Program
Creekside Intermediate School
Dexter, Michigan 48130

2G CONSULTING GROUP

Project No. 253566	
Drawn by: TSH	
Date: 9/26/2025	Plate No. 3
Scale: NTS	



Legend

Soil borings performed by 2G Drilling on September 8, 2025

Notes

1. Soil borings B-17 through B-20 drilled to a depth of 25 feet each.

Soil Boring Location Plan

2025 Dexter Bond Program
Wylie Elementary School
Dexter, Michigan 48130

2G CONSULTING GROUP

Project No. 253566	
Drawn by: TSH	
Date: 9/26/2025	Plate No. 4
Scale: NTS	

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321468° Longitude: -83.895888°

Soil Boring No. B-01

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Portland Cement Concrete (4 inches) 0.3							
				S-01	7 6 12	18			
		Medium Compact Brownsih Gray Clayey Sand with trace silt and gravel							
5			5	S-02	6 11 17	28			
		7.5		S-03	4 7 7	14			
10			10	S-04	8 8 6	14	7.8		5500*
		Very Stiff Brown Sandy Clay with trace silt and gravel							
15			15	S-05	5 5 8	13	9.6		6500*
		19.0							
20		Very Stiff Brownish Gray Silty Clay with trace sand and gravel	20	S-06	6 8 16	24	12.2		4500*
		22.0							
25		Very Stiff to Hard Gray Silty Clay with trace gravel	25	S-07	6 8 16	24	19.3		5000*
		29.0		S-08A	7				9000*
30		Medium Compact to Compact Gray Sandy Silt with trace clay and gravel	30	S-08B	16 33	49			

Total Depth: 45 ft
Drilling Date: August 27, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
20 feet during drilling operations; 22 feet upon completion

Notes:
Borehole collapsed at 30 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings; topped with cold-patch asphalt

Figure No. 1a

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321468° Longitude: -83.895888°

Soil Boring No. B-01

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
35		Medium Compact to Compact Gray Sandy Silt with trace clay and gravel *(continued)*	35	S-09	20 15 20	35			
40			40	S-10	8 12 17	29			
45		42.0 Medium Compact Gray Clayey Sand with trace silt and gravel 45.0	45	S-11	8 13 16	29			
50		End of Boring @ 45 ft	50						
55			55						
60			60						

Total Depth: 45 ft
Drilling Date: August 27, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
20 feet during drilling operations; 22 feet upon completion

Notes:
Borehole collapsed at 30 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings; topped with cold-patch asphalt

Figure No. 1b

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321651° Longitude: -83.895591°

Soil Boring No. B-02

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Portland Cement Concrete (4 inches) 0.3							
		Fill: Brown Sand with trace gravel 1.0		S-01	2 1 2	3	12.9		4500*
5		Fill: Very Stiff Brownish Gray Sandy Clay with trace gravel; occasional sand seams and wood fragments	5	S-02	3 3 4	7	9.7		6500*
		6.0		S-03	3 2 3	5			
		Loose Brown Clayey Sand with trace gravel; occasional cobbles 8.0							
10			10	S-04	8 6 9	15	7.9		9000*
15		Hard Mottled Brown Silty Clay with trace sand and gravel	15	S-05	4 4 5	9	13.5		9000*
		19.0		S-06	6 6 5	11			
20		Medium Compact Gray Silt with trace sand; occasional sand seams	20						
		23.0		S-07	6 8 10	18			
25		Medium Compact Gray Silty Sand	25						
		29.0		S-08	8 13 26	39			
30		Compact to Very Compact Clayey Silt with trace sand and gravel	30						

Total Depth: 45 ft
Drilling Date: August 27, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings; topped with cold-patch asphalt

Figure No. 2a

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321651° Longitude: -83.895591°

Soil Boring No. B-02

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Compact to Very Compact Clayey Silt with trace sand and gravel *(continued)*							
		32.0							
35		Hard Brownish Gray Sandy Clay with trace silt and gravel	35	S-09	18 27 36	63	8.8		9000*
		37.0							
40		Hard Gray Silty Clay with trace sand and gravel	40	S-10	27 28 37	65	14.0		9000*
		41.0							
45		Very Compact Gray Sand with trace silt	45	S-11	46 50/4"	---			
		45.0							
		End of Boring @ 45 ft							
50			50						
55			55						
60			60						

Total Depth: 45 ft
Drilling Date: August 27, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during and upon completion of drilling operations

Notes:
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings; topped with cold-patch asphalt

Figure No. 2b

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321775° Longitude: -83.895663°

Soil Boring No. B-03

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	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							
		Stiff to Very Stiff Brown Sandy Clay with trace silt and gravel; occasional cobbles		S-01	11 10 9	19	13.0		3000*
5			5	S-02	5 4 4	8	11.5		4500*
		6.0							
		Loose Brown Silty Sand with trace clay and gravel		S-03	3 2 3	5			
		8.0							
10			10	S-04	12 46 21	67			
		Very Compact Brownish Gray Clayey Sand with trace silt and gravel; occasional sand seams							
		14.0							
15			15	S-05	2 5 6	11	20.1		4000*
		Very Stiff Brown Silty Clay with trace sand							
		▽ 19.0							
20			20	S-06	13 18 17	35			
		Compact Brown Silty Sand with trace clay and gravel							
		24.0							
25			25	S-07	13 16 15	31			
		Compact Gray Sand with trace silt and gravel							
		29.0							
30		Hard Gray Silty Clay with trace sand	30	S-08	20 48 48	96	7.0		9000*

Total Depth: 45 ft
Drilling Date: August 27, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
19 feet during drilling operations; wet cave at 6 feet upon removal of drilling augers

Notes:
Borehole collapsed at 6 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 3a

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321775° Longitude: -83.895663°

Soil Boring No. B-03

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Hard Gray Silty Clay with trace sand *(continued)*							
		34.0							
35			35	S-09	23 28 32	60			
		Very Compact Gray Silty Sand with trace clay and gravel							
		39.0							
40			40	S-10	32 43 50/5"	---	5.2		9000*
		Hard Gray Sandy Clay with trace silt and gravel							
		42.0							
		Compact Gray Sand with trace silt and gravel							
45		45.0	45	S-11	13 18 32	50			
		End of Boring @ 45 ft							
50			50						
55			55						
60			60						

Total Depth: 45 ft
Drilling Date: August 27, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
19 feet during drilling operations; wet cave at 6 feet upon removal of drilling augers

Notes:
Borehole collapsed at 6 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 3b

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321892° Longitude: -83.895559°

Soil Boring No. B-04

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	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							
				S-01	11 7 4	11			
5		Loose to Medium Compact Brown Clayey Sand with trace silt and gravel; occasional cobbles	5	S-02	5 6 4	10			
				S-03	4 3 10	13			
		8.0							
10			10	S-04	20 19 11	30			
		Medium Compact Brown Clayey Sand with trace silt and gravel; occasional cobbles							
15		▽	15	S-05	6 5 6	11			
		16.0							
		Medium Compact Brownish Gray Clayey Sand with trace silt and gravel		S-06	11 10 15	25			
20			20						
		22.0							
				S-07	15 37 39	76			
25			25						
		Very Compact Brown Silty Sand with trace clay and gravel							
				S-08	20 40 40	80	9.7		8000*
30		30.0	30						

Total Depth: 45 ft
Drilling Date: August 26, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
15 feet during drilling operations; wet cave at 30-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 30-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 4a

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.321892° Longitude: -83.895559°

Soil Boring No. B-04

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
35		Hard Brownish Gray Sandy Clay with trace gravel	35	S-09	12 16 18	34	8.1		9000*
		35.0							
40		Medium Compact Gray Gravelly Sand with trace clay	40	S-10	11 10 12	22			
		41.0							
45		Hard Gray Silty Clay with trace sand and gravel	45	S-11	21 31 40	71	6.9		9000*
		45.0							
50		End of Boring @ 45 ft	50						
55			55						
60			60						

Total Depth: 45 ft
Drilling Date: August 26, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
15 feet during drilling operations; wet cave at 30-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 30-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 4b

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.320458° Longitude: -83.895170°

Soil Boring No. B-05

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Sand (3 inches) 0.3							
		Compact Gray Silty Sand with trace clay and gravel; occasional cobbles		S-01	15 23 26	49			
		3.0		S-02	18 23 24	47			
5		Compact Brownish Gray Sand with trace silt and gravel; occasional cobbles	5	S-03	17 22 22	44			
		8.0		S-04	22 17 15	32			
10		Compact Reddish Brown Sand with trace silt and gravel; occasional cobbles	10	S-05	12 17 19	36			
		12.0							
		Compact Reddish Brown Clayey Sand with trace gravel		S-06	17 23 24	47			
15		15.0	15	S-07	12 19 21	40			
20		Compact Brown Sandy Gravel with trace clay	20						
25		25.0	25						
		End of Boring @ 25 ft							
30			30						

Total Depth: 25 ft
Drilling Date: August 28, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
12 feet during drilling operations; wet cave at 11-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 11-1/2 ft after auger removal

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 5

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.320283° Longitude: -83.894967°

Soil Boring No. B-06

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

- 0.2: Topsoil: Dark Brown Sand (2 inches)
- Medium Compact to Compact Brown Gravelly Sand with trace silt
- 12.0: ▽
- Compact Reddish Brown Gravelly Sand with trace silt and clay
- 17.0
- Compact Brown Gravelly Sand with trace silt and clay; occasional sand seams
- 22.0
- Compact Gray Sandy Gravel with trace silt and clay
- 25.0
- End of Boring @ 25 ft

SOIL SAMPLE DATA

DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
5	S-01	16 17 18	35			
	S-02	16 13 11	24			
10	S-03	7 7 7	14			
	S-04	8 6 5	11			
15	S-05	16 20 24	44			
20	S-06	6 18 23	41			
25	S-07	16 21 27	48			
30						

Total Depth: 25 ft
Drilling Date: August 29, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
12 feet during drilling operations; wet cave at 7-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7-1/2 ft after auger removal

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 6

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.323710° Longitude: -83.899201°

Soil Boring No. B-07

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PRO-FILE	DESCRIPTION	DEPTH (ft)
		Topsoil: Dark Brown Sandy Clay (2 inches)	0.2
		Hard Brown Sandy Clay with trace silt and gravel	3.0
5		Hard Brown Silty Clay with trace sand and gravel; occasional cobbles	5
			6.0
10		Very Compact Brown Silty Sand with trace gravel; occasional cobbles	10
			10.0
		End of Boring @ 10 ft	
15			15
20			20
25			25
30			30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 3 4	7	9.5		9000*
S-02	8 13 24	37	14.0		9000*
S-03	28 40 50/5"	---			
S-04	48 50/4"	---			

Total Depth: 10 ft
Drilling Date: September 2, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; dry cave at 7 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 7

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.323572° Longitude: -83.899196°

Soil Boring No. B-08

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	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 (3 inches) 0.3							
		Fill: Very Loose Dark Brown Clayey Sand with trace gravel		S-01	2 1 1	2			
		4.0							
5		Hard Gray Silty Clay with trace gravel	5	S-02	4 4 7	11	10.4		9000*
		7.0		S-03	12 18 18	36			
		Compact Gray Sandy Silt with trace clay and gravel 9.0							
10		Very Compact Brown Sand with trace silt and gravel 10.0	10	S-04	24 33 36	69			
		End of Boring @ 10 ft							
15			15	S-05					
20			20	S-06					
25			25	S-07					
30			30						

Total Depth: 10 ft
Drilling Date: September 2, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; dry cave at 6-3/4 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 8

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.323265° Longitude: -83.899153°

Soil Boring No. B-09

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

Topsoil: Dark Brown Sandy Clay (2 inches) — 0.2

Hard Brown Sandy Clay with trace silt and gravel — 3.0

Very Stiff Mottled Brown and Gray Silty Clay with trace sand and gravel — 6.5

Loose Brown Silt with trace clay and sand — 9.0

Hard Gray Silty Clay with trace gravel — 10.0

End of Boring @ 10 ft

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	4 2 6	8	13.6		9000*
S-02	4 5 6	11	11.1		7000*
S-03	4 2 7	9			
S-04	5 6 6	12	10.3		9000*

Total Depth: 10 ft
Drilling Date: September 2, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; dry cave at 8 feet upon removal of drilling augers

Notes:
Borehole collapsed at 8 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 9

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.323254° Longitude: -83.898674°

Soil Boring No. B-10

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Sandy Clay (5 inches) 0.4	
		Hard Brown Silty Clay with trace sand and gravel 4.5	
5		Medium Compact Brown Sand with trace clay and gravel 5.0	5
		Medium Compact Brown Clayey Sand with trace silt and gravel 7.5	
10		Medium Compact Brown Sand with trace clay and gravel 10.0	10
		End of Boring @ 10 ft	
15			15
20			20
25			25
30			30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 4 6	10	14.5		9000*
S-02A	20 6		21.7		9000*
S-02B	9	15			
S-03	7 9 14	23			
S-04	10 11 16	27			

Total Depth: 10 ft
Drilling Date: September 9, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during dirlling operations; dry cave at 8-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 8-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 10

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.323073° Longitude: -83.898231°

Soil Boring No. B-11

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Medium Compact Brown Clayey Sand with trace silt and gravel		S-01	10 14 12	26			
		3.0							
5		Loose Brown Sand with trace silt and gravel	5	S-02	5 4 6	10			
		5.0							
		Very Stiff Brownish Gray Sandy Clay with trace silt and gravel		S-03	5 5 6	11	9.8		6000*
10		10.0	10	S-04	3 6 4	10	8.3		7000*
		End of Boring @ 10 ft							
15			15						
20			20						
25			25						
30			30						

Total Depth: 10 ft
Drilling Date: September 2, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; dry cave at 7-1/4 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 11

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.323859° Longitude: -83.897777°

Soil Boring No. B-12

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

- 0.3: Topsoil: Dark Brown Sand (4 inches)
- Fill: Loose to Medium Compact Brown Clayey Sand with trace silt and gravel
- 7.0: Fill: Very Stiff Gray Sandy Clay with trace silt and gravel; occasional roots (Organic Matter Content = 10.1%)
- 8.5: Hard Gray Silty Clay with trace sand and gravel
- 10.0: End of Boring @ 10 ft

SOIL SAMPLE DATA

DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
5	S-01	4 3 3	6			
	S-02	6 5 8	13			
	S-03	6 9 9	18	10.3		5000*
10	S-04	6 10 12	22	7.2		9000*

Total Depth: 10 ft
Drilling Date: August 29, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
6 feet during drilling operations; wet cave at 8 feet upon removal of drilling augers

Notes:
Borehole collapsed at 8 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 12

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.324221° Longitude: -83.897820°

Soil Boring No. B-13

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

- 0.3: Topsoil: Dark Brown Sandy Clay (3-1/2 inches)
- Hard Brown Silty Clay with trace sand and gravel
- 3.5: Medium Compact Brown Sand with trace silt and clay
- 7.0: Very Stiff Brownish Gray Silty Clay with trace sand and gravel
- 9.0: Hard Gray Silty Clay with trace gravel
- 10.0: End of Boring @ 10 ft

SOIL SAMPLE DATA

DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
0	S-01	2 2 5	7	12.9		9000*
5	S-02	4 8 9	17			
	S-03	5 7 8	15	11.6		5000*
10	S-04	5 8 14	22	7.1		9000*

Total Depth: 10 ft
Drilling Date: August 29, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
7 feet during drilling operations; wet cave at 7-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 13

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.327094° Longitude: -83.889376°

Soil Boring No. B-14

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Sand (2 inches) 0.2	
		Very Loose Brown Clayey Sand with trace silt and gravel	
		3.0	
		Medium Compact Brown Silty Sand with trace gravel	
5		4.5	5
		Hard Brown Silty Clay with trace sand and gravel	
10		10.0	10
		End of Boring @ 10 ft	
15			15
20			20
25			25
30			30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 2 2	4			
S-02	9 13 15	28			
S-03	4 5 6	11	9.5		9000*
S-04	5 9 10	19	10.5		8500*

Total Depth: 10 ft
Drilling Date: September 9, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; dry cave at 7-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 14

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.327125° Longitude: -83.889265°

Soil Boring No. B-15

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PRO-FILE		DEPTH (ft)
		Topsoil: Dark Brown Sand (2 inches) — 0.2	
		Fill: Loose Dark Brown Clayey Sand with trace silt and gravel	
		— 4.0	
5		Fill: Loose Brown Sand with trace silt and gravel; occasional clay clods	5
		— 6.0	
		Hard Gray Silty Clay with trace sand and gravel	
		— 9.5	
10		Medium Compact Gray Sand with trace clay and gravel — 10.0	10
		End of Boring @ 10 ft	
15			15
20			20
25			25
30			30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	3 4 2	6			
S-02	2 3 4	7			
S-03	3 6 8	14	9.8		9000*
S-04	4 8 11	19			

Total Depth: 10 ft
Drilling Date: September 9, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; wet cave at 8 feet upon removal of drilling augers

Notes:
Borehole collapsed at 8 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 15

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.327343° Longitude: -83.889315°

Soil Boring No. B-16

CONSULTING GROUP

SUBSURFACE PROFILE				SOIL SAMPLE DATA					
DEPTH (ft)	PRO-FILE	GROUND SURFACE ELEVATION: N/A	DEPTH (ft)	SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
		Topsoil: Dark Brown Sand (2 inches) 0.2							
		Fill: Loose Dark Brown Clayey Sand with trace silt and gravel		S-01	5 4 4	8			
5			5	S-02	7 7 3	10			
		6.0							
		Very Stiff Brown Silty Clay with trace gravel		S-03	3 2 2	4	9.5		4500*
		9.0							
10		Hard Gray Sandy Clay with trace silt and gravel 10.0	10	S-04	6 9 9	18	8.0		9000*
		End of Boring @ 10 ft							
15			15						
20			20						
25			25						
30			30						

Total Depth: 10 ft
Drilling Date: September 9, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
Dry during drilling operations; dry cave at 7-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 7-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 16

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.328801° Longitude: -83.882207°

Soil Boring No. B-17

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PRO-FILE	SUBSURFACE PROFILE	DEPTH (ft)
		Topsoil: Dark Brown Clayey Sand (2 inches) — 0.2	
		Fill: Loose Brown Clayey Sand with trace silt — 3.0	
5		Fill: Stiff Brown Silty Clay with trace sand and gravel; occasional roots and grass blades (Organic Matter Content = 3.7%) — 7.0	5
10		Medium Compact Brown Silty Sand with trace clay — 9.0	10
15		Medium Compact to Compact Brown Sand with trace clay and gravel; occasional clay seams	15
20		▽ — 19.5	20
25		Compact to Very Compact Brown Clayey Sand with trace silt and gravel — 25.0	25
30		End of Boring @ 25 ft	30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	5 4 4	8			
S-02	1 2 2	4	15.8		2500*
S-03	5 6 8	14			
S-04	11 11 11	22			
S-05	8 16 26	42			
S-06	19 22 24	46			
S-07	43 50/5"	---			

Total Depth: 25 ft
Drilling Date: September 8, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
19-1/2 feet during drilling operations; wet cave at 18-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 18-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 17

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.328782° Longitude: -83.881990°

Soil Boring No. B-18

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PROFILE	DESCRIPTION	DEPTH (ft)
		Topsoil: Dark Brown Sandy Clay (2 inches)	0.2
		Medium Compact Brown Clayey Sand with trace silt and gravel	3.0
5		Stiff Brown Sandy Clay with trace silt	5
			7.0
		Very Loose Brown Silty Sand with trace gravel; occasional clay clods	9.0
10		Medium Compact Brown Clayey Sand with trace silt and gravel	10
			12.0
15		Very Compact Brown Clayey Sand with trace silt and gravel	15
			18.0
20		Very Compact Brown Sand with trace silt and gravel	20
			23.0
25		Hard Brown Silty Clay with trace sand; occasional cobbles	25.0 25
		End of Boring @ 25 ft	
30			30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	12 11 9	20			
S-02	1 1 2	3	15.0		3500*
S-03	0 2 2	4			
S-04	5 10 19	29			
S-05	21 28 38	66			
S-06	23 26 31	57			
S-07	43 50/4"	---	10.4		9000*

Total Depth: 25 ft
Drilling Date: September 8, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
18 feet during drilling operations; wet cave at 19 feet upon removal of drilling augers

Notes:
Borehole collapsed at 19 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 18

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.328620° Longitude: -83.881992°

Soil Boring No. B-19

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PRO-FILE	DESCRIPTION	DEPTH (ft)
		Topsoil: Dark Brown Sand (5 inches)	0.4
		Fill: Hard Dark Brown Sandy Clay with trace gravel	2.5
5		Fill: Medium Compact Dark Brown Clayey Sand with trace silt	5
			7.0
10		Stiff to Very Stiff Brown Silty Clay with trace sand	10
			12.0
15		Compact Brown Clayey Sand with trace silt and gravel; occasional cobbles	15
20			20
			22.0
25		Very Compact Brown Sand with trace silt and gravel; occasional cobbles and boulders	25
			25.0
30		End of Boring @ 25 ft	30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	14 12 5	17	11.0		9000
S-02	4 1 10	11			
S-03	1 1 3	4	16.5		3000
S-04	0 1 2	3	14.9		5000
S-05	6 15 20	35			
S-06	21 22 17	39			
S-07	31 50/4"	---			

Total Depth: 25 ft
Drilling Date: September 8, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

Water Level Observation:
24-1/2 feet during drilling operations; wet cave at 22-1/2 feet upon removal of drilling augers

Notes:
Borehole collapsed at 24-1/2 ft after auger removal

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 19

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No. 253566

Latitude: 42.328626° Longitude: -83.882205°

Soil Boring No. B-20

CONSULTING GROUP

SUBSURFACE PROFILE

GROUND SURFACE ELEVATION: N/A

DEPTH (ft)	PROFILE		DEPTH (ft)
		Topsoil: Dark Brown Sand (2 inches) — 0.2	
		Very Loose Brown Silty Sand — 3.0	
5		Medium Brown Sandy Clay with trace silt and gravel — 5.5	5
		Very Stiff Brown Silty Clay with trace sand and gravel — 8.0	
10			10
15		Compact Brown Silty Sand with trace gravel; occasional cobbles — 18.0	15
20			20
		Compact Brown Clayey Sand with trace gravel — 24.0	
25		Stiff Brownish Gray Silty Clay with trace sand and gravel — 25.0	25
		End of Boring @ 25 ft	
30			30

SOIL SAMPLE DATA

SAMPLE TYPE-NO.	BLOWS/ 6-INCHES	STD. PEN. RESISTANCE (N)	MOISTURE CONTENT (%)	DRY DENSITY (PCF)	UNCONF. COMP. STR. (PSF)
S-01	1 2 2	4			
S-02	2 2 3	5	11.1	116	1210
S-03	13 16 15	31	11.1		4000*
S-04	8 19 20	39			
S-05	9 20 20	40			
S-06	15 20 25	45			
S-07	29 40 50/3"	---	9.2		3500*

Total Depth: 25 ft
Drilling Date: September 8, 2025
Inspector:
Contractor: 2G Drilling
Driller: Q. Tores

Drilling Method:
2-1/4-inch inside-diameter hollow-stem augers

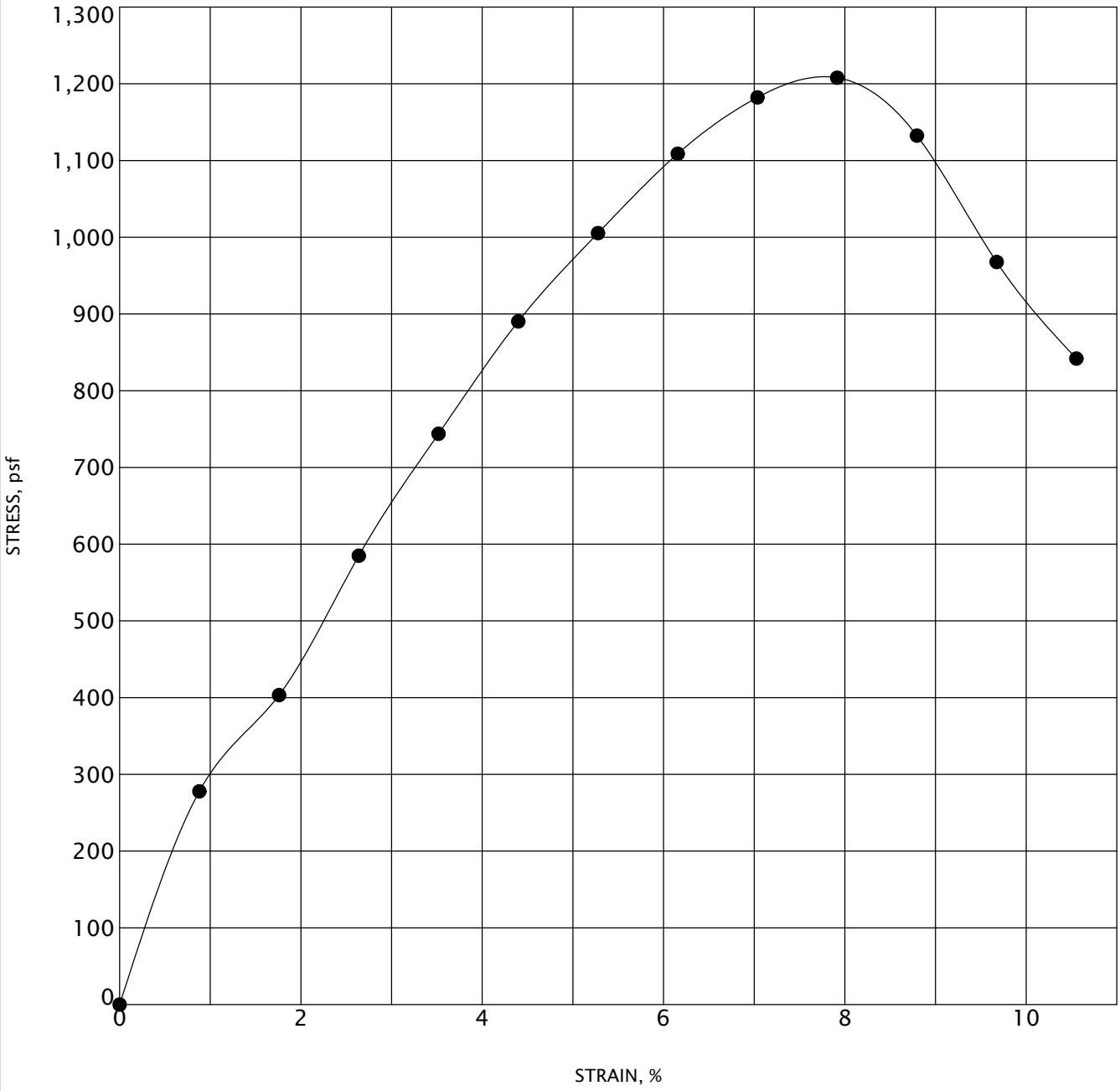
Water Level Observation:
23-1/2 feet during drilling operations; wet cave at 20 feet upon removal of drilling augers

Notes:
Borehole collapsed at 23-1/2 ft after auger removal
* Calibrated Hand Penetrometer

Excavation Backfilling Procedure:
Borehole backfilled with auger cuttings

Figure No. 20

SOIL / PAVEMENT BORING 253566.GPJ 20150116 G2 CONSULTING DATA TEMPLATE.GDT 10/13/25



Specimen		Classification	MC%	γ_d	UC
● B-20	S-02	Medium Brown Sandy Clay	11	116	1210

CONSULTING GROUP

UNCONFINED COMPRESSIVE STRENGTH TEST

Project Name: Dexter Schools 2025 Bond Program

Project Location: Dexter, Michigan

G2 Project No.: 253566

Figure No. 21

US_UNCONFINED 253566.GPJ 20140820 G2 CONSULTING DATA TEMPLATE.GDT 9/18/25

GENERAL NOTES TERMINOLOGY

Unless otherwise noted, all terms herein refer to the Standard Definitions presented in ASTM D 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, et

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).