PROJECT MANUAL

Smallwood State Park

Grinder House Renovation

Charles County, Maryland
2750 Sweden Point Road
Marbury, MD 20658

For the Department of Natural Resources

Z|S Project Number - 23021
DGS Project Number - P-030-221-010

Project Classification Code Class D

The John Grinder House is considered a historic building, as a Determination of Eligibility has been prepared and is currently in the process of being issued (2018 CH-359 MHT DOE FORM, Revised).

BID AND CONSTRUCTION DOCUMENTS SUBMISSION
26 September 2025

STATE OF MARYLAND

DEPARTMENT OF GENERAL SERVICES
Atif Chaudhry, Secretary
301 West Preston Street, Room 1405
Baltimore, MD 21201

BOARD OF PUBLIC WORKS
Wes Moore, Governor
Brooke E. Lierman, Comptroller
Dereck E. Davis, Treasurer

MINORITY BUSINESS ENTERPRISES ARE ENCOURAGED TO RESPOND TO THIS SOLICITIATION

Mechanical/Electrical Engineer: James Posey Associates
Civil Engineer: A. Morton Thomas and Associates, Inc.
Structural Engineer: Albrech Engineering, Inc.

ZIGER | SNEAD ARCHITECTS

1006 Morton Street
Baltimore, Maryland 21201
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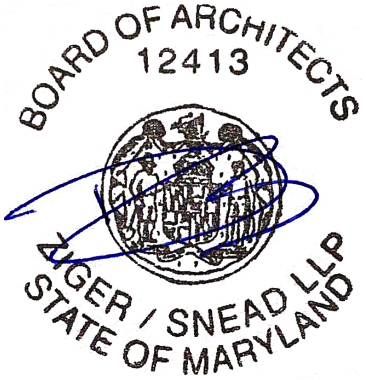
PROFESSIONAL TEAM

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Ziger|Snead Architects
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MEP ENGINEER
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Baltimore, MD 21117
410-265-6100



The Contract Documents for the indicated public improvement were prepared under my supervision and, to the best of my knowledge, information and belief, they comply with the relevant building codes of the State of Maryland.

Signature Date 03/28/2025
License No. 12413 Expiration Date 02/28/2026



I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

Signature _____ Date 03/28/2025
License No. 32561, Expiration Date 01/06/2026



I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

Signature __ _____ Date _3__/_24__/__2025____
License No. __23393_____, Expiration Date _8 __/_25__/__2026____



I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

Signature Thomas M Clippinger Date 03/28/2025

License No. 32060 Expiration Date 06/22/2027



I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

Signature Jeffrey S. Caldwell Date 3/25/2025

License No. 25280, Expiration Date 2/2/2027

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SECTION 01 1000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Work performed by Owner.
4. Multiple Work Packages.
5. Owner-furnished/Contractor-installed (OFCI) products.
6. Owner-furnished/Owner-installed (OFOI) products.
7. Contractor's use of site and premises.
8. Coordination with occupants.
9. Work restrictions.
10. Specification and Drawing conventions.
11. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.2 DEFINITIONS

A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.3 PROJECT INFORMATION

A. Project Identification: Smallwood State Park : Grinder House Renovation

1. Project Location: 2750 Sweden Point Road, Marbury, MD 20658.

B. Owner: Department of General Services, 301 West Preston Street, Room 1405, Baltimore, MD 21201.

C. Architect: Ziger Snead Architects, 1006 Morton Street, Baltimore, MD 21201.

D. Architect's Consultants: Architect has retained the following design professionals, who

have prepared designated portions of the Contract Documents:

1. Structural Engineer: Albrecht Engineering Inc, 3500 Boston Street, Suite 329, MS012, Baltimore, MD 21224
2. Civil Engineer: AMT Engineering, Inc. 700 King Farm Blvd, Suite 300, Rockville, MD 20850
3. MEP Engineer: James Posey Associates, 11155 Red Run Blvd, Suite 310, Baltimore, MD 21117

E. Web-Based Project Software: Project software will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for using web-based Project software.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:

1. The scope of work includes converting the former residence into a small park office. This involves replacing the roof structure and adding a new roof, replacing all the exterior doors and windows, furring out the interior face of the exterior wall and adding insulation to the walls and roof. All new interior finishes will be added.

   Building systems will be added including heating and cooling, electrical, lighting and water supply. A small kitchenette serves the breakroom.

   Sitework includes a restored gravel drive, an ADA parking space, brick walks and site lighting.

B. Type of Contract:

1. Project will be constructed under a single prime contract.

1.5 WORK PERFORMED BY OWNER

A. Cooperate fully with Owner, so work may be carried out smoothly, without interfering with or delaying Work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.

B. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory Work under this Contract.

1. Furnishings within Grinder House will be provided by the owner. Coordinate any built-in requirements, to include but not to be limited to blocking, reinforcements,

and/or permanent attachments to the building's structure..

1.6 CONTRACTOR'S USE OF SITE AND PREMISES

A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

1. Limits on Use of Site: Confine construction operations to areas identified by owner and within bounds of Limits of Disturbance as outlined in Contract Documents.
2. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to **40 feet** beyond building perimeter; **15 feet** beyond surface walkways, patios, surface parking, and utilities; and **25 feet** beyond constructed areas with permeable surfaces that require additional staging areas to limit compaction in the constructed areas.

C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.7 COORDINATION WITH OCCUPANTS

A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and authorities having jurisdiction.
2. Provide not less than 72 hours' notice to Owner of activities that will affect Owner's operations.

B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not

interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.8 WORK RESTRICTIONS

A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.

B. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:

1. Notify Owner not less than two days in advance of proposed utility interruptions.
2. Obtain Owner's written permission before proceeding with utility interruptions.

C. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.

1. Notify Owner not less than two days in advance of proposed disruptive operations.
2. Obtain Owner's written permission before proceeding with disruptive operations.

D. Nonsmoking Building: Smoking is not permitted within the building or within **25 feet** of entrances, operable windows, or outdoor-air intakes.

E. Smoking and Controlled Substance Restrictions: Use of tobacco products , alcoholic beverages, and other controlled substances on Owner's property is not permitted.

1.9 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used

in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
2. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.

C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

D. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
2. Abbreviations: Materials and products are identified by abbreviations scheduled on Drawings, and, published as part of the U.S. National CAD Standard.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

SECTION 01 2100 - ALLOWANCES

PART 1 - GENERAL

1.1 SUMMARY

Section includes administrative and procedural requirements governing allowances.

A. Types of allowances include the following:

Lump-sum allowances.

Related Requirements:

Department of General Services, General Conditions for Construction Contracts.

1.2 SELECTION AND PURCHASE

At the earliest practical date after award of the Contract, advise Architect of the date when final selection, or purchase and delivery, of each product or system described by an allowance must be completed by the Owner to avoid delaying the Work.

A. At Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

B. Purchase products and systems selected by Architect from the designated supplier.

1.3 ACTION SUBMITTALS

Submit proposals for purchase of products or systems included in allowances in the form specified for Change Orders.

1.4 INFORMATIONAL SUBMITTALS

Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

A. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

B. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 LUMP-SUM ALLOWANCES

Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.

A. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials ordered by Owner or selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

1.6 ADJUSTMENT OF ALLOWANCES

Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.

Include installation costs in purchase amount only where indicated as part of the allowance.

1. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other markups.
2. Submit substantiation of a change in scope of Work, if any, claimed in Change Orders related to unit-cost allowances.
3. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.

Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of Work has changed from what could have been foreseen from information in the Contract Documents.

4. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

Allowance No.1 – Historic Brick Unit Masonry Repair. Allow for 15% of overall area of elevations on both interior and exterior wythes. See drawings for additional information.

A. Allowance No. 2 – Historic Brick Unit Masonry Repointing. Allow for 25% of overall of elevations on both interior and exterior wythes. See drawings for additional information.

END OF SECTION 01 2100

SECTION 01 2200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

1.2 DEFINITIONS

A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

A. Unit prices include, but not necessarily limited to, all necessary material, plus cost for delivery, installation, insurance, overhead, and profit as required for a complete installation in accordance with the specified work.

Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

1.4 AUTHORITY

A. Measurement methods delineated in the individual Specifications Section compliment criteria of this Section.

Take all measurements and computed quantities. The Owner's representative shall verify measurements and quantities.

Assist Owner's Representative by providing necessary equipment, workers, and survey personnel as required.

1.5 MATERIAL QUANTITIES

A. Quantities and measurements supplied or placed in the Work will be verified by the Owner's Representative and shall determine payment.

If the actual Work requires more or fewer quantities than those quantities indicated, provide required quantities at the Unit Sum/Prices contracted.

Inspection: Inspect products covered by the Allowance promptly upon delivery for damage or defects.

Preparation: Coordinate materials and their installation for each Allowance with related materials and installations to ensure that each Allowance item is completely integrated with related construction activities.

Material Quantities:

1. Include in the Contract Sum all material quantities defined in the Contract Documents. No portion of the Material Allowances shall be utilized without approval from the Owner.

Quantities: Where the Allowance is stated as for certain quantity:

a. The Contract Sum will be considered to include quantity indicated.

Actual quantities will be determined by measurement, and the Contract Sum wil be adjusted by Change Order using the Unit Price stated.

At the Owner's request, prior to, or at the Project Closeout's Final Payment; credit the remaining unused material quantity amounts to the Owner by Change Order.

1.6 MEASUREMENT OF QUANTITIES

A. Measurement by Area: Measured by square dimension using mean length and width or radius.

Linear Measurement: Measured by linear dimension, at item centerline or mean chord.

1.7 PAYMENT

A. Unit Prices:

1. Indicate the Unit Price as well as the extended cost (total cost) for each Item on the Bid Form.

The Owner reserves right to reject the Contractor's measurement of work-in-place that involves use of established unit prices, and to have this Work measured by independent surveyour acceptable to the Contractor at the Owner's expense.

The Accepted Unit Prices will be included in the Agreement.

B. Payment includes: Full compensation for all required labor, supervision, Products, tools, equipment, plant, transportation, services and incidentals, erection, application or installation of the Item of the Work; overhead and profit.

Final payment for the Work governed by the Unit prices will be made on basis of actual measurements and quantities verified by the Owner's Representative and accepted by the Architect/Engineer multiplied by the Unit sum/Price for Work which is incorporated in or made necessary by the Work.

1.8 DEFECT ASSESSMENT

A. Replace the Work, or portions of the Work, not conforming to specified requirements.

If, in opinion of the Architect/Engineer, it is not practical to remove and replace the Work, the Architect/Engineer will direct one of the following remedies:

1. The defective Work may remain, but the Unit Sum/Price will be adjusted to new sum/price at discretion of the Architect/Engineer.

The defective Work will be partially repaired to instruction of the Architect/Engineer, and the Unit Sum/Price will be adjusted to new sum/price at discretion of the Architect/Engineer.

B. The individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.

Authority of the Architect/Engineer to assess defect and identify payment adjustment is final.

1.9 NON-PAYMENT FOR REJECTED PRODUCTS

A. Payment will not be made fro any of the following.

1. Products wasted or disposed of in manner that is not acceptable.

Products determined as unacceptable before or after placement.
Products placed beyond lines and levels of the required work.
Products remaining on hand after completion of the Work.
Loading, hauling, and disposing of the rejected Products.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF UNIT PRICES

A. "Unit Price No. 01 -: Historic Brick Unit Masonry Repair

1. Description: Per Section 04 032 " Historic Brick Unit Masonry Repair" provide all required labor and material, to repair and make good damaged or missing brickwork.

Unit of Measurement: **Square Feet**.
Quantity: ~476 SF, See Architectural Elevations

B. "Unit Price No. 02 -: Historic Brick Unit Masonry Repointing

1. Description: Per Section 04 0323 " Historic Brick Unit Masonry Repointing", provide all required labor and material, to repair and make good damaged or missing brickwork.
2. Unit of Measurement: **Square Feet**

Quantity: ~286 SF, See Architectural Elevations

END OF SECTION 01 2200

SECTION 01 2500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.

1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Substitution Request Form: Use form provided in Project Manual.
2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

a. Statement indicating why specified product or fabrication or installation

method cannot be provided, if applicable.

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

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

    a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
    b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

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

1.6 PROCEDURES

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

1.7 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

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

B. Substitutions for Convenience:

1. Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

a. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

   1) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
   2) Requested substitution does not require extensive revisions to the Contract Documents.
   3) Requested substitution is consistent with the Contract Documents and will produce indicated results.
   4) Requested substitution provides sustainable design characteristics that specified product provided.
   5) Substitution request is fully documented and properly submitted.
   6) Requested substitution will not adversely affect Contractor's construction schedule.
   7) Requested substitution has received necessary approvals of authorities having jurisdiction.
   8) Requested substitution is compatible with other portions of the Work.
   9) Requested substitution has been coordinated with other portions of the Work.
   10) Requested substitution provides specified warranty.
   11) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

B. Related Requirements:

1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work. Contractor will review said changes and indicate if these changes will result in a change to the contract sum or contract time and will provide additional information about these changes for review by Architect and Owner. .

1.4 PROPOSAL REQUESTS

A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.

1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
2. Within time specified in Proposal Request, or, 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.

a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
c. Include costs of labor and supervision directly attributable to the change.
d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
e. Quotation Form: Use forms acceptable to Architect.

B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Change Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701or form acceptable to the Owner and Architect.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

A. Related Requirements:

Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.

1. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.

Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:

Application for Payment forms with continuation sheets.

a. Submittal schedule.
b. Items required to be indicated as separate activities in Contractor's construction schedule.

Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

2. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.

Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

Identification: Include the following Project identification on the schedule of values:

Project name and location.
a. Name of Architect.
b. Architect's project number.
c. Contractor's name and address.
d. Date of submittal.

Arrange schedule of values consistent with format of AIA Document G703.

4. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:

Related Specification Section or Division.
a. Description of the Work.
b. Name of subcontractor.
c. Name of manufacturer or fabricator.
d. Name of supplier.
e. Change Orders (numbers) that affect value.
f. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.

Labor.
1) Materials.
2) Equipment.

Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.

5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.

Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.

7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.

Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.

Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

A. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as form for Applications for Payment.

B. Application for Payment Forms: Use forms acceptable to Architect and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.

C. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.

Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.

1. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
3. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.

4. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
5. Provide summary documentation for stored materials indicating the following:

Value of materials previously stored and remaining stored as of date of previous Applications for Payment.

a. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.

b. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

Transmittal: Submit three signed and notarized original copies of each Application for Payment to by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.

Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:

List of subcontractors.

6. Schedule of values.
7. BCGBS submittal for project materials cost data.
8. Contractor's construction schedule (preliminary if not final).
9. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
10. Products list (preliminary if not final).
11. BCGBS action plans.
12. Schedule of unit prices.
13. Submittal schedule (preliminary if not final).
14. List of Contractor's staff assignments.
15. List of Contractor's principal consultants.
16. Copies of building permits.
17. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
18. Initial progress report.
19. Report of preconstruction conference.
20. Certificates of insurance and insurance policies.
21. Performance and payment bonds.
22. Data needed to acquire Owner's insurance.

Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.

23. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:

Evidence of completion of Project closeout requirements.

24. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
25. Updated final statement, accounting for final changes to the Contract Sum.
26. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."

27. AIA Document G706A, "Contractor's Affidavit of Release of Liens."
28. AIA Document G707, "Consent of Surety to Final Payment."
29. Evidence that claims have been settled.
30. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:

1. General coordination procedures.
2. Coordination drawings.
3. RFIs.
4. Digital project management procedures.
5. Web-based Project management software package.
6. Project meetings.

B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.

C. Related Requirements:

1. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

A. BIM: Building Information Modeling.

B. RFI: Request for Information. Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:

1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.

1. Post copies of list in Project meeting room, in temporary field office, in web-based Project software directory, and in prominent location in each built facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
3. Make adequate provisions to accommodate items scheduled for later installation.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.

1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Contractor's construction schedule.
2. Preparation of the schedule of values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.

1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

    a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    b. Coordinate the addition of trade-specific information to coordination drawings in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    c. Indicate required installation sequences.

B. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format:

    a. Same digital data software program, version, and operating system as original Drawings.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format.
3. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.

    a. Architect makes no representations as to the accuracy or completeness of

digital data files as they relate to Drawings.

b. Contractor shall execute a data licensing agreement in the form of AIA Document C106,Agreement form acceptable to Owner and Architect.

1.7 REQUEST FOR INFORMATION (RFI)

A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Owner name.
3. Owner's Project number.
4. Name of Architect.
5. Architect's Project number.
6. Date.
7. Name of Contractor.
8. RFI number, numbered sequentially.
9. RFI subject.
10. Specification Section number and title and related paragraphs, as appropriate.
11. Drawing number and detail references, as appropriate.
12. Field dimensions and conditions, as appropriate.
13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
14. Contractor's signature.
15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.

1. Attachments shall be electronic files in PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following Contractor-generated RFIs will be returned without action:

    a. Requests for approval of submittals.
    b. Requests for approval of substitutions.
    c. Requests for approval of Contractor's means and methods.
    d. Requests for coordination information already indicated in the Contract Documents.
    e. Requests for adjustments in the Contract Time or the Contract Sum.
    f. Requests for interpretation of Architect's actions on submittals.
    g. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect of additional information.
3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."

    a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:

1. Project name.
2. Name and address of Contractor.
3. Name and address of Architect.
4. RFI number, including RFIs that were returned without action or withdrawn.
5. RFI description.
6. Date the RFI was submitted.
7. Date Architect's response was received.
8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

A. Use of Architect's Digital Data Files: Digital data files of Architect's BIM model, CAD drawings will be provided by Architect for Contractor's use during construction.

1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project Record Drawings.

2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
3. Contractor shall execute a data licensing agreement in the form of AIA Document C106 Digital Data Licensing Agreement form acceptable to Owner and Architect.

    a. Subcontractors and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of AIA Document C106,Agreement acceptable to Owner and Architect.

4. The following digital data files will be furnished for each appropriate discipline:

    a. Floor plans.
    b. Reflected ceiling plans.
    c. Other drawings by request.

B. Web-Based Project Management Software Package: Provide, administer, and use web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.

1. Web-based Project management software includes, at a minimum, the following features:

    a. Compilation of Project data, including Contractor, subcontractors, Architect, Architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    c. Document workflow planning, allowing customization of workflow between project entities.
    d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    e. Track status of each Project communication in real time, and log time and date when responses are provided.
    f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    g. Processing and tracking of payment applications.
    h. Processing and tracking of contract modifications.
    i. Creating and distributing meeting minutes.
    j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    k. Management of construction progress photographs.
    l. Mobile device compatibility, including smartphones and tablets.

2. Provide up to ten (10) Project management software user licenses for use of Owner, Architect, and Architect's consultants. Provide eight hours of software

training at Architect's office for web-based Project software users.

3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. Autodesk, Inc.
    b. Meridian Systems, Inc.
    c. Newforma, Inc.
    d. Procore Technologies, Inc.

C. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:

1. Assemble complete submittal package into a single indexed file, incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.
3. Certifications: Where digitally submitted certificates and certifications are required, provide a digital signature with digital certificate on where indicated.

1.9 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of seven days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and

authorized to conclude matters relating to the Work.

2. Agenda: Discuss items of significance that could affect progress, including the following:

    a. Responsibilities and personnel assignments.
    b. Tentative construction schedule.
    c. Phasing.
    d. Critical work sequencing and long lead items.
    e. Designation of key personnel and their duties.
    f. Lines of communications.
    g. Use of web-based Project software.
    h. Procedures for processing field decisions and Change Orders.
    i. Procedures for RFIs.
    j. Procedures for testing and inspecting.
    k. Procedures for processing Applications for Payment.
    l. Distribution of the Contract Documents.
    m. Submittal procedures.
    n. Sustainable design requirements.
    o. Preparation of Record Documents.
    p. Use of the premises and existing building.
    q. Work restrictions.
    r. Working hours.
    s. Owner's occupancy requirements.
    t. Responsibility for temporary facilities and controls.
    u. Procedures for moisture and mold control.
    v. Procedures for disruptions and shutdowns.
    w. Construction waste management and recycling.
    x. Parking availability.
    y. Office, work, and storage areas.
    z. Equipment deliveries and priorities.
    aa. First aid.
    bb. Security.
    cc. Progress cleaning.

3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other Sections and when required for coordination with other construction.

1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, and Owner's Commissioning Authority of scheduled meeting dates.
2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

a. Contract Documents.
b. Options.
c. Related RFIs.
d. Related Change Orders.
e. Purchases.
f. Deliveries.
g. Submittals.
h. Sustainable design requirements.
i. Review of mockups.
j. Possible conflicts.
k. Compatibility requirements.
l. Time schedules.
m. Weather limitations.
n. Manufacturer's written instructions.
o. Warranty requirements.
p. Compatibility of materials.
q. Acceptability of substrates.
r. Temporary facilities and controls.
s. Space and access limitations.
t. Regulations of authorities having jurisdiction.
u. Testing and inspecting requirements.
v. Installation procedures.
w. Coordination with other work.
x. Required performance results.
y. Protection of adjacent work.
z. Protection of construction and personnel.

3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.

D. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:

a. Preparation of Record Documents.
b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
c. Procedures for completing and archiving web-based Project software site data files.
d. Submittal of written warranties.
e. Requirements for completing sustainable design documentation.
f. Requirements for preparing operations and maintenance data.
g. Requirements for delivery of material samples, attic stock, and spare parts.
h. Requirements for demonstration and training.
i. Preparation of Contractor's punch list.
j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
k. Submittal procedures.
l. Coordination of separate contracts.
m. Owner's partial occupancy requirements.
n. Installation of Owner's furniture, fixtures, and equipment.
o. Responsibility for removing temporary facilities and controls.

4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

E. Progress Meetings: Conduct progress meetings at regular intervals.

1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

1) Review schedule for next period.

b. Review present and future needs of each entity present, including the following:

1) Interface requirements.
2) Sequence of operations.

3) Status of submittals.
4) Status of sustainable design documentation.
5) Deliveries.
6) Off-site fabrication.
7) Access.
8) Site use.
9) Temporary facilities and controls.
10) Progress cleaning.
11) Quality and work standards.
12) Status of correction of deficient items.
13) Field observations.
14) Status of RFIs.
15) Status of Proposal Requests.
16) Pending changes.
17) Status of Change Orders.
18) Pending claims and disputes.
19) Documentation of information for payment requests.

4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.

    a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.

1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.

    a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting, where revisions to the schedule have

been made or recognized. Issue revised schedule concurrently with report of each meeting.

c. Review present and future needs of each contractor present, including the following:

1) Interface requirements.
2) Sequence of operations.
3) Status of submittals.
4) Deliveries.
5) Off-site fabrication.
6) Access.
7) Site use.
8) Temporary facilities and controls.
9) Work hours.
10) Hazards and risks.
11) Progress cleaning.
12) Quality and work standards.
13) Status of RFIs.
14) Proposal Requests.
15) Change Orders.
16) Pending changes.

3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Startup construction schedule.
2. Contractor's Construction Schedule.
3. Construction schedule updating reports.
4. Daily construction reports.
5. Material location reports.
6. Site condition reports.
7. Unusual event reports.

B. Related Requirements:

1. Section 014000 "Quality Requirements" for schedule of tests and inspections.

1.3 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.

1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.

C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.

D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.

E. Event: The starting or ending point of an activity.

F. Float: The measure of leeway in starting and completing an activity.

1. Float time belongs to Owner.
2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

G. Resource Loading: The allocation of labor and equipment necessary for completing an activity as scheduled.

1.4 INFORMATIONAL SUBMITTALS

A. Format for Submittals: Submit required submittals in the following format:

1. Working electronic copy of schedule file.
2. PDF file.

B. Startup construction schedule.

1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.

C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.

1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports to contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.

1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
3. Total Float Report: List of activities sorted in ascending order of total float.
4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.

F. Daily Construction Reports: Submit at weekly intervals.

G. Material Location Reports: Submit at monthly intervals.

H. Site Condition Reports: Submit at time of discovery of differing conditions.

I. Unusual Event Reports: Submit at time of unusual event.

J. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.

B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:

1. Review software limitations and content and format for reports.
2. Verify availability of qualified personnel needed to develop and update schedule.
3. Discuss constraints, including interim milestones.
4. Review delivery dates for Owner-furnished products.
5. Review schedule for work of Owner's separate contracts.
6. Review submittal requirements and procedures.
7. Review time required for review of submittals and resubmittals.
8. Review requirements for tests and inspections by independent testing and inspecting agencies.
9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
10. Review and finalize list of construction activities to be included in schedule.
11. Review procedures for updating schedule.

1.6 COORDINATION

A. Coordinate Contractor's Construction Schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests, and other required schedules and reports.

1. Secure time commitments for performing critical elements of the Work from entities involved.
2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.7 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

B. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.

1. Contract completion date to not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

C. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:

1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
2. Temporary Facilities: Indicate start and completion dates for the following as applicable:

    a. Securing of approvals and permits required for performance of the Work.
    b. Temporary facilities.
    c. Construction of mock-ups, prototypes and samples.
    d. Owner interfaces and furnishing of items.
    e. Interfaces with Separate Contracts.
    f. Regulatory agency approvals.
    g. Punch list.

3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
5. Startup and Testing Time: Include no fewer than 15 days for startup and testing.
6. Commissioning Time: Include no fewer than 15 days for commissioning.
7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion.
8. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and Final Completion.

D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.

1. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
2. Owner-Furnished Products: Include a separate activity for each product. Include

delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.

3. Work Restrictions: Show the effect of the following items on the schedule:

    a. Coordination with existing construction.
    b. Limitations of continued occupancies.
    c. Uninterruptible services.
    d. Partial occupancy before Substantial Completion.
    e. Use-of-premises restrictions.
    f. Provisions for future construction.
    g. Seasonal variations.
    h. Environmental control.

4. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:

    a. Structural completion.
    b. Temporary enclosure and space conditioning.
    c. Permanent space enclosure.
    d. Completion of mechanical installation.
    e. Completion of electrical installation.
    f. Substantial Completion.

E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.
5. Pending modifications affecting the Work and the Contract Time.

G. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Final Completion percentage for each activity.

H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.

I. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

1.8 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. List of separate contractors at Project site.
3. Approximate count of personnel at Project site.
4. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Testing and inspection.
8. Accidents.
9. Meetings and significant decisions.
10. Unusual events.
11. Stoppages, delays, shortages, and losses.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Orders and requests of authorities having jurisdiction.
15. Change Orders received and implemented.
16. Construction Change Directives received and implemented.
17. Services connected and disconnected.
18. Equipment or system tests and startups.
19. Partial completions and occupancies.
20. Substantial Completions authorized.

B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List to be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
2. Material stored prior to previous report and since removed from storage and installed.
3. Material stored following previous report and remaining in storage.

C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3200

SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Preconstruction photographs.
2. Periodic construction photographs.
3. Final Completion construction photographs.

B. Related Requirements:

1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 INFORMATIONAL SUBMITTALS

A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.

B. Digital Photographs: Submit image files within three days of taking photographs.

1. Submit photos on CD-ROM or thumb-drive, by uploading to web-based Project management software site. Include copy of key plan indicating each photograph's location and direction.
2. Identification: Provide the following information with each image description in file

metadata tag:

a. Name of Project.
b. Name and contact information for photographer.
c. Name of Architect.
d. Name of Contractor.
e. Date photograph was taken.
f. Description of location, vantage point, and direction.
g. Unique sequential identifier keyed to accompanying key plan.

1.4 QUALITY ASSURANCE

A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

1.5 FORMATS AND MEDIA

A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of 12 megapixels, and at an image resolution of not less than 3200 by 2400 pixels, and with vibration-reduction technology. Use flash in low light levels or backlit conditions.

B. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.

C. Metadata: Record accurate date and time from camera.

D. File Names: Name media files with date and sequential numbering suffix.

1.6 CONSTRUCTION PHOTOGRAPHS

A. Photographer: Engage a qualified photographer to take construction photographs.

B. General: Take photographs with maximum depth of field and in focus.

1. Maintain key plan with each set of construction photographs that identifies each photographic location.

C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.

1. Flag construction limits before taking construction photographs.
2. Take 20 photographs to show existing conditions adjacent to property before starting the Work.

3. Take 20 photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take 50 photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken.

E. Final Completion Construction Photographs: Take 50 photographs after date of Substantial Completion for submission as Project Record Documents. Architect will inform photographer of desired vantage points.

F. Additional Photographs: Architect may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.

1. Three days' notice will be given, where feasible.
2. In emergency situations, take additional photographs within 24 hours of request.
3. Circumstances that could require additional photographs include, but are not limited to, the following:

    a. Special events planned at Project site.
    b. Immediate follow-up when on-site events result in construction damage or losses.
    c. Photographs shall be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
    d. Substantial Completion of a major phase or component of the Work.
    e. Extra record photographs at time of final acceptance.
    f. Owner's request for special publicity photographs.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3233

SECTION 01 3300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

Section includes requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.

A. Related Requirements:
1. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
2. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
3. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
4. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

A. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

B. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.

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

1.4 ACTION SUBMITTALS

Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.

1. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
2. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.

Submit revised submittal schedule to reflect changes in current status and timing for submittals.

Format: Arrange the following information in a tabular format:

Scheduled date for first submittal.

a. Specification Section number and title.
b. Submittal category: Action; informational.
c. Name of subcontractor.
d. Description of the Work covered.
e. Scheduled date for Architect's final release or approval.
f. Scheduled date of fabrication.
g. Scheduled dates for purchasing.
h. Scheduled dates for installation.
i. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.

Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings.

Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.

a. Digital Drawing Software Program: The Contract Drawings are available in Autocad Architecture 2011 or earlier issue by Autodesk..
b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
c. The following digital data files will by furnished for each appropriate discipline:

Floor plans.

1) Reflected ceiling plans.

Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

Initial Review: Allow 10 business days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.

5. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
6. Resubmittal Review: Allow 10 business days for review of each resubmittal.
7. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 15 business days for initial review of each submittal.
8. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 15 business days for review of each submittal. Submittal will be returned to Architect before being returned to Contractor.

Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:

Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

9. Name file with submittal number or other unique identifier, including revision identifier.

File name shall use Specification Section number followed by a dash and then a Section Identifier number followed by a dash and then a Descriptor of the content herein (e.g., 061000-1.3.A – Wood Windows, PD). Resubmittals shall include an alphabetic ‘R’ suffix after another decimal point corresponding to the revision number (e.g., 061000-1.3.A.R2 – Wood Windows, PD). A list of abbreviations by section is included below in parentheses “ “ within the following section: PART 2 – PRODUCTS – “2.1 - Submittal Procedures” and “2.2 - Delegated Design Services”.

Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and Construction Manager.

10. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner, containing the following information:

Project name.
a. Date.
b. Name and address of Architect.
c. Name of Construction Manager.
d. Name of Contractor.

Options: Clearly identify options requiring selection by Architect on the Transmittal sheet or Cover Page of all Submittals.

B. Deviations and Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

C. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.

Note date and content of previous submittal.
1. Note date and content of revision in label or title block and clearly indicate extent of revision.
2. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

D. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.

Submit electronic submittals via email as PDF electronic files.

Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.

Action Submittals: Submit PDF electronic copy of each submittal unless otherwise indicated. Architect will return PDF copy.
1. Informational Submittals: Submit PDF electronic copy of each submittal unless otherwise indicated. Architect will not return copies.
2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.

Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.

a. Provide a notarized statement on original paper copy certificates and certifications where indicated.

Product Data - “PD”: Collect information into a single submittal for each element of construction and type of product or equipment.

If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.

3. Mark each copy of each submittal to show which products and options are applicable.
4. Include the following information, as applicable:

Manufacturer's catalog cuts.

a. Manufacturer's product specifications.
b. Standard color charts.
c. Statement of compliance with specified referenced standards.
d. Testing by recognized testing agency.
e. Application of testing agency labels and seals.
f. Notation of coordination requirements.
g. Availability and delivery time information.

For equipment, include the following in addition to the above, as applicable:

Wiring diagrams showing factory-installed wiring.

h. Printed performance curves.
i. Operational range diagrams.
j. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

Submit Product Data before or concurrent with Samples.

5. Submit Product Data in one of the following formats:

PDF electronic file of the Product Data. Architect will return PDF.

a. Three paper copies of Product Data unless otherwise indicated. Architect will return two copies.

Shop Drawings - “SD”: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.

Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

Identification of products.

b. Schedules.
c. Compliance with specified standards.
d. Notation of coordination requirements.
e. Notation of dimensions established by field measurement.
f. Relationship and attachment to adjoining construction clearly indicated.
g. Seal and signature of professional engineer if specified.

Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.

6. Submit Shop Drawings in the following format:

   PDF electronic file of the Shop Drawing. Architect will return PDF.

Samples – "S": Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.

Transmit Samples that contain multiple, related components such as accessories together in one submittal package.

7. Identification: Attach label on unexposed side of Samples that includes the following:

   Generic description of Sample.
   a. Product name and name of manufacturer.
   b. Sample source.
   c. Number and title of applicable Specification Section.
   d. Specification paragraph number and generic name of each item.

For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.

8. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

   Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
   a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.

Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

   Number of Samples: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.

   Number of Samples: Submit sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.

Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

1) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.

Product Schedule – “PS”: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:

Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.

9. Manufacturer and product name, and model number if applicable.
10. Number and name of room or space.
11. Location within room or space.
12. Submit product schedule in the following format:

PDF electronic file of each Product Schedule. Architect will return PDF..

a. Three paper copies of product schedule or list unless otherwise indicated. Architect will return two copies.

Contractor's Construction Schedule – “CS”: Comply with requirements specified in Section 01 3200 "Construction Progress Documentation."

B. Application for Payment and Schedule of Values – “SV”: Comply with requirements in the General Conditions for Construction Contracts.

C. Test and Inspection Reports and Schedule of Tests and Inspections Submittals – “TR”: Comply with requirements specified in Section 01 4000 "Quality Requirements."

D. Closeout Submittals and Maintenance Material Submittals – “CO”: Comply with requirements specified in Section 01 7700 "Closeout Procedures."

E. Maintenance Data – “MD”: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."

F. Qualification Data “Q”: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

G. Welding Certificates – “C”: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.

H. Installer Certificates – “C”: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

I. Manufacturer Certificates – “C”: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

J. Product Certificates – “C”: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

K. Material Certificates – “C”: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

L. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

M. Product Test Reports – “TR”: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

N. Research Reports – “RR”: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:

Name of evaluation organization.
1. Date of evaluation.
2. Time period when report is in effect.
3. Product and manufacturers' names.
4. Description of product.
5. Test procedures and results.
6. Limitations of use.

Preconstruction Test Reports – “TR”: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.

O. Compatibility Test Reports – “TR”: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

P. Field Test Reports – “TR”: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

Q. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

Delegated-Design Services Certification – “SD/DD”: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.

Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.

A. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 7700 "Closeout Procedures."

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

3.2 ARCHITECT'S ACTION

Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action. action, as follows:

Approved.
1. No Exceptions.
2. Approved as Noted.
3. Revise and Resubmit.
4. Approved as Noted and Resubmit.
5. Not Approved.
6. Not Reviewed.
7. Comments Attached.

Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

B. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.

C. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.

D. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION

SECTION 013591 - HISTORIC TREATMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general protection and treatment procedures for entire Project and the following specific work:

1. Historic removal and dismantling.

1.2 DEFINITIONS

A. Consolidate: To strengthen loose or deteriorated materials in place.

Dismantle: To disassemble and detach items by hand from existing construction to the limits indicated, using small hand tools and small one-hand power tools, so as to protect nearby historic surfaces; and legally dispose of dismantled items off-site, unless indicated to be salvaged or reinstalled.

Existing to Remain: Existing items that are not to be removed or dismantled.

B. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.

Reconstruct: To remove existing item, replicate damaged or missing components, and reinstall in original position.

Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.

Reinstall: To protect removed or dismantled item, repair and clean it as indicated for reuse, and reinstall it in original position, or where indicated.

Remove: Specifically for historic spaces, areas, rooms, and surfaces, the term means to detach an item from existing construction to the limits indicated, using hand tools and hand-operated power equipment, and legally dispose of it off-site, unless indicated to be salvaged or reinstalled.

Repair: To correct damage and defects, retaining existing materials, features, and finishes while employing as little new material as possible. Includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.

Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.

Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.

Reproduce: To fabricate a new item, accurate in detail to the original, and in either the same or a similar material as the original, unless otherwise indicated.

Restore: To consolidate, replicate, reproduce, repair, and refinish as required to achieve the indicated results.

Retain: To keep existing items that are not to be removed or dismantled.

Reversible: New construction work, treatments, or processes that can be removed or undone in the future without damaging historic materials unless otherwise indicated.

Salvage: To protect removed or dismantled items and deliver them to Owner ready for reuse.

Stabilize: To provide structural reinforcement of unsafe or deteriorated items while maintaining the essential form as it exists at present; also, to reestablish a weather-resistant enclosure.

Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Construction Schedule for Historic Treatments: Indicate for entire Project the following for each activity to be performed in historic spaces, areas, and rooms, and on historic surfaces:

1. Detailed sequence of historic treatment work, with starting and ending dates, coordinated with Owner's continuing operations and other known work in progress.

Utility Services: Indicate how long utility services will be interrupted.

B. Qualification Data: For historic removal and dismantling specialist's workers.

Historic Treatment Program: Submit before work begins.

Fire-Prevention Plan: Submit before work begins.

1.4 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: An experienced firm regularly engaged in historic treatments similar in nature, materials, design, and extent to this work as specified in each section, and that has completed a minimum of five recent projects with a record of successful in-service performance that demonstrate the firm's qualifications to perform this work.

1. Field Supervisor Qualifications: Full-time supervisors experienced in historic treatment work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on Project site during times that historic treatment work is in progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.

Worker Qualification: Persons who are experienced in historic treatment work of types they will be performing.

Historic Treatment Program: Prepare a written plan for historic treatment for whole Project, including each phase or process and protection of surrounding materials during operations. Describe in detail materials, methods, and equipment to be used for each phase of work. Show compliance with indicated methods and procedures specified in this and other Sections.

2. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.

Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.

B. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-prevention devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include each fire watch's training, duties, and authority to enforce fire safety.

Regulatory Requirements: Comply with notification regulations of authorities having jurisdiction before beginning removal and dismantling work. Comply with hauling and disposal regulations of authorities having jurisdiction.

Standards: Comply with ANSI/ASSE A10.6.

Historic Treatment Preconstruction Conference: Conduct conference at Project site.

1.5 STORAGE AND PROTECTION OF HISTORIC MATERIALS

A. Salvaged Historic Materials:

1. Clean only loose debris from salvaged historic items unless more extensive cleaning is indicated.

Pack or crate items after cleaning; cushion against damage during handling. Label contents of containers.

Store items in a secure area until delivery to Owner.

Transport items to Owner's storage area on-site.

Protect items from damage during transport and storage.

B. Historic Materials for Reinstallation:

1. Repair and clean historic items as indicated and to functional condition for reuse.

Pack or crate items after cleaning and repairing; cushion against damage during handling. Label contents of containers.

Protect items from damage during transport and storage.

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

C. Existing Historic Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after historic treatment and construction work in the vicinity is complete.

1.6 PROJECT CONDITIONS

A. Hazardous Materials: Hazardous materials are present in construction affected by removal and dismantling work. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.

Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.

B. Storage or sale of removed or dismantled items on-site is not permitted unless otherwise indicated.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed or dismantled and location of utilities and services to remain that may be hidden by construction that is to be removed or dismantled.

1. Verify that affected utilities have been disconnected and capped.

Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage.

Before removal or dismantling of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures as a result of removal and dismantling work.

B. Perform surveys as the Work progresses to detect hazards resulting from historic treatment procedures.

3.2 PROTECTION, GENERAL

A. Comply with temporary barrier requirements in Section 015000 "Temporary Facilities and Controls."

Ensure that supervisory personnel are on-site and on duty when historic treatment work begins and during its progress.

Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from historic treatment procedures.

1. Use only proven protection methods, appropriate to each area and surface being protected.

Provide barricades, barriers, and temporary directional signage to exclude public from areas where historic treatment work is being performed.

Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of historic treatment work.

Contain dust and debris generated by removal and dismantling work and prevent it from reaching the public or adjacent surfaces.

Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
Protect floors and other surfaces along haul routes from damage, wear, and staining.
Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.

B. Temporary Protection of Historic Materials:

1. Protect existing historic materials with temporary protections and construction. Do not deface or remove existing materials.

Do not attach temporary protection to historic surfaces except as indicated as part of the historic treatment program and approved by Architect.

C. Comply with each product manufacturer's written instructions for protections and precautions.
Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.

Utility and Communications Services:

1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by the historic treatment work before commencing operations.

Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for the historic treatment work.
Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.

D. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as stone or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from historic treatment work.

Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.

E. Existing Roofing: Prior to the start of work in an area, install roofing protection as indicated.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

A. Protect motor vehicles, surrounding surfaces of building being restored, building site, plants, and surrounding buildings from harm or damage resulting from applications of chemical cleaners and paint removers.

Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in historic treatment program. Use covering materials and masking agents that are waterproof, UV resistant, and will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials staining.

Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.

Neutralize and collect alkaline and acid wastes and legally dispose of off Owner's property.

Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 PROTECTION FROM FIRE

A. General: Follow fire-prevention plan and the following.

1. Comply with NFPA 241 requirements unless otherwise indicated. Perform duties entitled "Owner's Responsibility for Fire Protection."

Remove and keep area free of combustibles including, rubbish, paper, waste, and chemicals, except to the degree necessary for the immediate work.

a. If combustible material cannot be removed, provide fire blankets to cover such materials.

2. Prohibit smoking by all persons within Project work and staging areas.

B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or highly combustible materials, including welding, torch-cutting, soldering, brazing, paint removal with heat, or other operations where open flames or implements utilizing high heat or combustible solvents and chemicals are anticipated:

1. Obtain Owner's approval for operations involving use of open-flame or welding or other high-heat equipment. Use of open-flame equipment is not permitted Notify Owner before each occurrence, indicating location of such work.

As far as practical, restrict heat-generating equipment to shop areas or outside the building.

Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.

Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.

Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.

Fire Watch: Before working with heat-generating equipment or highly combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows.

a. Train each fire watch in the proper operation of fire-control equipment and alarms.

Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.

Cease work with heat-generating equipment whenever fire-watch personnel are not present.

Have fire watch perform final fire-safety inspection each day beginning no sooner than 30 minutes after conclusion of work at each area of Project site to detect hidden or smoldering fires and to ensure that proper fire-prevention is maintained.

Maintain fire-watch personnel at each area of Project site until 60 minutes after conclusion of daily work.

C. Fire Extinguishers, Fire Blankets, and Rag Buckets: Maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire watch are trained in fire-extinguisher and blanket operation.

3.5 GENERAL HISTORIC TREATMENT

A. Ensure that supervisory personnel are present when historic treatment work begins and during its progress.

Halt the process of deterioration and stabilize conditions, unless otherwise indicated. Perform work as indicated on Drawings. Follow the procedures in subparagraphs below and procedures approved in historic treatment program:

1. Retain as much existing material as possible; repair and consolidate rather than replace.

Use additional material or structure to reinforce, strengthen, prop, tie, and support existing material or structure.

Use reversible processes wherever possible.

Use historically accurate repair and replacement materials and techniques unless otherwise indicated.

Record existing work before each procedure (preconstruction) and progress during the work with digital preconstruction documentation. Comply with requirements in Section 013233 "Photographic Documentation."

B. Notify Architect of visible changes in the integrity of material or components whether due to environmental causes including biological attack, UV degradation, freezing, or thawing; or due to structural defects including cracks, movement, or distortion.

1. Do not proceed with the work in question until directed by Architect.

C. Where missing features are indicated to be repaired or replaced, provide features whose designs are based on accurate duplications rather than on conjectural designs, subject to approval of Architect.

Where Work requires existing features to be removed or dismantled and reinstalled, perform these operations without damage to the material itself, to adjacent materials, or to the substrate.

Identify new and replacement materials and features with permanent marks hidden in the completed work to distinguish them from original materials. Record a legend of identification marks and the locations of the items on record Drawings.

3.6 HISTORIC REMOVAL AND DISMANTLING

A. General: Have removal and dismantling work performed by a qualified historic treatment specialist.

Perform work according to the historic treatment program.

Water-Mist Sprinkling: Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.

Anchorages:

1. Remove anchorages associated with removed items.

Dismantle anchorages associated with dismantled items.

In non-historic surfaces, patch holes created by anchorage removal or dismantling according to the requirements for new work.

In historic surfaces, patch or repair holes created by anchorage removal or dismantling according to Section specific to the historic surface being patched.

3.7 HISTORIC TREATMENT SCHEDULE

A. Spaces, areas, rooms, and surfaces requiring special care and treatment to ensure successful restoration and reconstruction are indicated on Drawings.

END OF SECTION 013591

SECTION 01 4000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.

C. Related Requirements:

1. Section 012100 "Allowances" for testing and inspection allowances.

1.3 DEFINITIONS

A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

B. Field Quality-Control Tests and Inspections: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, subcontractor, or sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.

1. Use of trade-specific terminology in referring to a Work result does not require that certain construction activities specified apply exclusively to specific trade(s).

D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.

1. Mockups are used for one or more of the following:

a. Verify selections made under Sample submittals.
b. Demonstrate aesthetic effects.
c. Demonstrate the qualities of products and workmanship.
d. Demonstrate successful installation of interfaces between components and systems.
e. Perform preconstruction testing to determine system performance.

2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.
3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.

E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.

F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) in accordance with 29 CFR 1910.7, by a testing agency accredited in accordance with NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

G. Source Quality-Control Tests and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "testing agency."

I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work, to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work, to evaluate that actual products incorporated into the

Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect.

1.4 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

B. Delegated Design Services Statement: Submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.5 CONFLICTING REQUIREMENTS

A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified is the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.6 INFORMATIONAL SUBMITTALS

A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.

B. Qualification Data: For Contractor's quality-control personnel.

C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities

having jurisdiction before starting work on the following systems:

1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
2. Primary wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.

D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.
2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

F. Reports: Prepare and submit certified written reports and documents as specified.

G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities and to coordinate Owner's quality-assurance and quality-control activities. Coordinate with Contractor's Construction Schedule.

B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.

1. Project quality-control manager may also serve as Project superintendent.

C. Submittal Procedure: Describe procedures for ensuring compliance with requirements

through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.

D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:

1. Contractor-performed tests and inspections, including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by Commissioning Authority.

E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring the Work into compliance with standards of workmanship established by Contract requirements and approved mockups.

F. Monitoring and Documentation: Maintain testing and inspection reports, including log of approved and rejected results. Include Work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming Work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.8 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, telephone number, and email address of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample-taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of technical representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Statement that products at Project site comply with requirements.
4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
6. Statement of whether conditions, products, and installation will affect warranty.
7. Other required items indicated in individual Specification Sections.

C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement of whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

1.9 QUALITY ASSURANCE

A. Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.

1. Requirements of authorities having jurisdiction supersede requirements for specialists.

G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect, demonstrate, repair, and perform service on installations of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:

1. Contractor's Responsibilities:

a. Provide test specimens representative of proposed products and construction.
b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
d. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
e. When testing is complete, remove test specimens and test assemblies, and mockups; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test,

inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from the Contract Documents.

K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups of size indicated.
2. Build mockups in location indicated or, if not indicated, as directed by Architect.
3. Notify Architectseven days in advance of dates and times when mockups will be constructed.
4. Employ supervisory personnel who will oversee mockup construction. Employ workers who will be employed to perform same tasks during the construction at Project.
5. Demonstrate the proposed range of aesthetic effects and workmanship.
6. Obtain Architect's approval of mockups before starting corresponding Work, fabrication, or construction.

    a. Allow seven days for initial review and each re-review of each mockup.

7. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

1.10 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by Work that failed to comply with the Contract Documents will be charged to Contractor.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.

1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
2. Engage a qualified testing agency to perform quality-control services.

a. Contractor will not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections, and state in each report whether tested and inspected Work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform duties of Contractor.

E. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."

F. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

G. Contractor's Associated Requirements and Services: Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency

sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified special inspector to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures, and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections, and stating in each report whether tested and inspected Work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected Work.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's,,and, authorities' having jurisdiction reference during normal working hours.

1. Submit log at Project closeout as part of Project Record Documents.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000

SECTION 01 4200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. General: Basic Contract definitions are included in the Conditions of the Contract.

B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.

C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."

D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."

E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.

F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.

G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.

H. "Provide": Furnish and install, complete and ready for the intended use.

I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

1. For standards referenced by applicable building codes, comply with dates of standards as listed in building codes.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."

B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States." The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. AABC - Associated Air Balance Council; www.aabc.com.
2. AAMA - American Architectural Manufacturers Association; (see FGIA).
3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
7. ABMA - American Boiler Manufacturers Association; www.abma.com.

8. ACI - American Concrete Institute; www.concrete.org.
9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
12. AF&PA - American Forest & Paper Association; www.afandpa.org.
13. AGA - American Gas Association; www.aga.org.
14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
16. AI - Asphalt Institute; www.asphaltinstitute.org.
17. AIA - American Institute of Architects (The); www.aia.org.
18. AISC - American Institute of Steel Construction; www.aisc.org.
19. AISI - American Iron and Steel Institute; www.steel.org.
20. AITC - American Institute of Timber Construction; (see PLIB).
21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
23. ANSI - American National Standards Institute; www.ansi.org.
24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
25. APA - APA - The Engineered Wood Association; www.apawood.org.
26. APA - Architectural Precast Association; www.archprecast.org.
27. API - American Petroleum Institute; www.api.org.
28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
29. ASA - Acoustical Society of America; www.acousticalsociety.org.
30. ASCE - American Society of Civil Engineers; www.asce.org.
31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).
32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; [**American Society of Mechanical Engineers (The)**]; www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWPA - American Wood Protection Association; www.awpa.com.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.

46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.
75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsinstitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; https://fgiaonline.org.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.;

www.floridaroof.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.
120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.

127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.
164. SDI - Steel Door Institute; www.steeldoor.org.
165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
167. SIA - Security Industry Association; www.securityindustry.org.
168. SJI - Steel Joist Institute; www.steeljoist.org.
169. SMA - Screen Manufacturers Association; www.smainfo.org.
170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.

171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
174. SPRI - Single Ply Roofing Industry; www.spri.org.
175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
179. SWI - Steel Window Institute; www.steelwindows.com.
180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
185. TMS - The Masonry Society; www.masonrysociety.org.
186. TPI - Truss Plate Institute; www.tpinst.org.
187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
188. TRI - Tile Roofing Industry Alliance; www.tileroofing.org.
189. UL - Underwriters Laboratories Inc.; www.ul.org.
190. UL LLC - UL LLC; www.ul.com.
191. USAV - USA Volleyball; www.usavolleyball.org.
192. USGBC - U.S. Green Building Council; www.usgbc.org.
193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
194. WA - Wallcoverings Association; www.wallcoverings.org.
195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
198. WI - Woodwork Institute; www.woodworkinstitute.com.
199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
200. WWPA - Western Wood Products Association; www.wwpa.org.

C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.

1. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
2. ICC - International Code Council; www.iccsafe.org.
3. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.

D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.

2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.

    a. Available from Defense Standardization Program; www.dsp.dla.mil.
    b. Available from U.S. General Services Administration; www.gsa.gov.
    c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.

6. MILSPEC - Military Specification and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of

the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; https://tfsweb.tamu.edu/.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 4200

SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. Related Requirements:

1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.

1.3 USE CHARGES

A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

B. Sewer Service: Pay sewer-service use charges for sewer usage by all entities for construction operations.

C. Water Service: Pay water-service use charges for water used by all entities for construction operations.

D. Electric Power Service: Pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.

B. Implementation and Termination Schedule: Within 15 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.

C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.

D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.

1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
3. Indicate methods to be used to avoid trapping water in finished work.

F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:

1. Locations of dust-control partitions at each phase of work.
2. HVAC system isolation schematic drawing.
3. Location of proposed air-filtration system discharge.
4. Waste-handling procedures.
5. Other dust-control measures.

G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:

1. Methods used to meet the goals and requirements of the Owner.
2. Concrete cutting method(s) to be used.
3. Location of construction devices on the site.
4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
6. Indicate locations of sensitive areas or other areas requiring special attention as

identified by Owner. Indicate means for complying with Owner's requirements.

1.5 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the United States Access Board's ADA-ABA Accessibility Guidelines, and, ICC/ANSI A117.1.

1.6 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Chain-Link Fencing: Minimum **2-inch**, **0.148-inch-** thick, galvanized-steel, chain-link fabric fencing; minimum **6 feet** high with galvanized-steel pipe posts; minimum **2-3/8-inch-** OD line posts and **2-7/8-inch-** OD corner and pull posts, with 1-5/8-inch- OD top rails.

B. Polyethylene Sheet: Reinforced, fire-resistive sheet, **10-mil** minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.

C. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum **36 by 60 inches**.

D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

E. Floor Protection Paper: Heavy duty, durable, non-staining paper for floor protection.

2.2 TEMPORARY FACILITIES

A. Field Offices: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:

1. Furniture required for Project-site documents, including file cabinets, plan tables, plan racks, and bookcases.
2. Drinking water and private toilet.
3. Heating and cooling equipment necessary to maintain a uniform indoor temperature of **68 to 72 deg F**.
4. Lighting fixtures capable of maintaining average illumination of **20 fc** at desk height.

C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

1. Store combustible materials apart from building.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

1. Heating, Cooling, and Dehumidifying Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
2. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of [**8**] <**Insert number**> at each return-air grille in system and remove at end of construction[**.**][**and clean HVAC system as required in Section 017700 "Closeout Procedures."**]

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

A. Conservation: Coordinate construction and use of temporary facilities with

consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

1. Connect temporary sewers as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application

of finishes and their proper curing or drying.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

1. Install electric power service underground unless otherwise indicated.
2. Connect temporary service to Owner's existing power source, as directed by Owner.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install WiFi cell phone access equipment for each field office.

I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.

J. Project Computer: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications.

1. Internet Service: Broadband modem, router, and ISP, equipped with hardware firewall, providing minimum 10.0 -Mbps upload and 15 -Mbps download speeds at each computer.

3.4 SUPPORT FACILITIES INSTALLATION

A. Comply with the following:

1. Provide construction for temporary field offices, shops, and sheds located within construction area or within **30 feet** of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
2. Utilize designated area within existing building for temporary field offices.
3. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.

1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.

1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
2. Prepare subgrade and install subbase and base for temporary roads and paved areas in accordance with Section 312000 "Earth Moving."
3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course in accordance with Section 321216 "Asphalt Paving."

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.

1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

F. Storage and Staging: Use designated areas of Project site for storage and staging needs.

G. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.

1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

H. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.

1. Identification Signs: Provide Project identification signs as indicated on Drawings.
2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.

    a. Provide temporary, directional signs for construction personnel and visitors.

3. Maintain and touch up signs, so they are legible at all times.

I. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

J. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."

K. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.

1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

1. Comply with work restrictions specified in Section 011000 "Summary."

C. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

D. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."

E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

F. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals, so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site

enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.

H. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.

I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.

K. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.

L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.

1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition in accordance with requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign, stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.

B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed.

C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard and replace stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.

D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.

    a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
    b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
    c. Remove and replace materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 5000

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Work of this 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 Requirements:

1. Section 311000 "Site Clearing" for removing existing trees and shrubs.

1.2 DEFINITIONS

A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line.

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

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

1.3 PREINSTALLATION MEETINGS

A. 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. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
b. Arborist's responsibilities.
c. Quality-control program.
d. Coordination of Work and equipment movement with the locations of protection zones.
e. Trenching by hand or with air spade within protection zones.
f. Field quality control.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
2. Detail fabrication and assembly of protection-zone fencing and signage.
3. Indicate extent of trenching by hand or with air spade within protection zones.

C. Samples: For each type of the following:

1. Organic Mulch: 1-pint volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For 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 video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

E. Quality-control program.

1.6 QUALITY ASSURANCE

A. Arborist Qualifications: Certified Arborist as certified by ISA and Licensed arborist in jurisdiction where Project is located.

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. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

1.7 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or 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

2.1 MATERIALS

A. Backfill Soil: Stockpiled soil mixed with planting soil of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
1. Planting Soil: Planting soil as specified in Section 329113 "Soil Preparation"

B. 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 inches maximum, 1/2 inch minimum.
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:

1. Protection-Zone Fencing: Galvanized-steel mesh fencing as noted on the drawings.

PART 3 - EXECUTION

3.1 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. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain. Flag each tree trunk at 54 inches above the ground.

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.

3.3 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 areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

B. Maintain protection zones free of weeds and trash.

C. 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. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 312000 "Earth Moving" unless otherwise indicated.

B. 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 approximately 3 inches back from new construction and as required for root pruning.

C. 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.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots as shown on Drawings and as follows:

1. Cut roots manually by 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.
2. Cut Ends: Do not paint cut root ends.
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

3.6 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

3.7 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.

3.8 REPAIR AND REPLACEMENT

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

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

3.9 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 015639

SECTION 01 6000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.

B. Related Requirements:

1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
2. Section 012500 "Substitution Procedures" for requests for substitutions.
3. Section 014200 "References" for applicable industry standards for products specified.
4. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.

1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.

C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:

1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.

E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."

F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.

1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:

    a. Name of product and manufacturer.
    b. Model and serial number.
    c. Capacity.
    d. Speed.
    e. Ratings.

3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.

C. Storage:

1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
2. Store products to allow for inspection and measurement of quantity or counting of units.

3. Store materials in a manner that will not endanger Project structure.
4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.
8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.

1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.

1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
3. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
4. Where products are accompanied by the term "as selected," Architect will make selection.
5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
6. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

    a. Submit additional documentation required by Architect in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Architect, whose determination is final.

B. Product Selection Procedures:

1. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered unless otherwise indicated.

    a. Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."

2. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

    a. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

C. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or a similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

D. Sustainable Product Selection: Where Specifications require product to meet sustainable product characteristics, select products complying with indicated

requirements. Comply with requirements in Division 01 sustainability requirements Section and individual Specification Sections.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration of Comparable Products: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with the following requirements:

1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects, with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

B. Architect's Action on Comparable Products Submittal: If necessary, Architect will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."

1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."
2. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

C. Submittal Requirements, Single-Step Process: When acceptable to Architect, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Architect of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 6000

SECTION 01 7300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:

1. Construction layout.
2. Field engineering.
3. Installation.
4. Cutting and patching.
5. Coordination of Owner's portion of the Work.
6. Progress cleaning.
7. Starting and adjusting.
8. Protection of installed construction.
9. Correction of the Work.

B. Related Requirements:

1. Section 011000 "Summary" for coordination of Owner-furnished products, and limits on use of Project site.
2. Section 013300 "Submittal Procedures" for submitting surveys.
3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.

B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 PREINSTALLATION MEETINGS

A. Layout Conference: Conduct conference at Project site.

1. Prior to establishing layout of new and existing perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:

    a. Contractor's superintendent.
    b. Professional surveyor responsible for performing Project surveying and layout.
    c. Professional surveyor responsible for performing site survey serving as basis for Project design.

2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
3. Review requirements for including layouts on Shop Drawings and other submittals.
4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For land surveyor.

B. Certificates: Submit certificate signed by land surveyor, certifying that location and elevation of improvements comply with requirements.

1.6 CLOSEOUT SUBMITTALS

A. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.7 QUALITY ASSURANCE

A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."

C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.

1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:

    a. Primary operational systems and equipment.
    b. Plumbing piping systems.
    c. Mechanical systems piping and ducts.
    d. Control systems.
    e. Communication systems.
    f. Fire-detection and -alarm systems.
    g. Electrical wiring systems.
    h. Operating systems of special construction.

3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:

    a. Water, moisture, or vapor barriers.
    b. Membranes and flashings.
    c. Equipment supports.
    d. Piping, ductwork, vessels, and equipment.
    e. Noise- and vibration-control elements and systems.

4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction 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.

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. In-Place Materials: Use materials for patching identical to in-place materials. For

exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.

B. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect[**through Construction Manager**] in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 INSTALLATION

A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces, unless otherwise indicated on Drawings.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.

C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.

F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.

G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.

1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
2. Allow for building movement, including thermal expansion and contraction.
3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.4 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect promptly.

B. Engage a land surveyor experienced in laying out the Work, using the following accepted surveying practices:

1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
2. Establish limits on use of Project site.
3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
4. Inform installers of lines and levels to which they must comply.
5. Check the location, level and plumb, of every major element as the Work progresses.
6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.

7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.

D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.

E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

3.5 FIELD ENGINEERING

A. Identification: Owner will identify existing benchmarks, control points, and property corners.

B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.

1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.

C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.

1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.

D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

E. Final Property Survey: Engage a land surveyor to prepare a final property survey

showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.

1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.6 CUTTING AND PATCHING

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

C. Temporary Support: Provide temporary support of Work to be cut.

D. Protection: Protect in-place 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.

E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."

F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original 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 neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete, and, Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
5. 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.
6. Proceed with patching after construction operations requiring cutting are complete.

H. 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 practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

    a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

    a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.

I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

A. Site Access: Provide access to Project site for Owner's construction personnel.

1. Provide temporary facilities required for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.
2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed and Owner-furnished, Owner-installed products.

B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel.

1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
2. Preinstallation Conferences: Include Owner's construction personnel at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.

1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above **80 deg F**.
3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.

    a. Use containers intended for holding waste materials of type to be stored.

4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.

1. Remove liquid spills promptly.
2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 017419 "Construction Waste Management and Disposal."

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."

B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.

D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.

C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.

C. Restore permanent facilities used during construction to their specified condition.

D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 7300

SECTION 01 7419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous demolition, and, construction waste.
2. Recycling nonhazardous demolition, and, construction waste.
3. Disposing of nonhazardous demolition, and, construction waste.

B. Related Requirements:

1. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
2. Section 044313.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
3. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.3 DEFINITIONS

A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.

C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner’s property.

D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.

E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.

F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition and construction waste becomes property of Contractor.

B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.5 ACTION SUBMITTALS

A. Waste Management Plan: Submit plan within 30 days of date established for commencement of the Work.

1.6 INFORMATIONAL SUBMITTALS

A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report Include the following information:

1. Material category.
2. Generation point of waste.
3. Total quantity of waste in **tons**.
4. Quantity of waste salvaged, both estimated and actual in **tons**.
5. Quantity of waste recycled, both estimated and actual in **tons**.
6. Total quantity of waste recovered (salvaged plus recycled) in **tons**.
7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.

B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.

C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.

D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.

E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include

manifests, weight tickets, receipts, and invoices.

F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

G. Qualification Data: For waste management coordinator, and, refrigerant recovery technician.

H. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

I. Refrigerant Recovery: Comply with requirements in Section 024116 "Structure Demolition", Section 024119 "Selective Demolition" for refrigerant recovery submittals.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. .

B. Refrigerant Recovery Technician Qualifications: Universal certified by EPA-approved certification program.

C. Refrigerant Recovery Technician Qualifications: Comply with requirements in Section 024116 "Structure Demolition.", Section 024119 "Selective Demolition."

D. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.

E. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:

1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
2. Review requirements for documenting quantities of each type of waste and its disposition.
3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
5. Review waste management requirements for each trade.

1.8 WASTE MANAGEMENT PLAN

A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. Distinguish between demolition and construction waste. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and, construction waste generated by the Work . Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.

1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with Section 024116 "Structure Demolition.", Section 024119 "Selective Demolition."
2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.

D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there were no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:

1. Total quantity of waste.
2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
3. Total cost of disposal (with no waste management).
4. Revenue from salvaged materials.
5. Revenue from recycled materials.
6. Savings in transportation and tipping fees by donating materials.
7. Savings in transportation and tipping fees that are avoided.
8. Handling and transportation costs. Include cost of collection containers for each type of waste.

9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS
PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."

B. Waste Management Coordinator: Engage a waste management coordinator to be responsible for implementing, monitoring, and reporting status of waste management work plan. Coordinator shall be present at Project site full time for duration of Project.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.

D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by 12 inches or more.

3.2 SALVAGING DEMOLITION WASTE

A. Comply with requirements in Section 024116 "Structure Demolition", Section 024119 "Selective Demolition" for salvaging demolition waste.

B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until installation.
4. Protect items from damage during transport and storage.
5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.

C. Salvaged Items for Sale, and, Donation: Not permitted on Project site.

D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area designated by Owner.
5. Protect items from damage during transport and storage.

E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

G. Plumbing Fixtures: Separate by type and size.

H. Lighting Fixtures: Separate lamps by type and protect from breakage.

I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING [**DEMOLITION**] [**AND**] [**CONSTRUCTION**] WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and Contractor.

C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.

D. Procedures: Separate recyclable waste from other waste materials, trash, and debris.

Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.

1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

    a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from the weather.
5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

B. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.

1. Pulverize concrete to maximum 4-inch size.
2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.

C. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.

1. Pulverize masonry to maximum 4-inch size.
2. Clean and stack undamaged, whole masonry units on wood pallets.

D. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.

E. Metals: Separate metals by type.

1. Structural Steel: Stack members according to size, type of member, and length.
2. Remove and dispose of bolts, nuts, washers, and other rough hardware.

F. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.

G. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a

dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.

H. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.

I. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.

J. Carpet and Pad: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.

1. Store clean, dry carpet and pad in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

K. Carpet Tile: Remove debris, trash, and adhesive.

1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.

L. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.

M. Conduit: Reduce conduit to straight lengths and store by material and size.

N. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

A. Packaging:

1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
2. Polystyrene Packaging: Separate and bag materials.
3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.

1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner’s property.

C. Burning: Do not burn waste materials.

END OF SECTION 01 7419

SECTION 01 7700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:

1. Substantial Completion procedures.
2. Final Completion procedures.
3. List of incomplete items.
4. Submittal of Project warranties.
5. Final cleaning.

B. Related Requirements:

1. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
2. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
3. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
4. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of cleaning agent.

B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.

C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.

B. Certificate of Insurance: For continuing coverage.

C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.

B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number.

    a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Owner's signature for receipt of submittals.

5. Submit testing, adjusting, and balancing records.
6. Submit sustainable design submittals not previously submitted.
7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
6. Advise Owner of changeover in utility services.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements.
10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect[**and Construction Manager**] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:

1. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list),

endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.

2. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
3. Submit pest-control final inspection report.
4. Submit Final Completion photographic documentation.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first, listed by room or space number.
2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:

    a. Project name.
    b. Date.
    c. Name of Architect.
    d. Name of Contractor.
    e. Page number.

4. Submit list of incomplete items in the following format:

    a. MS Excel Electronic File: Architect will return annotated file.
    b. PDF Electronic File: Architect will return annotated file.
    c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).

1.10 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than

date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

1. Submit on digital media acceptable to Architect.

E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS
PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:

a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
d. Remove tools, construction equipment, machinery, and surplus material from Project site.
e. Remove snow and ice to provide safe access to building.
f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free

condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
i. Vacuum and mop concrete.
j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
l. Remove labels that are not permanent.
m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
p. Clean ducts, blowers, and coils.
q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
r. Clean strainers.
s. Leave Project clean and ready for occupancy.

C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.

D. Construction Waste Disposal: Comply with waste-disposal requirements in Section 017419 "Construction Waste Management and Disposal."

3.2 CORRECTION OF THE WORK

A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 01 7700

SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory manuals.
2. Emergency manuals.
3. Systems and equipment operation manuals.
4. Systems and equipment maintenance manuals.
5. Product maintenance manuals.

B. Related Requirements:

1. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.

B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Architect and Commissioning Authority will comment on whether content of operation and maintenance submittals is acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to

revisions and field conditions.

B. Format: Submit operation and maintenance manuals in the following format:

1. Submit by uploading to web-based project software site. Enable reviewer comments on draft submittals.

C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.

D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.

1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.

1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.

2. Table of contents.
3. Manual contents.

B. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for Construction Manager.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 EMERGENCY MANUALS

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

C. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:

1. Fire.
2. Flood.
3. Gas leak.
4. Water leak.
5. Power failure.
6. Water outage.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

D. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

E. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
2. Performance and design criteria if Contractor has delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.

9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

C. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

D. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.

1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.

    a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.

2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.

D. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.
3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

E. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7823

SECTION 01 7839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for Project Record Documents, including the following:

1. Record Drawings.
2. Record specifications.
3. Record Product Data.
4. Miscellaneous record submittals.

B. Related Requirements:

1. Section 017300 "Execution" for final property survey.
2. Section 017700 "Closeout Procedures" for general closeout procedures.
3. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:

1. Number of Copies: Submit one set(s) of marked-up record prints.
2. Number of Copies: Submit copies of Record Drawings as follows:

a. Initial Submittal:

1) Submit Record Digital Data Files and one set(s) of plots.
2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.

b. Final Submittal:

1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.

2) Print each drawing, whether or not changes and additional information were recorded.

B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.

C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.

1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.

E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.4 RECORD DRAWINGS

A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.

a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
b. Accurately record information in an acceptable drawing technique.
c. Record data as soon as possible after obtaining it.
d. Record and check the markup before enclosing concealed installations.
e. Cross-reference record prints to corresponding photographic documentation.

2. Content: Types of items requiring marking include, but are not limited to, the following:

a. Dimensional changes to Drawings.
b. Revisions to details shown on Drawings.
c. Depths of foundations.
d. Locations and depths of underground utilities.
e. Revisions to routing of piping and conduits.
f. Revisions to electrical circuitry.

g. Actual equipment locations.
h. Duct size and routing.
i. Locations of concealed internal utilities.
j. Changes made following Architect's written orders.
k. Details not on the original Contract Drawings.
l. Field records for variable and concealed conditions.
m. Record information on the Work that is shown only schematically.

3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.

B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:

1. Format: Annotated PDF electronic file with comment function enabled.
2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
3. Refer instances of uncertainty to Architect for resolution.
4. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.

a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
b. Architect will provide data file layer information. Record markups in separate layers.

C. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.

1. Format: Annotated PDF electronic file with comment function enabled.
2. Identification: As follows:

a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

1.5 RECORD SPECIFICATIONS

A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.

B. Format: Submit record specifications as annotated PDF electronic file.

1.6 RECORD PRODUCT DATA

A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.

B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.

1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.

C. Format: Submit Record Product Data as annotated PDF electronic file.

1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.7 MISCELLANEOUS RECORD SUBMITTALS

A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

B. Format: Submit miscellaneous record submittals as PDF electronic file.

1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

1.8 MAINTENANCE OF RECORD DOCUMENTS

A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7839

SECTION 01 7900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Instruction in operation and maintenance of systems, subsystems, and equipment.
2. Demonstration and training video recordings.

1.3 INFORMATIONAL SUBMITTALS

A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Qualification Data: For facilitator.

C. Attendance Record: For each training module, submit list of participants and length of instruction time.

D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.

1. Identification: On each copy, provide an applied label with the following information:

    a. Name of Project.
    b. Name and address of videographer.
    c. Name of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Date of video recording.

2. Transcript:

    a. Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

3. At completion of training, submit complete training manual(s) for Owner's use prepared in same PDF file format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.5 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.

D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:

1. Inspect and discuss locations and other facilities required for instruction.
2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
3. Review required content of instruction.
4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.6 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.

B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.7 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:

    a. System, subsystem, and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.

2. Documentation: Review the following items in detail:

    a. Emergency manuals.
    b. Systems and equipment operation manuals.
    c. Systems and equipment maintenance manuals.
    d. Product maintenance manuals.
    e. Project Record Documents.
    f. Identification systems.
    g. Warranties and bonds.
    h. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:

    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Instructions on stopping.
    c. Shutdown instructions for each type of emergency.
    d. Operating instructions for conditions outside of normal operating limits.
    e. Sequences for electric or electronic systems.
    f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:

    a. Startup procedures.
    b. Equipment or system break-in procedures.
    c. Routine and normal operating instructions.
    d. Regulation and control procedures.
    e. Control sequences.
    f. Safety procedures.
    g. Instructions on stopping.
    h. Normal shutdown instructions.
    i. Operating procedures for emergencies.
    j. Operating procedures for system, subsystem, or equipment failure.
    k. Seasonal and weekend operating instructions.
    l. Required sequences for electric or electronic systems.
    m. Special operating instructions and procedures.

5. Adjustments: Include the following:

    a. Alignments.
    b. Checking adjustments.
    c. Noise and vibration adjustments.
    d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:

    a. Diagnostic instructions.
    b. Test and inspection procedures.

7. Maintenance: Include the following:

    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventive maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.

8. Repairs: Include the following:

a. Diagnosis instructions.
b. Repair instructions.
c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
d. Instructions for identifying parts and components.
e. Review of spare parts needed for operation and maintenance.

1.8 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."

B. Set up instructional equipment at instruction location.

1.9 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

1. Schedule training with Owner with at least seven days' advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.

F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.10 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full HD mode with vibration reduction technology.

1. Submit video recordings by uploading to web-based Project software site.
2. File Hierarchy: Organize folder structure and file locations in accordance with Project Manual table of contents. Provide complete screen-based menu.
3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged in accordance with Project Manual table of contents:

    a. Name of Contractor/Installer.
    b. Business address.
    c. Business phone number.
    d. Point of contact.
    e. Email address.

C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.

1. Film training session(s) in segments not to exceed 15 minutes.

    a. Produce segments to present a single significant piece of equipment per segment.
    b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.

D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.

1. Furnish additional portable lighting as required.

E. Narration: Describe scenes on video recording by dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.

F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.

G. Preproduced Video Recordings: Provide video recordings used as a component of

training modules in same format as recordings of live training.

PART 2 - PRODUCTS (Not Used)
PART 3 - EXECUTION (Not Used)

END OF SECTION 01 7900

SECTION 02 4119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
Demolition and removal of selected site elements.
Salvage of existing items to be reused or recycled.

B. Related Sections:

1. Section 01 3233 - "Photographic Documentation".
Section 01 3591 – “Historic Treatment Procedures.”
2. Section 01 7419 - "Construction Waste Management"
3. Section 02 4296 - "Historic Removal and Dismantling"

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.

Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse.

Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.

Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

Materials Ownership: Historic items, relics, antiques, and similar objects including, but not limited to, stone, wall caps and copings, fence panels, drain covers, site furnishings and equipment, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.

1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Predemolition Photographs or Video: Submit before Work begins.

Statement of Refrigerant Recovery: Signed by refrigerant recovery technician.

Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection. Indicate proposed locations and construction of barriers.

Proposed Safey Plan: Indicate how facilities and site shall remain partially accessible and/or operational during demolition operations.

Schedule of selective demolition activities with starting and ending dates of each activity.

1.5 CLOSEOUT SUBMITTALS

A. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

B. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

C. Hazardous Materials: Hazardous materials are present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.

D. Storage or sale of removed items or materials on-site is not permitted.

Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.8 WARRANTY

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

PART 2 - PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.

Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and/ or preconstruction videotapes.

1. Comply with requirements specified in Section 01 3233 "Photographic Documentation."

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

1. Comply with requirements for existing services/systems interruptions specified in Section 01 1000 "Summary."

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Owner will arrange to shut off indicated services/systems when requested by Contractor. Provide Owner minimum 7 days notice prior to shutdown.

If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.

a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

Equipment to Be Removed: Disconnect and cap services and remove equipment.

Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Comply with requirements for access and protection specified in Section 01 5000 "Temporary Facilities and Controls."

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
Dispose of demolished items and materials promptly. Comply with requirements in Section 01 7419 "Construction Waste Management and Disposal."

B. Reuse of Building Elements: Project has been designed to result in end-of-Project rates for reuse of building elements. Do not demolish building elements beyond what is indicated on Drawings without Architect's approval.

1. Building Structure and Shell: 75 percent.

C. Removed and Salvaged Items:

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

D. Removed and Reinstalled Items:

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

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

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 4119

SECTION 02 4296 - HISTORIC REMOVAL AND DISMANTLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes historic treatment procedures in the form of special types of selective demolition work for designated historic spaces, areas, rooms, and surfaces and the following specific work:

1. Removal and dismantling of indicated portions of building or structure and debris hauling. Salvage of existing items to be reused or recycled.

B. Related Sections:

1. Section 01 3591 "Historic Treatment Procedures"
Section 01 3200 "Construction Progress Documentation"
Section 01 7419 "Construction Waste Management"
Section 02 4119 "Selective Demolition"
Section 02 4296 "Historic Removal and Dismantling"

1.3 DEFINITIONS

A. Dismantle: To disassemble or detach a historic item from a surface, or a nonhistoric item from a historic surface, using gentle methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

Existing to Remain: Existing items that are not to be removed or dismantled, except to the degree indicated for performing required Work.

Remove: To take down or detach a nonhistoric item located within a historic space, area, or room, using methods and equipment to prevent damage to historic items and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

Retain: To keep existing items that are not to be removed or dismantled.

Salvage: To protect removed or dismantled items and deliver them to Owner.

1.4 FIELD CONDITIONS

A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.

B. Hazardous Materials: Hazardous materials are present in construction affected by removal and dismantling work. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.

1. Hazardous material remediation is specified elsewhere in the Contract Documents.

Do not disturb hazardous materials or items suspected of containing hazardous materials, except under procedures specified elsewhere in the Contract Documents.

If unanticipated asbestos is suspected, stop work in the area of potential hazard, shut off fans and other air handlers ventilating the area, and rope off area until the questionable material is identified. Reassign workers to continue work in unaffected areas. Resume work in the area of concern after safe working conditions are verified.

C. Storage of removed or dismantled items on-site is not permitted unless otherwise indicated.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 HISTORIC REMOVAL AND DISMANTLING EQUIPMENT

A. Removal Equipment: Use only hand-held tools, except as follows or unless otherwise approved by Architect on a case-by-case basis:

1. Light jackhammers are allowed subject to Architect's approval.

Large air hammers are not permitted.

B. Dismantling Equipment: Use manual, hand-held tools, except as follows or otherwise approved by Architect on a case-by-case basis:

1. Hand-held power tools and cutting torches are permitted only as submitted in the historic treatment program. They must be adjustable so as to penetrate or cut only the thickness of material being removed.

Pry bars more than 18 inches long and hammers weighing more than 2 lb are not permitted for dismantling work.

3.2 EXAMINATION

A. Preparation for Removal and Dismantling: Examine construction to be removed or dismantled to determine best methods to safely and effectively perform removal and dismantling work. Examine adjacent work to determine what protective measures are necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed or dismantled and location of utilities and services to remain that may be hidden by construction that is to be removed or dismantled.

1. Verify that affected utilities are disconnected and capped.

Inventory and record the condition of items to be removed and dismantled for reinstallation or salvage. Enter this information on the submittal of inventory of salvaged items.

Before removal or dismantling of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

Engineering Survey: Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures as a result of the work.

B. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.

1. Comply with requirements specified in Section 01 3233 "Photographic Documentation."

C. Perform surveys as the Work progresses to detect hazards resulting from historic removal and dismantling procedures.

3.3 HISTORIC REMOVAL AND DISMANTLING

A. General: Have removal and dismantling work performed by a qualified historic removal and dismantling specialist. Ensure that historic removal and dismantling specialist's field supervisors are present when removal and dismantling work begins and during its progress.

Unacceptable Equipment: Keep equipment that is not permitted for historic removal or dismantling work away from the vicinity where such work is being performed.

Removing and Dismantling Items on or Near Historic Surfaces:

1. Use only dismantling equipment and procedures within 12 inches of historic surface. Do not use pry bars. Protect historic surface from contact with or damage by tools.

Unfasten items in the opposite order from which they were installed.

Support each item as it becomes loosened to prevent stress and damage to the historic surface.

Dismantle anchorages.

B. Loose Plaster: Identify loose, nonhistoric plaster, and separate it from its substrate by tapping with a hammer and prying with a chisel or screwdriver. Do not use pry bars. Leave sound, firmly adhered plaster in place. Do not damage, remove, or dismantle historic plasterwork, except where indicated or where it is an immediate hazard to personnel and as approved by Architect.

END OF SECTION 02 4296

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Exterior slabs.

B. Related Sections include the following:

1. Division 2 Section "Earthwork".

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 SUBMITTALS

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

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.
2. Include strength test records for each mix design.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement in accordance with ACI 315 “Details and Detailing of Concrete Reinforcement”. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Material Test Reports: For each type of product indicated, indicating compliance with requirements.

E. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.
4. Curing compounds.
5. Bonding agents.
6. Adhesives.
7. Vapor barriers.
8. Repair materials.

F. Field quality-control test and inspection reports.

G. LEED Submittals.
1. LEED Materials Certification Form. Information to be supplied for this Form shall include:
   a. The percentages of pre-consumer and/or post-consumer recycled content in the supplied products.
   b. Indication of whether the raw materials have been extracted, harvested, or recovered, and the final product has been manufactured within 500 miles of the project site
2. VOC Reporting Form: For all installed products and materials, provide VOC content in grams/liter or lbs/gallon.

1.5 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, qualified according to ASTM C 1077 and ASTM E 329 for testing and inspections indicated.

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

D. Codes and Standards: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
3. ACI 347, “Guide to Formwork of Concrete”.
4. ACI 315, “Details and Detailing of Concrete Reinforcement”.

E. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 1064, galvanized.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 1064, galvanized.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II.
2. Fly Ash: ASTM C 618, Class F.
3. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
4. Blended Hydraulic Cement: ASTM C 595, Type IS or IL.
5. Silica Fume: ASTM C 1240, amorphous silica.

B. Normal-Weight Aggregates: ASTM C 33. Provide aggregates from a single source.

1. Coarse-Aggregate: Well-graded crushed stone or washed gravel with maximum aggregate size of 1-1/2 inches nominal for foundations and 1 inch for walls, slabs, beams and columns.
2. Fine Aggregate: Well-graded, washed, natural or manufactured sand free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

2.4 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Accelerating Admixture: ASTM C 494, Type C.
4. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
6. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
8. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.5 VAPOR BARRIERS

A. Polyolefin Geomembrane

1. Provide a 15 mil thick polyolefin geomembrane manufactured from ISO certified virgin resins under foundation slabs and on walls over polymeric waterproofing membrane conforming to ASTM E 1745, Class A.
   a. Permeance rating, ASTM E 96: 0.012 perms or lower.
   b. Puncture resistance, ASTM E 1745: minimum 2200 grams.
   c. Tensile strength, ASTM E 1745: minimum 50.0 lbf/in.
   d. Use a high density polyethylene tape with a minimum width of 4”.

2.6 CURING MATERIALS

A. Evaporation Retarder

1. Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
2. Products, not limited to the following:
   a. ChemMasters; Spray-Film.
   b. Dayton Superior Corporation; Sure Film.
   c. Euclid Chemical Company (The); Eucobar.
   d. Kaufman Products, Inc.; Vapor Aid.
   e. Lambert Corporation; Lambco Skin.
   f. Meadows, W. R., Inc.; Sealtight Evapre.
   g. Nox-Crete Products Group, Kinsman Corporation; Monofilm.
   h. Sika Corporation, Inc.; SikaFilm.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Curing Compound: Clear, waterborne, membrane-forming compound conforming to ASTM C 309, Type 1, Class B, dissipating.
   1. Products, not limited to the following:

      a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
      b. ChemMasters; Safe-Cure Clear.
      c. Euclid Chemical Company (The); Kurez DR VOX.
      d. Kaufman Products, Inc.; Thinfilm 420.
      e. Lambert Corporation; Aqua Kure-Clear.
      f. Meadows, W. R., Inc.; 1100 Clear.

2.7 RELATED MATERIALS

A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 per ASTM D 2240.

B. Expansion Joint Filler: Premolded joint filler as follows:
   1. Filler not exposed to traffic or weather shall meet requirements of ASTM D994.
   2. Filler exposed to traffic or weather shall meet requirements of ASTM D1751 or ASTM D1752

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 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. The proposed mix designs shall be accompanied by complete standard deviation analysis or trial mixture data.

B. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

C. The proposed mix design shall identify the amount of water to be withheld for addition at the project site.

D. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

   1. Fly Ash: 25 percent.
   2. Combined Fly Ash and Pozzolan: 25 percent.
   3. Ground Granulated Blast-Furnace Slag: 50 percent.

4. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Ground Granulated Blast-Furnace Slag, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

E. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.9 CONCRETE MIXTURES FOR STRUCTURAL ELEMENTS

A. Minimum Compressive Strength: 4500 psi at 28 days.

B. Maximum Water-Cementitious Materials Ratio: 0.45

C. Slump Limit: Select target slump for each concrete mixture not to exceed 9 in.

D. Air Content: 5-1/2 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

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

B. Perform cutting and bending in the shop to the greatest extent possible. Bend steel cold. Do not bend or straighten bars in a manner that will injure the material. Do not bend bars in the field except to correct minor errors or damage in shipment or handling, or to make shipment of certain bars practicable.

C. Furnish reinforcing bars in full lengths as shown on the Contract Documents. Do not splice bars unless specifically approved by the Architect.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete:

1. Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.

2. 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. Project-Site Mixing:

1. Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M.
2. Mix concrete materials in appropriate drum-type batch machine mixer.
3. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
4. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd.

C. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

B. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

C. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.2 VAPOR BARRIERS

A. Polyolefin Geomembrane

1. Deliver and store in accordance with manufacturer’s recommendations.
2. Prepare subgrade in accordance with geotechnical requirements and manufacturer’s recommendations.
3. Place, protect, and repair vapor barriers according to ASTM E 1643 and manufacturer's written instructions.
4. Lap joints 6 inches and seal with manufacturer's recommended tape. Seal all penetrations and block-outs per manufacturer’s instructions.

B. Granular Course: Cover vapor retarder with granular fill, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch or minus 3/4 inch.

1. Place and compact a 1/2-inch- thick layer of fine-graded granular material over granular fill.

3.3 STEEL REINFORCEMENT

A. Comply with Concrete Reinforcing Steel Institute's recommended practices presented in "Placing Reinforcing Bars".

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
1. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
2. Do not tack weld crossing reinforcing bars.
3. Reinforcing steel in the bottom of slabs resting on earth may be supported by concrete, brick, or mortar blocks. Do not use stones, clay bricks, wood blocks, or pieces of broken concrete to support reinforcing steel.

3.4 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints

1. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by the Architect.
2. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of slabs on grade.
4. Keyed joints are used in walls and floors and between walls and slabs or footings. Form keyed joints as indicated.

a. Embed keys at least 1-1/2 inches into concrete.
b. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
c. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
d. Space vertical joints in walls every 20 feet.
e. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
f. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade:

1. Form weakened-plane contraction joints, sectioning concrete into areas as close to square as possible, avoiding L- and T-shaped panels. Contraction joints should be straight and continuous, never staggered.
2. Maximum joint spacing shall be 36 times the slab thickness, unless otherwise noted.
3. Minimum contraction joint depth shall be one-fourth of concrete thickness, unless otherwise noted.
4. Grooved Joints

a. Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch.
b. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.

5. Sawed Joints
   a. Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades.
   b. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade

1. 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.
2. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
3. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
4. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints

1. Install dowel bars and support assemblies at joints where indicated.
2. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.5 CONCRETE PLACEMENT

A. General

1. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Provide temporary protective covering of adjacent surfaces to guard against spattering during placement.
2. Comply with ACI 304 “Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete”.
3. Before test sampling and placing concrete, water may be added at Project site up to the amount specified in the mix proportions, subject to limitations of ACI 301. Do not add water to concrete after adding high-range water-reducing admixtures to mixture and do not exceed the specified w/cm ratio.
4. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
5. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
6. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301 and ACI 309 “Guide for Consolidation of Concrete”.

a. Do not use vibrators to transport concrete inside forms.
b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
d. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

7. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
8. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
9. Maintain reinforcement in position on chairs during concrete placement.
10. Screed slab surfaces with a straightedge and strike off to correct elevations.
11. Slope surfaces uniformly to drains where required.
12. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
13. Do not further disturb slab surfaces before starting finishing operations.

B. Cold-Weather Placement:

1. Comply with ACI 306.1 and as follows: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When average air temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
4. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

C. Hot-Weather Placement

1. Comply with ACI 305.1 and as follows: Protect from hot weather conditions which can impair the quality and strength of concrete.

a. Maintain concrete temperature below 90 deg F at time of placement.
b. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water.
c. Using liquid nitrogen to cool concrete at Contractor's option.
d. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete.
e. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.6 FINISHING FLOORS AND SLABS

A. General

1. Comply with recommendations of ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
2. After screeding, consolidating, and leveling concrete slabs, do not work surface or begin floating until all bleed water had disappeared.

B. Float finish: Apply a float finish to slabs not exposed to view and exterior concrete to receive broom finish.

C. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.

D. Trowel Finish: Apply to interior slab surfaces that are exposed to view and slab surfaces to receive carpet, ceramic tile, paint, or other thin coating system.
   1. Immediately after float finish, begin trowelling operation using a power-driven trowel to uniform texture and appearance.
   2. Apply fine broom finish after trowelling to surfaces that will receive tile on mortar bed and where required by the waterproofing manufacturer.

3.7 MISCELLANEOUS CONCRETE ITEMS

A. Filling In

   1. Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place.
   2. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs

   1. Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations

   1. Provide machine and equipment bases and foundations as shown on the Contract Documents.
   2. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.8 CONCRETE PROTECTING AND CURING

A. General

   1. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.
   2. Start initial curing right after finishing, and keep continuously moist for at least 7 days. Begin final curing immediately after initial curing and continue for at least 7 days. Use sun shades, wind breaks, and evaporation retardant when necessary in accordance with ACI 308 recommendations.

B. Evaporation Retarder

1. 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.
2. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Unformed Surfaces

1. Begin curing immediately after finishing concrete.
2. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
3. Cure concrete surfaces to receive floor coverings or floor treatments by moist-curing, moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering.
4. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

    a. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

        1) Water.
        2) Continuous water-fog spray.
        3) Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers

    b. Moisture-Retaining-Cover Curing

        1) 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.
        2) Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    c. Curing Compound

        1) Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions.
        2) Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
        3) After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

    d. Curing and Sealing Compound:

        1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions.
        2) Recoat areas subjected to heavy rainfall within three hours after initial application.
        3) Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 CONCRETE SURFACE REPAIRS

A. Defective Concrete

1. Repair and patch defective areas as approved by the Architect.
2. Remove and replace concrete that cannot be repaired and patched to the Architect’s approval.

B. Patching Mortar

1. Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Unformed Surfaces

1. Surface defects include crazing, cracks wider than 0.01” or which penetrate to reinforcement regardless of width, spalls, pop-outs, honeycombs, rock pockets, voids and other objectionable conditions.
2. Repair defects on unformed surfaces that affect concrete's durability and structural performance as determined by the Architect, by cutting out defective area to sound concrete. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with fresh concrete to match existing before bonding agent has dried.
3. Repair isolated random cracks with the specified crack sealer following manufacturer’s instructions.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Headed bolts and studs and other embedded items.
3. Verification of use of required design mixture.
4. Concrete placement, including conveying and depositing.
5. Curing procedures and maintenance of curing temperature.

C. Concrete Tests

1. Contractor shall provide space and source of electrical power on the project site for facilities to be used for initial curing of concrete test specimens as required by ASTM C 31 for the use of the Testing Agency.

2. Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

   a. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

b. 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.

3. Slump

a. ASTM C 143/C 143M; one test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests when concrete consistency appears to change.

4. Air Content

a. ASTM C 231; pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature:

a. ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

6. Unit Weight

a. ASTM C 138; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C 31/C 31M.

a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
b. Cast and field cure sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M

a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
b. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
c. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
d. Test results shall be reported in writing to the 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.

9. Nondestructive Testing

a. Impact hammer, sonoscope, or other nondestructive device may be permitted by the Architect but will not be used as sole basis for approval or rejection of concrete.

D. Additional Tests

1. 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 the Architect.
2. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by the Architect.
3. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
4. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 03 3000

SECTION 040310 - HISTORIC MASONRY CLEANING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes historic treatment work consisting of cleaning historic clay brick and stone masonry surfaces.

B. Related Requirements:

1. Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.2 DEFINITIONS

A. Very Low-Pressure Spray: Less than 100 psi.

B. Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

C. Medium-Pressure Spray: 400 to 800 psi; 4 to 6 gpm.

D. High-Pressure Spray: 800 to 1200 psi; 4 to 6 gpm.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference on historic masonry cleaning at Project site.

1. Review methods and procedures related to cleaning historic masonry, including, but not limited to, the following:

a. Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
b. Materials, material application, and sequencing.
c. Quality-control program.
d. Fire-protection plan.
e. Cleaning program.
f. Coordination with building occupants.

1.4 SEQUENCING AND SCHEDULING

A. Work Sequence: Perform historic masonry cleaning work in the following sequence:

1. Remove plant growth.

2. Inspect masonry for open mortar joints. Where repairs are required, delay further cleaning work until after repairs are completed, cured, and dried to prevent the intrusion of water and other cleaning materials into the wall.
3. Remove paint.
4. Clean masonry.
5. Where water repellents or graffiti-resistant coatings are to be used on or near masonry work, delay application of these chemicals until after cleaning.

B. As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to historic masonry repair Sections. Patch holes in mortar joints according to historic masonry repointing Sections.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include material descriptions and application instructions.
2. Include test data substantiating that products comply with requirements.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For historic treatment specialists including field supervisors and workers paint-remover manufacturer and chemical-cleaner manufacturer.

B. Quality-control program.

C. Cleaning program.

1.7 QUALITY ASSURANCE

A. Historic Treatment Specialist Qualifications: A qualified historic masonry cleaning specialist. Experience cleaning new masonry work is insufficient experience for historic treatment work.

B. Paint-Remover Manufacturer Qualifications: A firm regularly engaged in producing masonry paint removers that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

C. Chemical-Cleaner Manufacturer Qualifications: A firm regularly engaged in producing masonry cleaners that have been used for similar applications with successful results, and with factory-authorized service representatives who are available for consultation and Project-site inspection, preconstruction product testing, and on-site assistance.

D. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

E. Cleaning Program: Prepare a written cleaning program that describes cleaning process in detail, including materials, methods, sequence, and equipment to be used; protection of surrounding materials; and control of runoff during operations.

1. If materials and methods other than those indicated are proposed for any phase of cleaning work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

F. Mockups: Prepare mockups of cleaning on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Cleaning: Clean an area approximately 25 sq. ft. for each type of masonry and surface condition.

a. Test cleaners and methods on samples of adjacent materials for possible adverse reactions. Do not test cleaners and methods known to have deleterious effect.
b. Allow a waiting period of not less than seven days after completion of sample cleaning to permit a study of sample panels for negative reactions.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit masonry cleaning work to be performed according to product manufacturers' written instructions and specified requirements.

B. Clean masonry surfaces only when air temperature is 40 deg F and above and is predicted to remain so for at least seven days after completion of cleaning.

PART 2 - PRODUCTS

2.1 PAINT REMOVERS

A. Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation, for removing paint from masonry; and containing no methylene chloride.

B. Covered or Skin-Forming Alkaline Paint Remover: Manufacturer's standard covered or skin-forming, alkaline paste or gel formulation, for removing paint from masonry; and containing no methylene chloride.

C. Solvent-Type Paste Paint Remover: Manufacturer's standard water-rinsable, solvent-type paste or gel formulation, for removing paint from masonry.

D. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry; and containing no methanol or methylene chloride.

E. Covered, Solvent-Type Paste Paint Remover: Manufacturer's standard, low-odor, covered, water-rinsable, solvent-type paste or gel formulation for removing paint from masonry; and containing no methanol or methylene chloride.

2.2 CLEANING MATERIALS

A. Water: Potable.

B. Hot Water: Water heated to a temperature of 140 to 160 deg F.

C. Detergent Solution, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent, and 20 quarts of hot water for every 5 gal. of solution required.

D. Mold, Mildew, and Algae Remover, Job Mixed: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 5 quarts of 5 percent sodium hypochlorite (bleach), and 15 quarts of hot water for every 5 gal. of solution required.

E. Nonacidic Gel Cleaner: Manufacturer's standard gel formulation, with pH between 6 and 9, that contains detergents with chelating agents and is specifically formulated for cleaning masonry surfaces.

F. Nonacidic Liquid Cleaner: Manufacturer's standard mildly alkaline liquid cleaner formulated for removing mold, mildew, and other organic soiling from ordinary building materials, including polished stone, brick, aluminum, plastics, and wood.

G. Mild-Acid Cleaner: Manufacturer's standard mild-acid cleaner containing no muriatic (hydrochloric), hydrofluoric, or sulfuric acid; or ammonium bifluoride or chlorine bleaches.

H. Acidic Cleaner: Manufacturer's standard acidic masonry cleaner composed of hydrofluoric acid or ammonium bifluoride blended with other acids, detergents, wetting agents, and inhibitors.

I. Two-Part Chemical Cleaner: Manufacturer's standard system consisting of potassium- or sodium-hydroxide-based, alkaline prewash cleaner and acidic afterwash cleaner that does not contain hydrofluoric acid.

2.3 ACCESSORY MATERIALS

A. Liquid Strippable Masking Agent: Manufacturer's standard liquid, film-forming, strippable masking material for protecting glass, metal, glazed masonry, and polished stone surfaces from damaging effects of acidic and alkaline masonry cleaners.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.

2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

    a. Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in contract.
    b. Leave residue on surfaces.

2.4 CHEMICAL-CLEANING SOLUTIONS

A. Dilute chemical cleaners with water to produce solutions not exceeding concentration recommended in writing by chemical-cleaner manufacturer.

B. Acidic Cleaner Solution for Brick and Unpolished Stone: Dilute acidic cleaner with water to produce hydrofluoric acid content of 3 percent or less, but not greater than that recommended in writing by chemical-cleaner manufacturer.

    1. Stones: Use only on unpolished granite, unpolished dolomite marble, and siliceous sandstone.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

A. Historic Treatment Specialist Firms: Subject to compliance with requirements, firms that may provide historic masonry cleaning include, but are not limited to, the following:

    1. Structural Restoration Services, Inc. 1 - 800 -775 -1004.
    2. Coastal Exteriors, LLC 410 - 252 - 3411
    3. Worcester Eisenbrandt 410 - 644 - 6580

3.2 PROTECTION

A. Remove associated hardware adjacent to immediate work area and store during masonry cleaning. Reinstall when masonry cleaning is complete.

    1. Provide temporary rain drainage during work to direct water away from building.

3.3 CLEANING MASONRY, GENERAL

A. Cleaning Appearance Standard: Cleaned surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

B. Proceed with cleaning in an orderly manner; work from top to bottom of each scaffold width and from one end of each elevation to the other. Ensure that dirty residues and rinse water do not wash over dry, cleaned surfaces.

C. Use only those cleaning methods indicated for each masonry material and location.

1. Brushes: Do not use wire brushes or brushes that are not resistant to chemical cleaner being used.
2. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that cleaning methods do not damage masonry.

    a. Equip units with pressure gauges.
    b. For chemical-cleaner spray application, use low-pressure tank or chemical pump suitable for chemical cleaner indicated, equipped with nozzle having a cone-shaped spray.
    c. For water-spray application, use fan-shaped spray that disperses water at an angle of 25 to 50 degrees.
    d. For high-pressure water-spray application, use fan-shaped spray that disperses water at an angle of at least 40 degrees.
    e. For heated water-spray application, use equipment capable of maintaining temperature between 140 and 160 deg F at flow rates indicated.
    f. For steam application, use steam generator capable of delivering live steam at nozzle.

D. Perform each cleaning method indicated in a manner that results in uniform coverage of all surfaces, including corners, moldings, and interstices, and that produces an even effect without streaking or damaging masonry surfaces. Keep wall wet below area being cleaned to prevent streaking from runoff.

E. Perform additional general cleaning, paint and stain removal, and spot cleaning of small areas that are noticeably different when viewed according to the "Cleaning Appearance Standard" Paragraph above, so that cleaned surfaces blend smoothly into surrounding areas.

F. Water Application Methods:

1. Water-Soak Application: Soak masonry surfaces by applying water continuously and uniformly to limited area for time indicated. Apply water at low pressures and low volumes in multiple fine sprays using perforated hoses or multiple spray nozzles. Erect a protective enclosure constructed of polyethylene sheeting to cover area being sprayed.
2. Water-Spray Applications: Unless otherwise indicated, hold spray nozzle at least 6 inches from masonry surface, and apply water in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

G. Steam Cleaning: Apply steam to masonry surfaces at the very low pressures indicated for each type of masonry. Hold nozzle at least 6 inches from masonry surface, and apply steam in horizontal back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.

H. Chemical-Cleaner Application Methods: Apply chemical cleaners to masonry surfaces according to chemical-cleaner manufacturer's written instructions; use brush or spray application. Do not spray apply at pressures exceeding 50 psi. Do not allow chemicals to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

I. Rinse off chemical residue and soil by working upward from bottom to top of each treated area at each stage or scaffold setting. Periodically during each rinse, test pH of rinse water running off of cleaned area to determine that chemical cleaner is completely removed.

1. Apply neutralizing agent and repeat rinse if necessary to produce tested pH of between 6.7 and 7.5.

J. After cleaning is complete, remove protection no longer required. Remove tape and adhesive marks.

3.4 PRELIMINARY CLEANING

A. Removing Plant Growth: Completely remove visible plant, moss, and shrub growth from masonry surfaces. Carefully remove plants, creepers, and vegetation by cutting at roots and allowing remaining growth to dry as long as possible before removal. Remove loose soil and plant debris from open masonry joints to whatever depth they occur.

B. Preliminary Cleaning: Before beginning general cleaning, remove extraneous substances that are resistant to planned cleaning methods. Extraneous substances include paint, calking, asphalt, and tar.

1. Carefully remove heavy accumulations of rigid materials from masonry surface with sharp chisel. Do not scratch or chip masonry surface.
2. Remove paint and calking with alkaline paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Repeat application up to two times if needed.

3. Remove asphalt and tar with solvent-type paste paint remover.

    a. Comply with requirements in "Paint Removal" Article.
    b. Apply paint remover only to asphalt and tar by brush without prewetting.
    c. Allow paint remover to remain on surface for 10 to 30 minutes.
    d. Repeat application if needed.

3.5 PAINT REMOVAL

A. Paint-Remover Application, General: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.

B. Paint Removal with Alkaline Paste Paint Remover:

1. Remove loose and peeling paint using low -pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with brushes.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and paint residue.
5. Repeat process if necessary to remove all paint.
6. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
7. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.

C. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:

1. Remove loose and peeling paint using low -pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low -pressure spray to remove chemicals and paint residue.
7. Apply acidic cleaner or manufacturer's recommended afterwash to surface, while surface is still wet, using low-pressure spray equipment or soft-fiber brush. Let cleaner or afterwash remain on surface as a neutralizing agent for period recommended in writing by chemical-cleaner or afterwash manufacturer.
8. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
9. For spots of remaining paint, apply alkaline paste paint remover according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph.

D. Paint Removal with Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low -pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply thick coating of paint remover to painted surface with natural-fiber cleaning brush, deep-nap roller, or large paint brush. Apply in one or two coats according to manufacturer's written instructions.
3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and paint residue.

E. Paint Removal with Covered, Solvent-Type Paste Paint Remover:

1. Remove loose and peeling paint using low -pressure water spray, scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
2. Apply paint remover to dry, painted surface with trowel, spatula, or as recommended in writing by manufacturer.
3. Apply cover according to manufacturer's written instructions.
4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
5. Scrape off paint and remover.
6. Rinse with cold water applied by low -pressure spray to remove chemicals and paint residue.

3.6 CLEANING BRICKWORK

A. Cold-Water Soak:

1. Apply cold water by intermittent spraying to keep surface moist.
2. Use perforated hoses or other means that apply a fine water mist to entire surface being cleaned.
3. Apply water in cycles of 5 minutes on and 20 minutes off.

4. Continue spraying until surface encrustation has softened sufficiently to permit its removal by water wash, as indicated by cleaning tests.
5. Remove soil and softened surface encrustation from surface with cold water applied by low-pressure spray.

B. Cold-Water Wash: Use cold water applied by low -pressure spray.

C. Hot-Water Wash: Use hot water applied by low -pressure spray.

D. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi. Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.

E. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low -pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

F. Mold, Mildew, and Algae Removal:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by low -pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

G. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply gel cleaner in 1/8-inch thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period established by mockup.
4. Remove bulk of gel cleaner.
5. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
6. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

H. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.

2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period established by mockup.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

I. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period established by mockup.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

J. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period established by mockup.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.7 CLEANING UNPOLISHED STONEWORK

A. Cold-Water Soak:

1. Apply cold water by intermittent spraying to keep surface moist.
2. Use perforated hoses or other means that will apply a fine water mist to entire surface being cleaned.
3. Apply water in cycles of 5 minutes on and 20 minutes off.
4. Continue spraying until surface encrustation has softened sufficiently to permit its removal by water wash, as indicated by cleaning tests.
5. Remove soil and softened surface encrustation from surface with cold water applied by low-pressure spray.

B. Cold-Water Wash: Use cold water applied by low -pressure spray.

C. Hot-Water Wash: Use hot water applied by low -pressure spray.

D. Steam Cleaning: Apply steam at very low pressures not exceeding 30 psi. Remove dirt softened by steam with wood scrapers, stiff-nylon or -fiber brushes, or cold-water wash, as indicated by cleaning tests.

E. Detergent Cleaning:

1. Wet surface with cold water applied by low-pressure spray.

2. Scrub surface with detergent solution using medium-soft brushes until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from mortar joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet.
3. Rinse with cold water applied by low -pressure spray to remove detergent solution and soil.
4. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

F. Mold, Mildew, and Algae Removal:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply mold, mildew, and algae remover by brush or low-pressure spray.
3. Scrub surface with medium-soft brushes until mold, mildew, and algae are thoroughly dislodged and can be removed by rinsing. Use small brushes for mortar joints and crevices. Dip brush in mold, mildew, and algae remover often to ensure that adequate fresh cleaner is used and that surface remains wet.
4. Rinse with cold water applied by low -pressure spray to remove mold, mildew, and algae remover and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup.

G. Nonacidic Gel Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply gel cleaner in 1/8-inch thickness by brush, working into joints and crevices. Apply quickly and do not brush out excessively, so area is uniformly covered with fresh cleaner and dwell time is uniform throughout area being cleaned.
3. Let cleaner remain on surface for period established by mockup.
4. Remove bulk of gel cleaner.
5. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
6. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

H. Nonacidic Liquid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period established by mockup.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

I. Mild-Acid Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period established by mockup.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and soil.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

J. Acidic Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply cleaner to surface in two applications by brush or low-pressure spray.
3. Let cleaner remain on surface for period established by mockup.
4. Rinse with cold water applied by low -pressure spray to remove chemicals and soil. Rinse until all foaming, if any, stops and suds disappear.
5. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

K. Two-Part Chemical Cleaning:

1. Wet surface with cold water applied by low-pressure spray.
2. Apply alkaline prewash cleaner to surface by brush or roller.
3. Let cleaner remain on surface for period recommended in writing by chemical-cleaner manufacturer unless otherwise indicated.
4. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
5. Apply acidic afterwash cleaner to terra cotta in two applications, while surface is still wet, using low-pressure spray equipment, deep-nap roller or soft-fiber brush.
6. Let neutralizer remain on surface for period recommended in writing by manufacturer unless otherwise indicated.
7. Rinse with cold water applied by medium-pressure spray to remove chemicals and soil.
8. Repeat cleaning procedure above, where required to produce cleaning effect established by mockup. Do not repeat more than once. If additional cleaning is required, use steam cleaning.

3.8 FINAL CLEANING

A. Clean adjacent non masonry surfaces of spillage and debris. Use detergent and soft brushes or cloths.

B. Remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

C. Remove masking materials, leaving no residues that could trap dirt.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

B. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

C. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 040310

SECTION 040322 - HISTORIC BRICK UNIT MASONRY REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

Section includes historic treatment work consisting of repairing historic clay brick masonry as follows:

Repairing unit masonry, including replacing units.
1. Removing abandoned anchors.
2. Painting steel uncovered during the work.
3. Reanchoring veneers.

Related Requirements:

Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.
4. Section 024296 "Historic Removal and Dismantling" for historic removal and dismantling work.
5. Section 040323 “Historic Brick Unit Masonry Repointing”
6. Section 076200 "Sheet Metal Flashing and Trim" for metal flashing installed in or on repaired masonry.

1.3 DEFINITIONS

Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

B. Saturation Coefficient: Ratio of the weight of water absorbed during immersion in cold water to weight absorbed during immersion in boiling water; used as an indication of resistance of masonry units to freezing and thawing.

1.4 PREINSTALLATION MEETINGS

Preinstallation Conference: Conduct conference on historic masonry repair and repointing at Project site.
1. Review methods and procedures related to repairing historic brick masonry, including, but not limited to, the following:

Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
a. Materials, material application, sequencing, tolerances, and required clearances.

b. Quality-control program.
c. Fire-protection plan.
d. Unit masonry historic treatment program.
e. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

Order sand and gray portland cement for colored mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

A. Work Sequence: Perform masonry historic treatment work in the following sequence, which includes work specified in this and other Sections:

Remove plant growth.

1. Inspect masonry for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
2. Remove paint.
3. Clean masonry.
4. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
5. Repair masonry, including replacing existing masonry with new masonry materials.
6. Rake out mortar from joints to be repointed.
7. Point mortar and sealant joints.
8. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
9. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to "Masonry Unit Patching" Article. Patch holes in mortar joints according to Section 040323 "Historic Brick Unit Masonry Repointing."

1.6 ACTION SUBMITTALS

Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

Shop Drawings:

Include plans, elevations, sections, and locations of masonry repair work on the structure.

2. Show full-size patterns with complete dimensions for new molded brick shapes and brick arches and their jointing, showing relationship of existing units to new units.
3. Show provisions for expansion joints or other sealant joints.
4. Show provisions for flashing, lighting fixtures, conduits, and weep holes as required.

5. Show replacement and repair anchors. Include details of anchors within individual masonry units, with locations of anchors and dimensions of holes and recesses in units required for anchors.
6. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of each point of contact or anchorage.

Samples for Initial Selection: For the following:

Colored Mortar: Submit sets of mortar that will be left exposed in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.

Have each set contain a close color range of at least six Samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.

a. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

Sand Types Used for Mortar: Minimum 8 oz. of each in plastic screw-top jars.

For blended sands, provide Samples of each component and blend. Identify blend ratio.

b. Identify sources, both supplier and quarry, of each type of sand.

Patching Compound: Submit sets of patching compound Samples in the form of plugs (patches in drilled holes) in sample units of masonry representative of the range of masonry colors on the building.

Have each set contain a close color range of at least **six** Samples of different mixes of patching compound that match the variations in existing masonry when cured and dry.

Include similar Samples of accessories involving color selection.

Samples for Verification: For the following:

Each type of masonry unit to be used for replacing existing units. Include sets of Samples to show the full range of shape, color, and texture to be expected.

For each brick type, provide straps or panels containing at least four bricks. Include multiple straps for brick with a wide range.

Each type of patching compound in the form of briquettes, at least 3 inches long by 1-1/2 inches wide. Document each Sample with manufacturer and stock number or other information necessary to order additional material.

7. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.7 INFORMATIONAL SUBMITTALS

Qualification Data: For historic treatment specialists .

A. Quality-control program.

B. Unit masonry historic treatment program.

1.8 QUALITY ASSURANCE

Historic Treatment Specialist Qualifications: A qualified historic brick masonry repair specialist. Experience installing standard unit masonry is insufficient experience for masonry historic treatment work.

Historic Treatment Worker Qualifications: When masonry units are being patched, assign at least one worker per crew who is trained and certified by manufacturer of patching compound to apply its products.

Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

A. Unit Masonry Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of historic treatment work, including protection of surrounding materials and Project site.

Include methods for keeping exposed mortar damp during curing period.

1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation.

Masonry Repair: Prepare sample areas for each type of masonry material indicated to have repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work. Include the following as a minimum:

Replacement: Four brick units replaced.

a. Reanchoring Veneers: Install three masonry repair anchors in mockup wall assembly of each anchor type required.
b. Patching: Three small holes at least 1 inch in diameter for each type of brick material indicated to be patched, so as to leave no evidence of repair.

Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on masonry units as follows:

Provide test specimens as indicated and representative of proposed materials and existing construction.

1. Replacement Brick: Test each proposed type of replacement masonry unit, according to sampling and testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction).
2. Existing Brick: Test each type of existing masonry unit indicated for replacement, according to testing methods in ASTM C 67 for compressive strength, 24-hour cold-water absorption, five-hour boil absorption, saturation coefficient, and initial rate of absorption (suction). Carefully remove five existing units from locations designated by Architect. Take testing samples from these units.
3. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by testing service.
4. Temporary Patch: As directed by Architect, provide temporary materials followed by permanent repairs at locations from which existing samples were taken.

1.10 DELIVERY, STORAGE, AND HANDLING

Deliver masonry units to Project site strapped together in suitable packs or pallets or in heavy-duty cartons and protected against impact and chipping.

A. Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

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

C. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

D. Store lime putty covered with water in sealed containers.

E. Store sand where grading and other required characteristics can be maintained and contamination avoided.

F. Handle masonry units to prevent overstressing, chipping, defacement, and other damage.

1.11 FIELD CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repair work to be performed according to product manufacturers' written instructions and specified requirements.

A. Temperature Limits, General: Repair masonry units only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

B. Cold-Weather Requirements: Comply with the following procedures for masonry repair unless otherwise indicated:

When air temperature is below 40 deg F, heat mortar ingredients, masonry repair materials, and existing masonry walls to produce temperatures between 40 and 120 deg F.

1. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after repair.

Hot-Weather Requirements: Protect masonry repair when temperature and humidity conditions produce excessive evaporation of water from mortar and repair materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.

C. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

Source Limitations: Obtain each type of material for repairing historic masonry (face brick, cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 OWNER-FURNISHED MATERIAL

Salvaged brick: The existing building consists of the original two-story house and a two-story addition that appears to be from a similar era with similar brick.

1. There are two smaller one-story additions that are more recent and have visibly different bricks. One of the smaller one-story additions is to be demolished and brick can be salvaged from this for repairs and replacement, and for the infill of existing openings at the other, matching one story addition from the same era. This salvaged brick is not to be used at the older two-story portions of the building in any exposed locations. If the salvaged brick is the same vertical dimension and has similar compressive strength, it can be considered for use as building brick in concealed locations at the two-story portion of the building.

2. Any salvaged brick from the original two story building can be considered for reuse on the same original two story building, provided it has the same vertical dimension.

2.3 MASONRY MATERIALS

Face Brick: Provide face brick, including molded, ground, cut, or sawed shapes where required to complete masonry repair work.

Brick Matching Existing: Provide units with colors, color variation within units, surface texture, size, and shape to match existing brickwork and with physical properties within 10 percent of those determined from preconstruction testing of selected existing units.

For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

Special Shapes **(including but not limited to the brick shapes required for the replacement flat/jack arch on the north elevation):**

Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position, and where shapes produced by sawing would result in sawed surfaces being exposed to view.

a. Provide specially ground units, shaped to match patterns, for arches and where indicated **(including but not limited to the brick shapes required for the replacement flat/jack arch on the north elevation).**
b. Mechanically chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

Tolerances as Fabricated: According to tolerance requirements in ASTM C 216, Type FBX.

2. Date Identification: Emboss in the clay body on a concealed, interior surface of each unit in easily read 1/2-inch- high characters, "MADE <**Insert year**>." Manufacturer's name may also be embossed.

Building Brick: Provide building brick according to ASTM C 62, of same vertical dimension as face brick, for masonry work concealed from view.

Grade SW where in contact with earth.

3. Grade SW, Grade MW, or Grade NW for concealed backup.

Salvaged Brick: Obtain salvaged brick from location shown on Drawings. Clean off residual mortar.

2.4 MORTAR MATERIALS

Portland Cement: ASTM C 150/C 150M, Type I or Type II; white or gray where required for color matching of mortar.

Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

Hydrated Lime: ASTM C 207, Type S.

A. Factory-Prepared Lime Putty: ASTM C 1489.

B. Quicklime: ASTM C 5, pulverized lime.

C. Mortar Sand: ASTM C 144 unless otherwise indicated.

Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

1. Colored Mortar: Provide natural sand of color necessary to produce required mortar color.
2. For exposed mortar, provide sand with rounded edges.

Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

Water: Potable.

2.5 MANUFACTURED REPAIR MATERIALS

Brick Patching Compound: Factory-mixed natural hydraulic lime product that is custom manufactured for patching brick masonry.

1. Use formulation that is vapor and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than the masonry units being repaired, and develops high bond strength to all types of masonry.
2. Use formulation having working qualities and retardation control to permit forming and sculpturing where necessary.
3. Formulate patching compound used for patching brick in colors and textures to match each unit being patched. Provide not less than three colors to enable matching the color, texture, and variation of each unit.

2.6 ACCESSORY MATERIALS

Masonry Repair Anchors, Expansion Type: Mechanical fasteners designed for masonry veneer stabilization consisting of 1/4-inch- diameter, Type 304 stainless-steel rod with brass expanding shells at each end and water-shedding washer in the middle. Expanding shells shall be designed to provide positive mechanical anchorage to veneer on one end and backup masonry on the other.

Masonry Repair Anchors, Spiral Type: Driven-in, Type 304 stainless-steel spiral rods designed to be installed in drilled holes and relying on screw effect rather than adhesive to secure them to backup and veneer. Anchors are flexible in plane of veneer but rigid perpendicular to it.

Masonry Repair Anchors, Rod/Screen Tube Type: Type 304 stainless-steel screen tube with Type 304 stainless-steel rod, adhesive-installed by injection with manufacturer's standard epoxy adhesive, and complete with other devices required for installation.

Masonry Repair Anchors, Expanding Grout Sleeve Type: Fabric sleeve system with Type 304 stainless-steel tube through which system manufacturer's grout is pumped to expand the sleeve, fill cavities within wall, and bond mechanically and chemically with interior of wall construction; and complete with other devices required for installation.

Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.

A. Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer according to MPI #23 (surface-tolerant, anti-corrosive metal primer).

Surface Preparation: Use coating requiring no better than SSPC-SP 2, "Hand Tool Cleaning" surface preparation according to manufacturer's literature or certified statement.

1. VOC Limit: Use coating with a VOC content of 400 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could do the following:

Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in Contract.
a. Leave residue on surfaces.

2.7 MORTAR MIXES

Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

A. Measurement and Mixing: Measure natural hydraulic lime materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

Do not use admixtures in mortar unless otherwise indicated.

C. Mixes: Mix mortar materials in the following proportions:
1. Rebuilding (Setting) Mortar by Type: ASTM C 270, Proportion Specification, **Type O** unless otherwise indicated; with cementitious material limited to portland cement and lime.
2. Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 PROHIBITED METHODS

It is forbidden to use mechanical grinders to rake out any joints or for brick repair, due to the potential damage to the soft brick. Pneumatic chisels are approved.

3.2 HISTORIC TREATMENT SPECIALIST

Historic Treatment Specialist Firms: Subject to compliance with requirements, firms that may provide historic brick repair include, but are not limited to, the following:

Structural Restoration Services, Inc. 1 - 800 -775 -1004.

1. Coastal Exteriors, LLC 410 - 252 - 3411
2. Worcester Eisenbrandt 410 - 644 - 6580

3.3 PROTECTION

Prevent mortar from staining face of surrounding masonry and other surfaces.

Cover sills, ledges, and other projecting items to protect them from mortar droppings.

1. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
2. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

Remove gutters and downspouts and associated hardware adjacent to immediate work area, and store during masonry repair work. Reinstall when repairs are complete.

Provide temporary rain drainage during work to direct water away from building.

3.4 MASONRY REPAIR, GENERAL

Repair Appearance Standard: Repaired surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

3.5 ABANDONED ANCHOR REMOVAL

Remove abandoned anchors, brackets, wood nailers, and other extraneous items no longer in use unless indicated to remain.

Remove items carefully to avoid spalling or cracking masonry.

1. Notify Architect before proceeding if an item cannot be removed without damaging surrounding masonry. Do the following where directed:

   Cut or grind off item approximately 3/4 inch beneath surface, and core drill a recess of same depth in surrounding masonry as close around item as practicable.

   a. Immediately paint exposed end of item with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended dry film thickness per coat. Keep paint off sides of recess.

Patch the hole where each item was removed unless directed to remove and replace the masonry unit.

3.6 BRICK REMOVAL AND REPLACEMENT

At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

When removing single bricks, remove material from center of brick and work toward outside edges.

Support and protect remaining masonry that surrounds removal area.

A. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

B. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

C. Remove in an undamaged condition as many whole bricks as possible.

Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.

1. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
2. Store brick for reuse. Store off ground, on skids, and protected from weather.
3. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

D. Replace removed damaged brick with other removed brick and salvaged brick in good condition, where possible, or with new brick matching existing brick. Do not use broken units unless they can be cut to usable size.

E. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

Maintain joint width for replacement units to match existing joints.

1. Use setting buttons or shims to set units accurately spaced with uniform joints.

Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.

2. Rake out mortar used for laying brick before mortar sets according to Section 040323 "Historic Brick Unit Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is sufficiently hard to support units, remove shims and other devices interfering with pointing of joints.

Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.7 BACKUP MASONRY REMOVAL AND REPLACEMENT

Where backup masonry is fractured or unstable and at locations indicated, remove mortar and masonry units that are broken or deteriorated and rebuild with whole, new brick or whole salvaged units. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

A. Support and protect remaining masonry that surrounds removal area.

B. Maintain flashing, reinforcement, anchors, lintels, and adjoining construction in an undamaged condition. Coordinate with new flashing, reinforcement, and lintels, which are specified in other Sections.

C. Notify Architect of unforeseen detrimental conditions, including voids, cracks, bulges, loose units beyond the removal area, rotted wood, rusted metal, and other deteriorated items.

D. Remove in an undamaged condition as many whole bricks as possible.

Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
1. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.
2. Store brick for reuse. Store off ground, on skids, and protected from weather.
3. Deliver cleaned brick not required for reuse to Owner unless otherwise indicated.

Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

E. Replace removed damaged brick with salvaged backup brick in good condition, where possible, or with new building brick matching existing backup brick. Do not use broken units unless they can be cut to usable size.

F. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

G. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with sufficient mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min.. Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

H. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.8 REANCHORING VENEERS

Install masonry repair anchors in horizontal mortar joints and according to manufacturer's written instructions. Space anchors not more than 16 inches o.c. vertically and 24 inches o.c. horizontally apart unless otherwise indicated. Install at locations to avoid penetrating flashing.

A. Recess anchors 5/8 inch or more from surface of mortar joint, and fill recess with pointing mortar according to Section 040323 "Historic Brick Unit Masonry Repointing."

3.9 PAINTING STEEL UNCOVERED DURING THE WORK

Notify Architect if steel is exposed during masonry removal. Where Architect determines that steel is structural, or for other reasons cannot be totally removed, prepare and paint it as follows:

Surface Preparation: Remove paint, rust, and other contaminants according to SSPC-SP 2, "Hand Tool Cleaning", as applicable to comply with paint manufacturer's recommended preparation.

1. Antirust Coating: Immediately paint exposed steel with two coats of antirust coating, following coating manufacturer's written instructions and without exceeding manufacturer's recommended rate of application (dry film thickness per coat).

If on inspection and rust removal, the thickness of a steel member is found to be reduced from rust by more than 1/16 inch, notify Architect before proceeding.

3.10 MASONRY UNIT PATCHING

Patch the following masonry units unless another type of repair or replacement is indicated:

Units indicated to be patched.

1. Units with holes.
2. Units with chipped edges or corners. Patch chipped edges or corners measuring more than 3/4 inch in least dimension.
3. Units with small areas of deep deterioration. Patch deep deteriorations measuring more than 3/4 inch in least dimension and more than 1/4 inch deep.

Remove and replace existing patches unless otherwise indicated or approved by Architect.

B. Patching Bricks:

Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch thick, but not less than recommended in writing by patching compound manufacturer.

1. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of masonry unit.
2. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
3. Rinse surface to be patched and leave damp, but without standing water.
4. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.

5. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch or more than 2 inches thick. Roughen surface of each layer to provide a key for next layer.
6. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of the masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
7. Keep each layer damp for 72 hours or until patching compound has set.

3.11 FINAL CLEANING

After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

Do not use metal scrapers or brushes.

1. Do not use acidic or alkaline cleaners.

Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

B. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

C. Remove masking materials, leaving no residues that could trap dirt.

3.12 FIELD QUALITY CONTROL

Testing Agency: Owner will engage qualified testing agencies to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

3.13 MASONRY-WASTE DISPOSAL

Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property.

A. Masonry Waste: Remove masonry waste and legally dispose of off Owner's property.

END OF SECTION 040322

SECTION 040323 - HISTORIC BRICK UNIT MASONRY REPOINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

Section includes historic treatment work consisting of repointing brick masonry as follows:

Repointing joints with mortar.

Related Requirements:

Section 013591 "Historic Treatment Procedures" for general historic treatment requirements.

1.3 DEFINITIONS

Low-Pressure Spray: 100 to 400 psi; 4 to 6 gpm.

1.4 PREINSTALLATION MEETINGS

Preinstallation Conference: Conduct conference historic masonry repair and repointing at Project site.

Review minutes of Preliminary Historic Treatment Conference that pertain to masonry historic treatment and repointing.

1. Review methods and procedures related to repointing historic brick masonry, including, but not limited to, the following:

   Historic treatment specialist's personnel, equipment, and facilities needed to make progress and avoid delays.

   a. Quality-control program.
   b. Fire-protection plan.
   c. Unit masonry historic treatment program.
   d. Coordination with building occupants.

1.5 SEQUENCING AND SCHEDULING

Order sand and gray portland cement for pointing mortar immediately after approval of mockups. Take delivery of and store at Project site a sufficient quantity to complete Project.

A. Work Sequence: Perform masonry historic treatment work in the following sequence, which includes work specified in this and other Sections:

Remove plant growth.

1. Inspect masonry for open mortar joints and repair before cleaning to prevent the intrusion of water and other cleaning materials into the wall.
2. Remove paint.
3. Clean masonry.
4. Rake out mortar from joints surrounding masonry to be replaced and from joints adjacent to masonry repairs along joints.
5. Repair masonry, including replacing existing masonry with new masonry materials.
6. Rake out mortar from joints to be repointed.
7. Point mortar and sealant joints.
8. After repairs and repointing have been completed and cured, perform a final cleaning to remove residues from this work.
9. Where water repellents are to be used on or near masonry work, delay application of these chemicals until after pointing and cleaning.

As scaffolding is removed, patch anchor holes used to attach scaffolding. Patch holes in masonry units according to Section 040322 "Historic Brick Unit Masonry Repair." Patch holes in mortar joints according to "Repointing Masonry" Article below.

1.6 ACTION SUBMITTALS

Product Data: For each type of product.

Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

1. Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

Shop Drawings:

Include plans, elevations, sections, and locations of repointing work on the structure.

2. Show provisions for expansion joints or other sealant joints.
3. Show locations of scaffolding and points of scaffolding in contact with masonry. Include details of contact or anchorage.

Samples for Initial Selection: For the following:

Pointing Mortar: Submit sets of mortar for pointing in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.

Have each set contain a close color range of at least six Samples of different mixes of colored sands and cements that produce a mortar matching the existing, cleaned mortar when cured and dry.

a. Submit with precise measurements on ingredients, proportions, gradations, and sources of colored sands from which each Sample was made.

Sand Type Used for Pointing Mortar: Minimum 8 oz. of each in plastic screw-top jars.

For blended sands, provide Samples of each component and blend. Identify blend ratio.

b. Identify sources, both supplier and quarry, of each type of sand.

Sealant materials.

4. Include similar Samples of accessories involving color selection.

Samples for Verification: For the following:

Each type, color, and texture of pointing mortar in the form of sample mortar strips, 6 inches long by 1/2 inch wide, set in aluminum or plastic channels.

Include with each Sample a list of ingredients with proportions of each. Identify sources, both supplier and quarry, of each type of sand and brand names of cementitious materials and pigments if any.

Sealant materials.

5. Accessories: Each type of anchor, accessory, and miscellaneous support.

1.7 INFORMATIONAL SUBMITTALS

1.8 Qualification Data: For historic treatment specialists.

Preconstruction Test Reports: For existing masonry units and mortar.

A. Quality-control program.

B. Unit masonry historic treatment program.

1.9 QUALITY ASSURANCE

Historic Treatment Specialist Qualifications: A qualified historic masonry repointing specialist. Experience in pointing or repointing only new or nonhistoric masonry is insufficient experience for masonry historic treatment work.

A. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising worker performance and preventing damage.

B. Unit Masonry Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for each phase of historic treatment work, including protection of surrounding materials and Project site.

Include methods for keeping pointing mortar damp during curing period.

1. If materials and methods other than those indicated are proposed for any phase of historic treatment work, add to the quality-control program a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

Mockups: Prepare mockups of historic treatment on existing surfaces to demonstrate aesthetic effects and to set quality standards for materials and execution.

Repointing: Rake out joints in two separate areas , each approximately 36 inches high by 48 inches wide for each type of repointing required, and repoint one of the areas.

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.

1.10 PRECONSTRUCTION TESTING

Refer to Characterization/Analysis of Historic Mortar report by Keystone Preservation Group in the appendix of the Project Manual. Complete

Provide test specimens as indicated and representative of proposed materials and existing construction.

1. Existing Brick: Test each type of existing brick indicated for repointing, according to testing methods in ASTM C 67 for compressive strength and initial rate of absorption (suction). Carefully remove three existing units from locations designated by Architect. Take testing samples from these units.
2. Existing Mortar: Test according to ASTM C 295, modified as agreed by testing service and Architect for Project requirements, to determine proportional composition of original ingredients, sizes and colors of aggregates, and approximate strength. Use X-ray diffraction, infrared spectroscopy, and differential thermal analysis to supplement microscopical methods. Carefully remove existing mortar from within joints at five locations designated by testing service.
3. Temporary Patch: As directed by Architect, provide temporary materials at locations from which existing samples were taken.

1.11 DELIVERY, STORAGE, AND HANDLING

Deliver packaged materials to Project site in manufacturer's original and unopened containers, labeled with manufacturer's name and type of products.

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

B. Store hydrated lime in manufacturer's original and unopened containers. Discard lime if containers have been damaged or have been opened for more than two days.

C. Store lime putty covered with water in sealed containers.

D. Store sand where grading and other required characteristics can be maintained and contamination avoided.

1.12 FIELD CONDITIONS

Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit repointing work to be performed according to product manufacturers' written instructions and specified requirements.

A. Temperature Limits, General: Repoint mortar joints only when air temperature is between 40 and 90 deg F and is predicted to remain so for at least seven days after completion of the Work unless otherwise indicated.

B. Cold-Weather Requirements: Comply with the following procedures for mortar-joint pointing unless otherwise indicated:

When air temperature is below 40 deg F, heat mortar ingredients and existing masonry walls to produce temperatures between 40 and 120 deg F.

1. When mean daily air temperature is below 40 deg F, provide enclosure and heat to maintain temperatures above 32 deg F within the enclosure for seven days after pointing.

Hot-Weather Requirements: Protect mortar-joint pointing when temperature and humidity conditions produce excessive evaporation of water from mortar materials. Provide artificial shade and wind breaks, and use cooled materials as required to minimize evaporation. Do not apply mortar to substrates with temperatures of 90 deg F and above unless otherwise indicated.

C. For manufactured repair materials, perform work within the environmental limits set by each manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

Source Limitations: Obtain each type of material for repointing historic masonry (cement, sand, etc.) from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 MORTAR MATERIALS

Portland Cement: ASTM C 150/C 150, Type I or Type II; white or gray or both where required for color matching of exposed mortar.

Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

Hydrated Lime: ASTM C 207, Type S.

A. Factory-Prepared Lime Putty: ASTM C 1489.

B. Quicklime: ASTM C 5, pulverized lime.

C. Mortar Sand: ASTM C 144 unless otherwise indicated.

Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.

1. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.
2. Provide sand with rounded edges.

Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

Water: Potable.

2.3 ACCESSORY MATERIALS

Sealant Materials:

Sealant manufacturer's standard elastomeric sealant(s) of base polymer and characteristics indicated below and according to applicable requirements in Section 079200 "Joint Sealants."

Type: Single-component, nonsag urethane sealant.

Colors: Provide colors of exposed sealants to match colors of mortar adjoining installed sealant unless otherwise indicated.

1. Ground-Mortar Aggregate: Custom crushed and ground pointing mortar sand or existing mortar retrieved from joints. Grind to a particle size that matches the adjacent mortar aggregate and color. Remove all fines passing the 100 sieve.

Joint-Sealant Backing:

Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

2. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended in writing by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

Masking Tape: Nonstaining, nonabsorbent material; compatible with mortar, joint primers, sealants, and surfaces adjacent to joints; and that easily comes off entirely, including adhesive.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

Previous effectiveness in performing the work involved.

1. Minimal possibility of damaging exposed surfaces.
2. Consistency of each application.
3. Uniformity of the resulting overall appearance.
4. Do not use products or tools that could do the following:

Remove, alter, or harm the present condition or future preservation of existing surfaces, including surrounding surfaces not in Contract.

a. Leave residue on surfaces.

2.4 MORTAR MIXES

Preparing Lime Putty: Slake quicklime and prepare lime putty according to appendix to ASTM C 5 and manufacturer's written instructions.

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again adding only enough water to produce a damp, unworkable mix that will retain its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black, which is limited to 2 percent, unless otherwise demonstrated by a satisfactory history of performance.

Do not use admixtures in mortar unless otherwise indicated.

B. Mixes: Mix mortar materials in the following proportions:
1. Pointing Mortar by Type: ASTM C 270, Proportion Specification, **Type O** unless otherwise indicated; with cementitious material limited to portland cement and lime. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 HISTORIC TREATMENT SPECIALIST

Historic Treatment Specialist Firms: Subject to compliance with requirements, firms that may provide historic masonry repointing include, but are not limited to, the following:

Structural Restoration Services, Inc. 1 - 800 -775 -1004.
1. Coastal Exteriors, LLC 410 - 252 - 3411
2. Worcester Eisenbrandt 410 - 644 - 6580

3.2 PROHIBITED METHODS

It is forbidden to use mechanical grinders to rake out any joints or for brick repair, due to the potential damage to the soft brick. Pneumatic chisels are approved.

3.3 PROTECTION

Prevent mortar from staining face of surrounding masonry and other surfaces.

Cover sills, ledges, and other projecting items to protect them from mortar droppings.

1. Keep wall area wet below rebuilding and pointing work to discourage mortar from adhering.
2. Immediately remove mortar splatters in contact with exposed masonry and other surfaces.

Remove gutters and downspouts and associated hardware adjacent to immediate work area and store during masonry repointing work. Reinstall when repointing is complete.

Provide temporary rain drainage during work to direct water away from building.

3.4 MASONRY REPOINTING, GENERAL

Appearance Standard: Repointed surfaces are to have a uniform appearance as viewed from 20 feet away by Architect.

3.5 REPOINTING MASONRY

Rake out and repoint joints to the following extent:

Joints indicated as sealant-filled joints.

1. Joints at locations of the following defects:

   Holes and missing mortar.
   a. Cracks that can be penetrated 1/4 inch or more by a knife blade 0.027 inch thick.
   b. Cracks 1/8 inch or more in width and of any depth.
   c. Hollow-sounding joints when tapped by metal object.
   d. Eroded surfaces 1/4 inch or more deep.
   e. Deterioration to point that mortar can be easily removed by hand, without tools.
   f. Joints filled with substances other than mortar.

Do not rake out and repoint joints where not required.

B. Rake out joints as follows, according to procedures demonstrated in approved mockup:

Remove mortar from joints to depth of 2 times joint width, but not less than 3/4 inch or not less than that required to expose sound, unweathered mortar. Do not remove unsound mortar more than 2 inches deep; consult Architect for direction.

1. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
2. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

   Cut out mortar by hand with chisel and resilient mallet. **If power tools are preferred, pneumatic chisels designed for the purpose of removing existing mortar in joints are allowed. Do not use power-operated grinders without Architect's written approval based on approved quality-control program.**
   a. Cut out center of mortar bed joints by hand or with pneumatic chisel. Remove remaining mortar in bed joints and mortar in head joints by hand with chisel and resilient mallet. Strictly adhere to approved quality-control program.

Notify Architect of unforeseen detrimental conditions, including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

C. Pointing with Mortar:

Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.

1. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
2. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow it to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
3. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
4. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

   Acceptable curing methods include covering with wet burlap and plastic sheeting, periodic hand misting, and periodic mist spraying using system of pipes, mist heads, and timers.
   a. Adjust curing methods to ensure that pointing mortar is damp throughout its depth without eroding surface mortar.

Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Remove mortar and repoint.

Pointing with Sealant: Comply with Section 079200 "Joint Sealants" and as follows:

After raking out, keep joints dry and free of mortar and debris.

5. Clean and prepare joint surfaces. Prime joint surfaces unless sealant manufacturer recommends against priming. Do not allow primer to spill or migrate onto adjoining surfaces.
6. Fill sealant joints with specified joint sealant:

   Install cylindrical sealant backing beneath the sealant. Where space is insufficient for cylindrical sealant backing, install bond-breaker tape.
   a. Install sealant using only proven installation techniques that ensure that sealant is deposited in a uniform, continuous ribbon, without gaps or air pockets, and with complete wetting of the joint bond surfaces equally on both sides. Fill joint flush with surrounding masonry and matching the contour of adjoining mortar joints.
   b. Install sealant as recommended in writing by sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead:

      Fill joints to a depth equal to joint width, but not more than 1/2 inch deep or less than 1/4 inch deep.

   Tool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant from surfaces adjacent to joint.

c. Sanded Joints: Immediately after first tooling, apply ground-mortar aggregate to sealant, gently pushing aggregate into the surface of sealant. Lightly retool sealant to form smooth, uniform beads, slightly concave. Remove excess sealant and aggregate from surfaces adjacent to joint.
d. Do not allow sealant to overflow or spill onto adjoining surfaces, or to migrate into the voids of adjoining surfaces, particularly rough textures. Remove excess and spillage of sealant promptly as the work progresses. Clean adjoining surfaces by the means necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes, as demonstrated in an approved mockup.

Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.6 FINAL CLEANING

After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low-pressure spray.

Do not use metal scrapers or brushes.
1. Do not use acidic or alkaline cleaners.

Clean adjacent nonmasonry surfaces. Use detergent and soft brushes or cloths.

B. Clean mortar and debris from roof; remove debris from gutters and downspouts. Rinse off roof and flush gutters and downspouts.

C. Remove masking materials, leaving no residues that could trap dirt.

3.7 FIELD QUALITY CONTROL

Testing Agency: Owner will engage qualified testing agencies to perform tests and inspections. Allow inspectors use of lift devices and scaffolding, as needed, to perform inspections.

A. Architect's Project Representatives: Architect will assign Project representatives to help carry out Architect's responsibilities at the site, including observing progress and quality of portion of the Work completed. Allow Architect's Project representatives use of lift devices and scaffolding, as needed, to observe progress and quality of portion of the Work completed.

B. Notify Architect's Project representatives in advance of times when lift devices and scaffolding will be relocated. Do not relocate lift devices and scaffolding until Architect's Project representatives have had reasonable opportunity to make inspections and observations of work areas at lift device or scaffold location.

END OF SECTION 040323

SECTION 05 5000 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Loose steel lintels.
2. Miscellaneous steel framing and supports for applications where framing and supports are not specified in other Sections.

1.3 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. Drawings shall be signed and sealed by a Professional Engineer licensed in the project jurisdiction.

1.4 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of columns and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
2. Provide allowance for trimming and fitting at site.

PART 2 - PRODUCTS

2.1 METALS

A. Steel Pipe: ASTM A 53; finish, type, and weight class as follows:
   1. Type F, or Type S, Grade A, standard weight (Schedule 40), unless another grade and weight are required by structural loads.

B. Steel Tubing: Cold-formed steel tubing, ASTM A 500, Grade A, unless another grade is required by structural loads.

C. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Fasteners: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

E. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).

2.2 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.3 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.4 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 4 inches unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

C. For members, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

2.7 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with applicable standard listed below:
   1. ASTM A 123/A 123M, for galvanizing steel and iron products.
   2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Preparation: Prior to fabrication, field verify required dimensions.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

D. Field Welding: Comply with the following requirements:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

   1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000

SECTION 06 0312 - HISTORIC WOOD REPAIR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

Section includes historic treatment of wood in the form of repairing wood features as follows:

Repairing wood trim and ceiling soffits at porch.

Related Requirements:

Section 01 3591 "Historic Treatment Procedures" for general historic treatment requirements.
1. Section 02 4296 "Historic Removal and Dismantling" for historic removal and dismantling work.

1.3 SEQUENCING AND SCHEDULING

Perform historic wood repair in the following sequence, which includes work specified in this and other Sections:

Before removing wood components for on-site or off-site repair, tag each component with location-identification numbers. Indicate on tags and building plans the locations of each component, such as "Baseboard on North Side of Room 101."
1. Dismantle hardware and tag with location-identification numbers.
2. In the shop, label each repaired component and whole or partial replacement with permanent location-identification number in inconspicuous location and remove site-applied tags.
3. Sort units by condition, separating those that need extensive repair.
4. Clean surfaces.
5. General Wood-Repair Sequence:

   Remove paint to bare wood.
   a. Repair wood by consolidation, replacement, partial replacement, `and patching.
   b. Sand, prime, fill, sand again, and prime surfaces again for refinishing.

Repair, refinish, and replace hardware if required. Reinstall operating hardware.
6. Reinstall components.
7. Apply finish coats.
8. Install remaining hardware.

1.4 ACTION SUBMITTALS

Product Data: For each type of product.

Include recommendations for product application and use. Include test data substantiating that products comply with requirements.

Shop Drawings:

Include plans, elevations, and sections showing locations and extent of repair and replacement work, with enlarged details of replacement parts indicating materials, profiles, joinery, reinforcing, method of splicing or attaching wood members to other surfaces, accessory items, and finishes.

1. Include field-verified dimensions and the following:

Full-size shapes and profiles with complete dimensions for replacement components and their jointing, showing relationship of existing components to new components.

a. Templates and directions for installing hardware and anchorages.
b. Identification of each new unit and its corresponding location in the building on annotated plans and elevations.

Samples for Verification: For the following products in manufacturer's standard sizes unless otherwise indicated, finished as required for use in the Work:

Replacement Wood: 12-inch- long, full-size molding sections with applied finish.

Additional Samples of replacement members that show fabrication techniques, materials, and finishes as requested by Architect.

Repaired Wood: Prepare Samples using existing wood removed from site, repaired, and prepared for refinishing.

2. Refinished Wood: Prepare Samples using existing wood removed from site, repaired, and refinished.
3. Hardware: Full-size units with each factory-applied or restored finish.

1.5 INFORMATIONAL SUBMITTALS

Wood Historic Treatment Program: Submit before work begins.

1.6 QUALITY ASSURANCE

Wood-Repair-Material Manufacturer Qualifications: A firm regularly engaged in producing wood consolidant and wood-patching compound that have been used for similar historic wood-treatment applications with successful results, and with factory-authorized service representatives who are available for consultation, Project-site inspection, and on-site assistance.

A. Wood Historic Treatment Program: Prepare a written, detailed description of materials, methods, equipment, and sequence of operations to be used for historic treatment work, including protection of surrounding materials and Project site.

If materials and methods other than those indicated are proposed for any phase of historic treatment work, add a written description of such materials and methods, including evidence of successful use on comparable projects, and demonstrations to show their effectiveness for this Project.

Mockups: Prepare mockups of historic treatment repair processes to demonstrate aesthetic effects and to set quality standards for materials and execution, and for fabrication and installation. Prepare mockups so they are as inconspicuous as practicable.

Locate mockups on existing surfaces where directed by Architect and in locations that enable viewing under same conditions as the completed Work.

1. Wood Baseboard Repair: Prepare an approximately 72-inch length of baseboard to serve as mockup to demonstrate samples of each type of wood repair.
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.

1.7 PRECONSTRUCTION TESTING

Preconstruction Testing Service: Engage a qualified historic treatment specialist to perform preconstruction testing on historic wood materials as follows:

Provide test specimens representative of proposed materials and existing construction.

1. Test historic treatment products and methods for effectiveness and compliance with specified requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

Pack, deliver, and store products in suitable packs, heavy-duty cartons, or wooden crates; surround with sufficient packing material to ensure that products will not be deformed, broken, or otherwise damaged.

A. Until installed, store products inside a well-ventilated area and protect from weather, moisture, soiling, abrasion, extreme temperatures, and humidity, and where environmental conditions comply with manufacturer's requirements.

1.9 FIELD CONDITIONS

Weather Limitations: Proceed with historic wood repair only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.

PART 2 - PRODUCTS

2.1 HISTORIC WOOD REPAIR, GENERAL

Quality Standard: Comply with applicable requirements in Section 12, "Historic Restoration Work," and related requirements in AWI/AWMAC/WI's "Architectural Woodwork Standards" for construction, finishes, grade rules, and other requirements unless otherwise indicated.

Exception: Industry practices cited in Section 12, Article 1.5, "Industry Practices," of the Architectural Woodwork Standards do not apply to the work of this Section.

2.2 REPLICATED WOOD ITEMS

Replicated Wood Paneling Railings Trim: Custom-fabricated replacement wood units and components.

Joint Construction: Joints matching existing joints.
1. Wood Species: Match species of existing wood.
2. Wood Cut: Match cut of existing wood.
3. Wood Member and Trim Profiles: Match profiles and detail of existing.
4. Hardware: Reuse existing unless otherwise indicated.

2.3 WOOD-REPLACEMENT MATERIALS

Wood, General: Clear fine-grained lumber; kiln dried to a moisture content of 6 to 12 percent at time of fabrication; free of finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch deep by 2 inches wide.

Species: Match species of each existing type of wood component or assembly unless otherwise indicated.

Paneling Railings: Match existing species.

A. Interior Trim: Match existing species.

B. Coordinate with requirements of 06 4020 - "Interior Architectural Woodwork"

2.4 WOOD-REPAIR MATERIALS

Source Limitations: Obtain wood consolidant and wood-patching compound from single source from single manufacturer.

A. Wood Consolidant: Ready-to-use product designed to penetrate, consolidate, and strengthen soft fibers of wood materials that have deteriorated due to weathering and decay and designed specifically to enhance the bond of wood-patching compound to existing wood.

Products: Source both the consolidant and the epoxy from the same single source manufacturer to ensure compatibility.Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

Abatron, Inc.; LiquidWood.
a. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100.
b. Gougeon Brothers, Inc.; West System.
c. Protective Coating Company; PC-Petrifier PC-Rot Terminator.
d. System Three Resins, Inc.; RotFix.

Wood-Patching Compound: Source both the consolidant and the epoxy from the same single source manufacturer to ensure compatibility. Two-part, epoxy-resin, wood-patching compound; knife-grade formulation as recommended in writing by manufacturer for type of wood repair indicated, tooling time required for the detail of work, and site conditions. Compound shall be designed for filling voids in damaged wood materials that have deteriorated due to weathering and decay. Compound shall be capable of filling deep holes and spreading to featheredge.

Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

Abatron, Inc.; LiquidWood with WoodEpox.
e. Advanced Repair Technology, Inc.; Primatrate with Flex-Tec HV.
f. ConServ Epoxy LLC; Flexible Epoxy Consolidant 100 with Flexible Epoxy Patch 200.
g. Gougeon Brothers, Inc.; West System thickened with filler.
h. Polymeric Systems, Inc.; QuickWood.
i. Protective Coating Company; PC-Woody.
j. System Three Resins, Inc.; Sculpwood.

2.5 INFRARED PAINT REMOVERS

Acceptable Manufacturers of Infrared Paint Removal Technology include the following:

1. Silent Paint Remover™ Model 1100: 1100-watt, infrared paint stripper. Manufactured by Viking Sales, Incorporated, which is located at: 7710 Victor-Mendon Road, Victor, NY 14564; Tele: 585-924-8070; Email: info@silentpaintremover.com; Web: info@silentpaintremover.com. Philadelphia, PA Distributor: Earth+Flax
2. Speedheater™ Standard IR Paint Remover Model 1100-15 Manufactured by Eco-Strip, which is located at: 2473 Rolling Plains Drive, Herndon, VA 20171; Tele: 703-810-7297; Email: https://eco-strip.com/contact-2/: Web: https://eco-strip.com

2.6 PASTE PAINT REMOVERS

Alkaline Paste Paint Remover: Manufacturer's standard alkaline paste or gel formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methylene chloride

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. ABR Products, Inc.; 800 Brush Grade.
b. Diedrich Technologies Inc., a division of Sandell Construction Solutions; 606Multi-Layer Paint Remover 606X Extra Thick Multi-Layer Paint Remover.
c. EaCo Chem, Inc.; Stripper Cream.
d. PROSOCO, Inc.; Sure Klean Heavy-Duty Paint Stripper.
e. Shore Corporation; 2200 Alka Strip

B. Low-Odor, Solvent-Type Paste Paint Remover: Manufacturer's standard low-odor, water-rinsable, solvent-type paste, gel, or foamed emulsion formulation for removing paint from masonry, stone, wood, plaster, or metal as required to suit Project; and containing no methanol or methylene chloride.

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. ABR Products, Inc.; ABR Citrus Paint Removers Super Bio Strip Gel.
b. Cathedral Stone Products, Inc.; S-301 S-303 S-305.
c. Dumond Chemicals, Inc.; Peel Away 7 without paper covering Smart Strip Smart Strip Pro.
d. EaCo Chem, Inc.; InStrip.
e. PROSOCO, Inc.; Enviro Klean SafStrip Enviro Klean SafStrip 8

2.7 MISCELLANEOUS MATERIALS

Cleaning Materials:

Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium pyrophosphate (TSPP), 1/2 cup of laundry detergent that contains no ammonia, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of warm water for each 5 gal. of solution required.

1. Mildewcide: Commercial, proprietary mildewcide or a solution prepared by mixing 1/3 cup of household detergent that contains no ammonia, 1 quart of 5 percent sodium hypochlorite bleach, and 3 quarts of warm water.

2.8 WOOD FINISHES

Unfinished Replacement Units: Provide exposed interior wood surfaces of replacement units unfinished; smooth, filled, and suitably prepared for on-site priming and finishing.

PART 3 - EXECUTION

3.1 PREPARATION

Protect adjacent materials from damage by historic wood repair.

A. Clean wood of mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. After cleaning, rinse thoroughly with fresh water. Allow to dry before repairing or painting.

B. Condition replacement wood members and replacement units to prevailing conditions at installation areas before installing.

3.2 HISTORIC WOOD REPAIR, GENERAL

Historic Treatment Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from 5 feet away for interior work and from 20 feet away for exterior work.

A. General: In treating historic items, disturb them as minimally as possible and as follows:

Stabilize and repair wood to reestablish structural integrity and weather resistance while maintaining the existing form of each item.

1. Remove coatings in the gentlest method possible. Preferred method is using Infrared Paint Removal Technology

2.
3. Apply borate preservative treatment before repair.
4. Repair items in place where possible.
5. Install temporary protective measures to protect wood-treatment work that is indicated to be completed later.

Mechanical Abrasion: Where mechanical abrasion is needed for the work, use only the gentlest mechanical methods, such as scraping and natural-fiber bristle brushing, that will not abrade wood substrate, reducing clarity of detail. Do not use abrasive methods, such as sanding, wire brushing, or power tools, except as indicated as part of the historic treatment program and as approved by Architect.

B. Repair Wood: Match existing materials and features, retaining as much original material as possible to perform repairs.

Unless otherwise indicated, repair wood by consolidating, patching, splicing, or otherwise reinforcing wood with new wood matching existing wood or with salvaged, sound, original wood.

1. Where indicated, repair wood by limited replacement matching existing material.

Replace Wood: Where indicated, duplicate and replace units with units made from salvaged, sound, original wood or with new wood matching existing wood. Use surviving prototypes to create patterns for duplicate replacements.

Do not use substitute materials unless otherwise indicated.

2. Compatible substitute materials may be used.

Identify removed items with numbering system corresponding to item locations, to ensure reinstallation in same location. Key items to Drawings showing location of each removed unit. Permanently label units in a location that will be concealed after reinstallation.

3.3 WOOD PATCH-TYPE REPAIR

General: Patch wood that exhibits depressions, holes, or similar voids, and that has limited amounts of rotted or decayed wood.

Verify that surfaces are sufficiently clean and free of paint residue prior to patching.

1. Treat wood with wood consolidant prior to application of patching compound. Coat wood surfaces by brushing, applying multiple coats until wood is saturated and refuses to absorb more. Allow treatment to harden before filling void with patching compound.
2. Remove rotted or decayed wood down to sound wood.

Apply borate preservative treatment to accessible surfaces either before applying wood consolidant or after removing rotted or decayed wood. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom. Allow treatment to dry.

B. Apply wood-patching compound to fill depressions, nicks, cracks, and other voids created by removed or missing wood.

Prime patch area with application of wood consolidant or manufacturer's recommended primer.

1. Mix only as much patching compound as can be applied according to manufacturer's written instructions.
2. Apply patching compound in layers as recommended in writing by manufacturer until the void is completely filled.
3. Sand patch surface smooth and flush with adjacent wood, without voids in patch material, and matching contour of wood member.
4. Clean spilled compound from adjacent materials immediately.

3.4 WOOD-REPLACEMENT REPAIR

General: Replace parts of or entire wood items at locations indicated on Drawings.

Remove surface-attached items from wood surface before performing wood-replacement repairs unless otherwise indicated.

1. Verify that surfaces are sufficiently clean and free of paint residue prior to repair.
2. Remove broken, rotted, and decayed wood down to sound wood.
3. Custom fabricate new wood to replace missing wood; either replace entire wood member or splice new wood part into existing member.
4. Secure new wood using finger joints, multiple dowels, or splines with adhesive and nailing to ensure maximum structural integrity at each splice. Use only concealed fasteners. Fill nail holes and patch surface to match surrounding sound wood.

Apply borate preservative treatment to accessible surfaces after replacements are made. Apply treatment liberally by brush to joints, edges, and ends; top, sides, and bottom.

B. Repair remaining depressions, holes, or similar voids with patch-type repairs.

C. Clean spilled materials from adjacent surfaces immediately.

D. Reinstall items removed for repair into original locations.

3.5 FIELD QUALITY CONTROL

Manufacturers Field Service: Engage wood-repair-material manufacturers' factory-authorized service representatives for consultation and Project-site inspection, and provide on-site assistance when requested by Architect.

3.6 ADJUSTMENT

Adjust existing and replacement operating items, hardware, and accessories for a tight fit at contact points and for smooth operation and tight closure. Lubricate hardware and moving parts.

3.7 CLEANING AND PROTECTION

Protect wood surfaces from contact with contaminating substances resulting from construction operations. Monitor wood surfaces adjacent to and below exterior concrete and masonry during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances contact wood surfaces, remove contaminants immediately.

A. Clean exposed surfaces immediately after historic wood repair. Avoid damage to coatings and finishes. Remove excess sealants, patching materials, dirt, and other substances.

END OF SECTION 06 0312

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Rooftop equipment bases and support curbs.
4. Wood blocking, cants, and nailers.
5. Wood furring and grounds.
6. Wood sleepers.
7. Plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Sustainable Design Submittals:
1. None.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, [mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.

1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat items indicated on Drawings, and the following:

1. Framing for raised platforms.
2. Framing for stages.
3. Concealed blocking.
4. Framing for non-load-bearing partitions.
5. Framing for non-load-bearing exterior walls.
6. Roof construction.
7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Non-Load-Bearing Interior Partitions: Construction or No. 2 grade.

1. Application: Interior partitions not indicated as load bearing.
2. Species:

    a. Southern pine or mixed southern pine; SPIB.
    b. Northern species; NLGA.
    c. Eastern softwoods; NeLMA.
    d. Western woods; WCLIB or WWPA.

B. Framing Other Than Non-Load-Bearing Partitions: Any species and grade with a modulus of elasticity of at least 1,300,000 psi (7590 MPa) and an extreme fiber stress in bending of at least 850 psi (4.83 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

1. Application: Framing other than interior partitions not indicated as load-bearing.

C. Exposed Framing: Hand-select material for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.

1. Species and Grade: As indicated above for load-bearing construction of same type.

2.5 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi (17.9 MPa) for 12-inch nominal-(286-mm actual-) depth members.
2. Modulus of Elasticity, Edgewise: 1,800,000 psi (12 400 MPa).

2.6 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Rooftop equipment bases and support curbs.
4. Cants.
5. Furring.
6. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any species.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.

2. Eastern softwoods; No. 2 Common grade; NeLMA.
3. Northern species; No. 2 Common grade; NLGA.
4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 1/2-inch (13-mm) nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 or ICC-ES AC308 as appropriate for the substrate.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.

1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.

1. Use for wood-preservative-treated lumber and where indicated.

2.10 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch (25-mm) nominal thickness, compressible to 1/32 inch (0.8 mm); selected from manufacturer's standard widths to suit width of sill members indicated.

B. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.

C. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

D. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install shear wall panels to comply with manufacturer's written instructions.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

H. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

3.2 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 06 1600 - SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof sheathing.
2. Composite ventilated nail base insulated roof sheathing.
3. Subflooring and underlayment.
4. Sheathing joint-and-penetration treatment materials.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for plywood backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. For air-barrier and water-resistant glass-mat gypsum sheathing, include manufacturer's technical data and tested physical and performance properties of products.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated plywood.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications:

1. For testing and inspecting agency providing tests and inspections related to air-barrier and water-resistant glass-mat gypsum sheathing: an independent agency, qualified in accordance with ASTM E329 for testing indicated, and certified by Air Barrier Association of America, Inc.

B. Manufacturer Qualifications: A qualified manufacturer that is certified for chain of custody by an FSC-accredited certification body.

C. Certified Wood: Provide an invoice including vendor's chain-of-custody number, product cost, and entity being invoiced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Certified Wood: The following wood products shall be labeled according to the AF&PA's Sustainable Forestry Initiative, be certified as "FSC Pure" according to FSC STD-01-001 and FSC STD-40-004, or be certified and labeled according to the standards of the Programme for Endorsement of Forest Certification.

1. Plywood.
2. Oriented strand board.
3. Particleboard underlayment.
4. Hardboard underlayment.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat items indicated on Drawings, and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 WALL SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior sheathing.

1. Span Rating: Not less than 32/16.
2. Nominal Thickness: Not less than 1/2 inch.

2.4 ROOF SHEATHING

A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exterior sheathing.

1. Span Rating: Not less than 48/24.
2. Nominal Thickness: Not less than 1/2 inch.

2.5 COMPOSITE VENTILATED NAIL BASE INSULATED ROOF SHEATHING

A. Vented, Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: ASTM C1289, Type II, Class 1, Grade 2/UL 790, with DOC PS 2, Exposure 1 oriented strand board adhered to spacers on one face.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF ThermaCal1 or comparable product by one of the following:

    a. Atlas Molded Products, a division of Atlas Roofing Corporation
    b. Cornell Performance Building Products, a Subsidiary of GAF
    c. Hunter Panels; a Carlisle company
    d. Johns Manville; a Berkshire Hathaway company
    e. The Dow Chemical Company

2. Polyisocyanurate-Foam Thickness: 2.5 inch LTTR R-value 14.4, tongue and groove
3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.
4. Spacers: Wood furring strips or blocks not less than **1 inch** thick and spaced not more than 12 inches o.c.

2.6 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: Either DOC PS 1 or DOC PS 2, single-floor panels or sheathing.

1. Span Rating: Not less than 48/24.

2. Nominal Thickness: Not less than 23/32 inch.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For roof and, wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Screws for Fastening Sheathing to Wood Framing: ASTM C1002.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening Composite Nail Base Insulated Roof Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours in accordance with ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.8 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with ASTM D3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesive shall have a VOC content of 50 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too

small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.10.1, "Fastening Schedule," in the ICC's International Building Code.
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in the ICC's International Residential Code for One- and Two-Family Dwellings.
3. ICC-ES evaluation report for fastener.

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall,and, roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 INSTALLATION OF WOOD STRUCTURAL PANEL

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Screw to wood framing.
b. Space panels **1/8 inch** apart at edges and ends.

2. Subflooring:

a. Screw to wood framing.
b. Space panels **1/8 inch** apart at edges and ends.

3. Wall and Roof Sheathing:

a. Screw to wood framing.
b. Space panels **1/8 inch** apart at edges and ends.

END OF SECTION 06 1600

SECTION 06 2013 - EXTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior trim.
2. Lumber siding.
3. Lumber soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

1. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:

1. For each species and cut of lumber and panel products, with half of exposed surface finished; **12 inch long piece** for lumber and **8 by 10 inches** for panels.

1.3 INFORMATIONAL SUBMITTALS

A. Compliance Certificates:

1. For lumber that is not marked with grade stamp.

B. Sample Warranties: For manufacturer's warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation.

1. Protect materials from weather by covering with waterproof sheeting, securely

anchored.
2. Provide for air circulation around stacks and under coverings.

1.5 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.6 WARRANTY

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with applicable rules of any rules-writing agency certified by the American Lumber Standard Committee's (ALSC) Board of Review. Grade lumber by an agency certified by the ALSC's Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

B. Hardboard: ANSI A135.4.

2.2 EXTERIOR TRIM

A. Lumber Trim for Opaque Finish:

1. Species and Grade:

a. Northern white cedar, D Select; NeLMA or NLGA.

b. Approved Equivalent naturally weather-resistive wood

2. Maximum Moisture Content: 15 percent.
3. Finger Jointing: Not allowed.
4. Face Surface: Surfaced (smooth).
5. Factory Priming: Factory coated on faces and edges with exterior primer compatible with topcoats specified.

B. Moldings for Opaque Finish: MMPA WM 4, N-grade wood moldings, without finger jointing, made from kiln-dried stock to patterns included in MMPA's "WM/Series Softwood Moulding Patterns."

1. Species: Northern white cedar, D Select; NeLMA or NLGA, or other naturally resistive wood species.
2. Provide Shapes, profiles and configurations as indicated in drawings.

2.3 LUMBER SIDING

A. Provide kiln-dried lumber siding complying with DOC PS 20.

B. Species and Grade:

1. Northern white cedar, D Select; NeLMA or NLGA
2. Approved equivalent naturally weather-resistive wood

C. Pattern:

1. Clapboard Siding, actual overall dimensions of 5-1/2 by 3/4 inch, measured on the face and edge, with 4 inch exposure, unless indicated otherwise in drawings.

2.4 LUMBER SOFFITS

A. Provide kiln-dried lumber siding complying with DOC PS 20.

B. Species and Grade:

1. Northern white cedar, D Select; NeLMA or NLGA
2. Approved equivalent naturally weather-resistive wood

C. Pattern:

1. V-edge, smooth-faced tongue and groove, actual face width (coverage) and thickness of 3-1/8 by 23/32 inch.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than **1-1/2 inches** into wood substrate.

1. For face-fastening siding, provide ringed-shank siding nails unless otherwise indicated.
2. For redwood, provide stainless steel fasteners.
3. For prefinished items, provide matching prefinished aluminum fasteners where face fastening is required.
4. For applications not otherwise indicated, provide stainless steel fasteners.

B. Wood Glue: Waterproof resorcinol glue recommended by manufacturer for exterior carpentry use.

C. Flashing: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim" for flashing materials installed in exterior finish carpentry.

2.6 FABRICATION

A. Back out or kerf backs of standing and running trim wider than **5 inches**, except members with ends exposed in finished work.

B. Ease edges of lumber less than **1 inch** in nominal thickness to **1/16-inch** radius and edges of lumber **1 inch** or more in nominal thickness to **1/8-inch** radius.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed.

1. Cut to required lengths and prime ends.
2. Comply with requirements in Section 099113 "Exterior Painting."

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.

1. Do not use manufactured units with defective surfaces, sizes, or patterns.

B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials.

1. Use concealed shims where necessary for alignment.
2. Scribe and cut exterior finish carpentry to fit adjoining work.
3. Refinish and seal cuts as recommended by manufacturer.
4. Install to tolerance of **1/8 inch in 96 inches** for level and plumb. Install adjoining exterior finish carpentry with **1/32-inch** maximum offset for flush installation and **1/16-inch** maximum offset for reveal installation.
5. Coordinate exterior finish carpentry with materials and systems in or adjacent to it.
6. Provide cutouts for mechanical and electrical items that penetrate exterior finish carpentry.

3.4 INSTALLATION OF STANDING AND RUNNING TRIM

A. Install flat-grain lumber with bark side exposed to weather.

B. Install cellular PVC trim to comply with manufacturer's written instructions.

C. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than **36 inches** long, except where necessary.

1. Use scarf joints for end-to-end joints.
2. Stagger end joints in adjacent and related members.

D. Fit exterior joints to exclude water.

1. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint.
2. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

E. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.

3.5 INSTALLATION OF SIDING

A. Install siding to comply with manufacturer's written instructions and warranty requirements.

B. Horizontal Lumber Siding:

1. Apply starter strip along bottom edge of sheathing or sill.
2. Install first course of siding, with lower edge at least **1/8 inch** below starter strip and subsequent courses lapped **1 inch** minimum over course below.

    a. Nail at each stud.
    b. Do not allow nails to penetrate more than one thickness of siding.

3. Leave **1/8-inch** gap at trim and corners unless otherwise recommended by manufacturer .
4. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
5. Install prefabricated outside corners as recommended by manufacturer of siding materials.

C. Flashing: Install metal flashing as indicated on Drawings and as recommended by siding manufacturer.

D. Finish: Apply finish within two weeks of installation.

3.6 ADJUSTING

A. Replace exterior finish carpentry that is damaged or does not comply with requirements.

1. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

B. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean exterior finish carpentry on exposed and semiexposed surfaces.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 2013

SECTION 06 2023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

All new interior standing and running trim, including custom wainscot panels and wood base as indicated on the drawings.

Related Requirements:

Section 06 1000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view and for framing exposed to view.

1. Section 06 4020 "Interior Architectural Woodwork" for shop-fabricated interior woodwork not specified in this Section .
2. Section 09 9123 "Interior Painting" for priming and backpriming of interior finish carpentry and whiteboard paint at sliding doors.
3. Section 12 2413 - Roller Window Shades

1.3 DEFINITIONS

A. MDF: Medium-density fiberboard.

B. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.

B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, or textures.

C. Samples for Verification:

For each species and cut of lumber and panel products with non-factory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. for lumber and 8 by 10 inches for panels.

1. For each finish system and color of lumber and panel products with factory-applied finish, 50 sq. in. for lumber and 8 by 10 inches for panels.

1.5 INFORMATIONAL SUBMITTALS

Evaluation Reports: For fire-retardant-treated wood, from ICC-ES.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

B. Deliver interior finish carpentry materials only when environmental conditions meet requirements specified for installation areas. If interior finish carpentry materials must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry materials until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.

Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

1. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 QUALITY ASSURANCE

Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

A. Installer Qualifications: Fabricator of Products

B. Mockups:

Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Interior trim.

B. Lumber: DOC PS 20 and the following grading rules:

NeLMA: Northeastern Lumber Manufacturers' Association, "Standard Grading Rules for Northeastern Lumber."
1. NHLA: National Hardwood Lumber Association, "Rules for the Measurement and Inspection of Hardwood & Cypress."
2. NLGA: National Lumber Grades Authority, "Standard Grading Rules for Canadian Lumber."
3. SPIB: The Southern Pine Inspection Bureau, "Standard Grading Rules for Southern Pine Lumber."
4. WCLIB: West Coast Lumber Inspection Bureau, Standard No. 17, "Grading Rules for West Coast Lumber."
5. WWPA: Western Wood Products Association, "Western Lumber Grading Rules."

C. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.

For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

MDF: ANSI A208.2, [Grade 130] <Insert grade>[, made with binder containing no urea-formaldehyde resin].

D. Particleboard: ANSI A208.1, [Grade M-2] [Grade M-2-Exterior Glue] [Grade M-2, made with binder containing no urea-formaldehyde resin].

E. Particleboard and MDF: Provide at least 80 percent recycled content.

2.2 INTERIOR STANDING AND RUNNING TRIM

A. Hardwood Lumber Trim for Opaque Finish: Premium grade

Species and Grade: Closed grain hardwoods, birch, maple or poplar, D Select WWPA.
1. Maximum Moisture Content: 10 percent.
2. Finger Jointing: Not allowed.
3. Gluing for Width: Use for lumber trim wider than 6 inches.
4. Veneered Material: Not allowed.
5. Face Surface: Surfaced (smooth).
6. Matching: Selected for compatible grain and color.

B. Moldings for Opaque Finish: Premium Grade.

Hardwood Moldings:

Species: Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar.
a. Maximum Moisture Content: 9 percent.

Finger Jointing: Not allowed.
2. See drawings for required molding profiles.

2.3 MISCELLANEOUS MATERIALS

A. Sliding Door Hardware: HAWA Junior 250/B

B. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.

C. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

D. VOC content not to exceed 70 g/L.

2.4 FABRICATION

A. Back out or kerf backs of the following members except those with ends exposed in finished work:

Interior standing and running trim except shoe and crown molds.

B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.

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

3.2 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

B. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.3 INSTALLATION, GENERAL

A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, too small to fabricate with proper jointing arrangements, or with defective surfaces, sizes, or patterns.

B. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.

1. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
3. Coordinate interior finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate interior finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints where necessary for alignment.

Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.

1. Install trim after gypsum-board joint finishing operations are completed.
2. Install without splitting; drill pilot holes before fastening where necessary to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 SHELVING INSTALLATION

A. Install standards for adjustable shelf supports according to manufacturer's written instructions. Fasten to framing members, blocking, or metal backing, or use toggle bolts or hollow wall anchors. Space fasteners not more than 12 inches o.c.

B. Cut shelves to neatly fit openings with only enough gap to allow shelves to be removed and reinstalled. Install shelves, fully seated on cleats, brackets, and supports.

Fasten shelves to brackets to comply with bracket manufacturer's written instructions or as shown on drawings provide bored holes with pin type shelf support.

3.6 ADJUSTING

A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.7 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.8 PROTECTION

A. Protect installed products from damage from weather and other causes during construction.

B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.

Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

1. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 06 2023

SECTION 06 4023 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Stair Handrails, Newell posts & Balustrades
2. Wood cabinets.
3. Shop finishing.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing interior architectural woodwork that are concealed within other construction before interior architectural woodwork installation.
2. Section 062023 “Interior Finish Carpentry” for standing and running trim, wainscot paneling, wood base, crown and other moldings.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

A. Product Data:

1. Wood cabinets for transparent and opaque finishes.
2. Cabinet hardware and accessories.
3. Anchors.
4. Adhesives.
5. Shop finishing materials.

B. Samples: For each exposed product and for each shop-applied color and finish specified.

1. Size:

a. Panel Products: **12 inches by 12 inches**.

b. Veneer Leaves: Representative of and selected from flitches to be used for transparent-finished interior architectural woodwork.
c. Lumber Products: Not less than 5 inches wide by 12 inches long, for each species and cut, finished on one side and one edge.
d. Lumber and Panel Products with Shop-Applied Opaque Finish: 5 inches wide by 12 inches long for lumber and 8 by 10 inches for panels, for each finish system and color.

1) Finish one-half of exposed surface.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For the following:

1. Composite wood products.
2. Adhesives.

B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Architectural Woodwork Standards, Section 2.

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 where environmental conditions comply with requirements specified in "Field Conditions" Article.

1. Handle and store fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions.

1.7 FIELD CONDITIONS

A. Environmental Limitations without Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels designed for building occupants for the remainder of the construction period.

B. Environmental Limitations with Humidity Control: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature between **60 and 90 deg F** and relative humidity between 25 and 55 percent during the remainder of the construction period.

C. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings.

1. Locate concealed framing, blocking, and reinforcements that support woodwork by field

measurements before being concealed by construction, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where interior architectural woodwork is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 WOOD MATERIALS, GENERAL

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Do not use plain-sawn softwood lumber with exposed, flat surfaces more than 3-1/2 inches wide.
2. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Composite Wood Products: Formaldehyde emission rates shall not be greater than the following when tested according to ASTM D6007 or ASTM E1333:

    a. Hardwood Plywood: 0.05 ppm.
    b. Particleboard: 0.09 ppm.
    c. MDF More Than 5/16 Inch Thick: 0.11 ppm.
    d. MDF 5/16 Inch or Less in Thickness: 0.13 ppm.

2. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
3. Particleboard (Medium Density): ANSI A208.1, Grade M-2-Exterior Glue.
4. Softwood Plywood: DOC PS 1, medium-density overlay.
5. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.
6. Thermally Fused Laminate (TFL) Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of ISO 4586.

C. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain requirements that are more stringent than the Architectural Woodwork Standards. Comply with Contract Documents and Architectural Woodwork Standards.

D. Certified Wood: Wood products shall be labeled according to the AF&PA's Sustainable Forestry Initiative, be certified as "FSC Pure" according to FSC STD-01-001 and FSC STD-40-004, or be certified and labeled according to the standards of the Programme for Endorsement of Forest Certification.

2.2 STAIR HANDRAILS, NEWEL POSTS & BALUSTRADES

A. Wood Species: Oak, Pine, Maple or Polar

B. Profile(s): As indicated in the Drawings or otherwise noted below.

1. Newel Posts: 4091 Standard Box Newel
2. Pickets: 1" x 1" Square
3. Top Rail: Smoot Moldings SM-9010 or Equivalent

a. Provide end fittings, flares and bending parts as indicated in the Drawings.

4. Wall Mounted Railing: WM-240 Railing by Smoot Moldings or Equivalent.

a. Provide end fittings, flares and bending parts as indicated in the Drawings.

5. Wall Brackets: LJ-3127 Wall Rail Bracket by WoodStairs.com or Equivalent
6. Treads & Risers: 5/4 Solid Wood Stair Treads w/ Square Edge Front

2.3 WOOD CABINETS

A. Architectural Woodwork Institute (AWI) Grade: Premium

B. Type of Construction: Frameless.

B. Door and Drawer Front Interface Style: Shaker Style w/ Solid Wood Stiles & Rails.

C. Wood for Exposed Surfaces:
1. Species: Baltic Birch, Maple or Poplar
2. Cut: Plain or Flat Sawn

D. Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Compatible species to that indicated for exposed surfaces, stained to match.
2. Drawer Subfronts, Backs, and Sides: Solid-hardwood lumber.
3. Drawer Bottoms: Hardwood plywood.

E. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

F. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Nailers: softwood lumber, kiln-dried to less than 15 percent moisture content.

1. Preservative Treatment: Provide softwood lumber treated by pressure process, AWPA U1; Use Category UC3b.

    a. Provide where in contact with concrete or masonry
    b. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
    c. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
    d. Mark lumber with treatment quality mark of an inspection agency approved by the American Lumber Standards Committee's (ALSC) Board of Review.

B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.

C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

1. Provide metal expansion sleeves or expansion bolts for post-installed anchors.
2. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

D. Adhesives: Do not use adhesives that contain urea formaldehyde.

E. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.

1. Adhesives shall have a VOC content of 70 g/L or less.
2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

2.5 FABRICATION

A. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

B. Fabricate interior architectural woodwork to dimensions, profiles, and details indicated.

1. Ease edges to radius indicated for the following:

    a. Edges of Solid-Wood (Lumber) Members: **1/16 inch** unless otherwise indicated.
    b. Edges of Rails and Similar Members More Than 3/4 Inch (19 mm) Thick: **1/8 inch**.

C. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site.

1. Disassemble components only as necessary for shipment and installation.
2. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.
3. Notify Architect seven days in advance of the dates and times interior architectural woodwork fabrication will be complete.
4. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled.

a. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting.
b. Verify that parts fit as intended, and check measurements of assemblies against field measurements indicated on approved Shop Drawings before disassembling for shipment.

D. Stairs: Cut rough carriages to accurately fit treads and risers.

1. Glue treads to risers, and glue and nail treads and risers to carriages.
2. House [wall] [and] [face] stringers, and glue and wedge treads and risers.
3. Fabricate stairs with treads and risers no more than 1/8 inch from indicated position and no more than 1/16 inch out of relative position for adjacent treads and risers.

2.6 SHOP PRIMING

A. Preparations for Finishing: Comply with the Architectural Woodwork Standards for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

B. Interior Architectural Woodwork for Opaque Finish: Shop prime with one coat of wood primer as specified in Section 099123 "Interior Painting."

1. Backpriming: Apply one coat of primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

C. Interior Architectural Woodwork for Opaque Finish: Shop-seal concealed surfaces with required pretreatments and first coat of finish as specified in Section 099300 "Staining and Transparent Finishing."

1. Backpriming: Apply one coat of sealer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to surfaces installed in contact with concrete or masonry and to end-grain surfaces.

2.7 SHOP FINISHING

A. Finish interior architectural woodwork with opaque finish at fabrication shop. Defer only final touchup, cleaning, and polishing until after installation.

B. Preparation for Finishing: Comply with Architectural Woodwork Standards, Section 5 for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing interior architectural woodwork, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of interior architectural woodwork. Apply two coats to end-grain surfaces.

C. Opaque Finish:

1. Architectural Woodworking Standards Grade: Same as item to be finished.

2. Finish System:

   a. 4: Latex Acrylic, Water Based.

3. Color: As selected by Architect from manufacturer's full range.
4. Sheen: As selected by Architect.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition interior architectural woodwork to humidity conditions in installation areas for not less than 72 hours prior to beginning of installation.

3.2 INSTALLATION

A. Grade: Install interior architectural woodwork to comply with same grade as item to be installed.

B. Assemble interior architectural woodwork and complete fabrication at Project site to the extent that it was not completed during shop fabrication.

C. Install interior 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.

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

E. Preservative-Treated Wood: Where cut or drilled in field, treat cut ends and drilled holes in accordance with AWPA M4.

F. Fire-Retardant-Treated Wood: Install fire-retardant-treated wood to comply with chemical treatment manufacturer's written instructions, including those for adhesives used to install woodwork.

G. Anchor interior architectural woodwork to anchors or blocking built in or directly attached to substrates.

1. Secure with countersunk, concealed fasteners and blind nailing.
2. Use fine finishing nails[or finishing screws] for exposed fastening, countersunk and filled flush with interior architectural woodwork.
3. For shop-finished items, use filler matching finish of items being installed.

H. Stairs: Securely anchor carriages to supporting substrates.

1. Install stairs with treads and risers no more than 1/8 inch from indicated position.
2. Secure with countersunk, concealed fasteners and blind nailing.
3. Use fine finishing nails[or finishing screws] for exposed fastening, countersunk and filled

flush with wood surface.

I. Railings:

1. Install rails with no more than 1/8 inch in 96-inch variation from a straight line.
2. Stair Rails: Glue and dowel or pin balusters to treads and railings, and railings to newel posts.

   a. Secure with countersunk, concealed fasteners and blind nailing.
   b. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with wood surface.

3. Wall Rails: Support rails on wall brackets securely fastened to wall framing.

   a. Space rail brackets not more than 48”o.c.

3.3 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.

1. Inspection entity is to prepare and submit report of inspection.

3.4 REPAIR

A. Repair damaged and defective interior architectural woodwork, where possible, to eliminate functional and visual defects and to result in interior architectural woodwork being in compliance with requirements of Architectural Woodwork Standards for the specified grade.

B. Where not possible to repair, replace defective woodwork.

C. Shop Finish: Touch up finishing work specified in this Section after installation of interior architectural woodwork.

1. Fill nail holes with matching filler where exposed.
2. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are shop applied.

D. Field Finish: See Section 099123 "Interior Painting" for final finishing of installed interior architectural woodwork not indicated to be shop finished.

3.5 CLEANING

A. Clean interior architectural woodwork on exposed and semiexposed surfaces.

END OF SECTION 06 4023

SECTION 06 7400 - FIBERGLASS COLUMNS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced plastic columns.

2. Aluminum vented plinth

1.2 COORDINATION

A. Coordinate installation of anchorages for columns and supports. Furnish setting drawings, templates, and directions for installing anchorages. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation Instructions and recommendations
2. Storage and handling requirements and recommendations
3. Installation methods

B. Shop Drawings: Include plans, sections, details, and attachments to other work.

C. Samples: Representative sections of cap, base, and top/bottom of column shaft, including typical profiles for each component.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

B. Columns shall be stored in the manufacturer’s crates until ready for use. If necessary to remove from crates, store in crated position with duplicate supports as originally crated.

C. Capitals and bases shall be stored in the manufacturer’s packaging until ready for use.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual locations and other construction contiguous with columns by field measurements before fabrication.

1.6 WARRANTY

A. Manufacturer's standard lifetime warranty.

PART 2 - PRODUCTS

2.1 GLASS-FIBER-REINFORCED PLASTIC COLUMNS

A. Molded Glass-Fiber-Reinforced Columns:

1. Provide products from the following basis-of-design manufacturer or approved equal:
   a. Basis-of-Design Product: American Porch Architectural Details

2. Material: Fiber-reinforced polymer

3. Configuration: 2-part, split for reassembly

4. Column Style: Round Tapered, Smooth

5. Base/Cap Style: Tuscan Cap and Tuscan Base

6. Column Bottom Shaft Diameter: 10"

7. Column Overall Height: As indicated on Drawings, subject to field verification.

8. Color: Manufacturer's standard.

B. Aluminum Vented Plinth
1. Provide products from the following basis-of-design manufacturer or approved equal:
   a. Basis-of-Design Product: Chadsworth Incorporated
2. Material: Aluminum
3. Size: 13 ¼" x 13 ¼" x 1 ¾"
4. Finish: Field Painted

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B633 or ASTM F1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

2.3 FABRICATION

A. Shop Assembly: Shop fabricate column components to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch material cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Fit exposed connections accurately together to form hairline joints.

D. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space the anchoring devices to secure columns and supports rigidly in place.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing columns to in-place construction. All anchors to be concealed in finished construction.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing gratings. Set units accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

C. Fit exposed connections accurately together to form hairline joints. Prepare joints as required for appropriate filler and finishing to eliminate visible joints from finished construction. Prepare for painting per Section 099114 “Exterior Painting (MPI Standards)”.

3.2 INSTALLATION OF GLASS-FIBER-REINFORCED PLASTIC COLUMNS

A. Comply with manufacturer's written instructions for installing columns.

3.3 INSTALLATION OF ALUMINUM VENTED PLINTH

A. Comply with manufacturer's written instructions for installing plinth base.

END OF SECTION 067400

SECTION 07 2100 - THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

Glass-fiber batt insulation.
Spray polyurethane foam insulation.
Acoustic blanket insulation.
Polyiso roof insulation board

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indexes less than Class A, 25 and 450 when tested in accordance with ASTM E84.

Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.

Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

Thermal-Resistance Value (R-Value): R-value as indicated on Drawings in accordance with ASTM C518.

2.2 GLASS-FIBER BATT INSULATION

Glass-Fiber Sound Attenuation Batt Insulation, Unfaced, lightweight, flexible fiberglass insulation batts: ASTM C665, Type I; passing ASTM E136 for combustion characteristics.

Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

CertainTeed; SAINT-GOBAIN
Johns Manville; a Berkshire Hathaway company
Knauf Insulation
Owens Corning

1. Size: full depth of cavity
2. Sound Transmission Class: ASTM C423, STC based on manufacturer's published data on thickness and wall assembly.

2.3 SPRAY POLYURETHANE FOAM INSULATION

High Density Closed-Cell Polyurethane Foam Insulation: Spray-applied polyurethane foam using water as a blowing agent, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

   a. BaySystems NorthAmerica, LLC.
   Demilec (USA) LLC.
   Gaco Western Inc.
   Icynene Inc.
   SWD Urethane Company.

2. Minimum density of 2.0 lb/cu. ft., thermal resistivity of R-value 6.5/inch

2.4 ACOUSTIC BLANKET INSULATION

Unfaced glass fiber acoustical insulation, complying with ASTM C 665, Type I.

Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

CertainTeed; SAINT-GOBAIN
Johns Manville; a Berkshire Hathaway company
Knauf Insulation
Owens Corning

1. Size: full depth of cavity
2. Sound Transmission Class: ASTM C423, STC 49 or greater.

2.5 POLYISOCYANURATE FOAM-PLASTIC BOARD INSULATION

Polyisocyanurate Board Insulation, : ASTM C1289, glass-fiber-mat faced, Type II, Class1, Grade 2, felt or glass-fiber mat facer on both major surfaces

1. Compressive strengthL 20 psi.
2. Size: 48 by 96 inches.
3. Thickness: 1”, R5.7 min.

4. Basis of Design: Subject to compliance with requirements, provide one of the following or approved equal:

a. GAF
b. Atlas Roofing Corporation Atlas Roofing Corporation
c. Carlisle Coatings & Waterproofing Inc.
d. Firestone Building Products
e. Hunter Panels
f. Johns Manville
g. Rmax, Inc

5. Manufacturers who are not listed but who do offer products that comply with the requirements of this section shall be considered as substitute manufacturers, subject to the conditions specified in Division 1 Section Product Substitution Procedures.

6. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.
7. Labeling: Provide identification of mark indicating R-value of each piece of insulation 12 inches and wider in width.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

Glass-Fiber or Mineral-Wool Batt Insulation: Install in cavities formed by framing members according to the following requirements and written instructions provided by the manufacturer:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.

Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.

Install continuous ventilation troughs between roof framing members in insulated attic spaces .

For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

For wood-framed construction, install blankets according to ASTM C 1320 and as follows:

a. With faced blankets having stapling flanges, secure insulation by inset, stapling flanges to sides of framing members.

B. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

Acoustic Blanket Insulation: Install in cavities formed by framing members according to the written instructions provided by the manufacturer:

Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

C. Poly-Iso Roof Insulation Board: Install according to manufacturer's written instructions.

3.4 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

SECTION 072726 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. High-build, vapor impermeable barrier for installation over existing concrete slab.

1.3 ACTION SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating each substrate; technical data; dry film thickness; and tested physical and performance properties of products.

1. High-build, vapor impermeable barrier.

B. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

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

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer to be licensed by ABAA in accordance with ABAA's Quality Assurance Program and to employ ABAA-certified installers and supervisors on Project.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply vapor barrier within the range of ambient and substrate temperatures recommended in writing by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect vapor-barrier performance.
2. Do not apply vapor barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Vapor-Barrier Performance: Vapor-barrier assembly and seals with adjacent construction to 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**. Vapor-barrier assemblies to be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Vapor-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested in accordance with ASTM E2357.

C. Vapor Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft. pressure difference; ASTM E2178.

D. Adhesion to Substrate: Minimum 16 lbf/sq. in. when tested in accordance with ASTM D4541.

2.2 HIGH-BUILD VAPOR BARRIERS, VAPOR RETARDING

A. High-Build, Vapor-Retarding Air Barrier, Synthetic Polymer Type: Synthetic polymer membrane with an installed dry film thickness, according to manufacturer's written instructions, of **35 mils** or thicker over smooth, void-free substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:

    a. Carlisle Coatings & Waterproofing Inc
    b. GCP Applied Technologies Inc.
    c. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
    d. W. R. Meadows, Inc

2.3 ACCESSORY MATERIALS

A. Provide primers, transition strips, termination strips, joint reinforcing fabric and strips, joint sealants, counterflashing strips, flashing sheets and metal termination bars, termination mastic, substrate patching materials, adhesives, tapes, foam sealants, lap sealants, and other accessory materials that are recommended in writing by air-barrier manufacturer to produce a complete air-barrier assembly and that are compatible with primary air-barrier material and adjacent construction to which they may seal.

B. Primer: Liquid solvent-borne primer recommended for substrate by air-barrier material manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION OF ACCESSORIES

A. Install accessory materials in accordance with vapor-barrier manufacturer's written instructions and details to form a seal with adjacent construction and ensure continuity of air and water barrier.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

C. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

1. Transition Strip: Roll firmly to enhance adhesion.
2. Preformed Silicone Extrusion: Set in full bed of silicone sealant applied to walls, frame, and vapor-barrier material.

D. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

E. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

F. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

G. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending **6 inches** beyond repaired areas in strip direction.

3.2 INSTALLATION OF PRIMARY AIR-BARRIER MATERIAL

A. Apply vapor-barrier material to form a seal with strips and transition strips and to achieve a continuous vapor barrier in accordance with vapor-barrier manufacturer's written instructions and details. Continue vapor barrier up onto exposed exterior wall sill plates. Apply vapor-barrier material within manufacturer's recommended application temperature ranges.

1. Unless manufacturer recommends in writing against priming, apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by vapor-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Where multiple prime coats are needed to achieve required bond, allow adequate drying time between coats.

B. High-Build Vapor Barriers: Apply continuous unbroken vapor-barrier material to substrates according to the following thickness. Apply vapor-barrier material in full contact around protrusions such as masonry ties.

1. High-build, vapor impermeable barrier: Total dry film thickness as recommended in writing by manufacturer to comply with performance requirements, but not less than 35 mils, applied in one or more equal coats.

C. Do not cover vapor barrier until it has been inspected by DGS Inspector and DNR Project Manager.

D. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.3 FIELD QUALITY CONTROL

A. ABAA Quality Assurance Program: Perform examinations, preparation, installation, testing, and inspections under ABAA's Quality Assurance Program.

B. Inspections: Vapor-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of vapor-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Vapor-barrier dry film thickness.
3. Continuous structural support of vapor-barrier system has been provided.
4. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
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. Surfaces have been primed, if applicable.
8. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
9. Termination mastic has been applied on cut edges.
10. Strips and transition strips have been firmly adhered to substrate.
11. Compatible materials have been used.
12. Transitions at changes in direction and structural support at gaps have been provided.
13. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
14. All penetrations have been sealed.

C. Vapor barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional vapor-barrier material, in accordance with manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

D. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

E. Prepare test and inspection reports.

END OF SECTION 072726

SECTION 07 3113 - ASPHALT SHINGLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Glass-fiber-reinforced asphalt shingles.
2. Underlayment materials.
3. Ridge vents.
4. Ridge Cap Shingles
5. Starter Shingles
6. Self Adhering Ice and Water Membrane

1.2 DEFINITIONS

A. Roofing Terminology: See ASTM D1079 for definitions of terms related to roofing Work in this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Asphalt shingles.
2. Underlayment materials.
3. Ridge Cap Shingles
4. Starter Shingles
5. Ridge vents.
6. Self Adhering Ice and Water Membrane

B. Shop Drawings:

1. For metal flashing and trim.
2. Metal Chimney Chase Cover

C. Samples: For each exposed product and for each color and blend specified, in sizes indicated.

1. Asphalt Shingles: Full size.
2. Ridge Cap Shingles: Full size.
3. Starter Shingles: Full size.
4. Ridge Vent: **12-inch** long Sample.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For manufacturer's materials warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For asphalt shingles to include in maintenance manuals.

B. Materials warranties.

C. Roofing Installer's warranty.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Asphalt Shingles: 100 sq. ft. of each type and in each color and blend, in unbroken bundles.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture in accordance with manufacturer's written instructions.

B. Store underlayment rolls on end, on pallets or other raised surfaces. Do not double-stack rolls.

C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing Work is not in progress.

D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Proceed with installation only when existing and forecasted weather conditions permit product installation and related Work to be performed in accordance with manufacturer's written instructions and warranty requirements.

1. Install self-adhering, polymer-modified bitumen sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

1.9 WARRANTY

A. Materials Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Manufacturing defects.
b. Excessive mold, mildew or algae growth.
c. Blistering, curling or granule loss.

2. Materials Warranty Period: 25 years from date of Substantial Completion, prorated, with first 10 years nonprorated.
3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 110 mph for 15 years from date of Substantial Completion.
4. Algae-Resistance Warranty Period: Asphalt shingles will not discolor for 25 years from date of Substantial Completion.
5. Workmanship Warranty Period: 20 years from date of Substantial Completion.

B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt shingle roofing that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain each type of product from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance in accordance with ASTM E108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

B. Wind Resistance: Provide asphalt shingles that comply with requirements of ASTM D3161/D3161M, Class F, and with ASTM D7158/D7158M, Class H.

C. Energy Performance, ENERGY STAR: Provide asphalt shingles that are listed on the DOE's "ENERGY STAR Roof Product List" for steep-slope roof products.

D. Solar Reflectance Index: Not less than 29 when calculated according to ASTM E 1980,

based on testing identical products by a qualified testing agency.

2.3 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

A. Three-Tab-Strip Asphalt Shingles: ASTM D3462/D3462M; glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF Timberline HDZ Shingles (color Weatherwood) or comparable product by one of the following:

a. Atlas Molded Products, a division of Atlas Roofing Corporation
b. CertainTeed; SAINT-GOBAIN

2. Strip Size: Manufacturer's standard.
3. Algae Resistance: Granules resist algae discoloration.
4. Color and Blends: As selected by Architect from manufacturer's full range.

B. Ridge Cap Shingles: Manufacturer's standard units to match asphalt shingles.

C. Starter Shingle: Manufacturer's standard units to match asphalt shingles.

2.4 UNDERLAYMENT MATERIALS

A. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Polyiso Roof and Wall Insulation
b. CertainTeed; SAINT-GOBAIN
c. GAF
d. Owens Corning

B. Self Adhering Ice and Water Membrane: Self adhering sheet membrane as underlayment for sloped roofs complying with the following: ASTM D412, D461, D903, D1970, D3767, E96, G90

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. GAF

b. GCP Applied Tecnhnologies
c. Owens Corning
d. Atlas Roofing
e. CertainTeed; SAINT-GOBAIN

2. Material: Cold applied, self adhering membrane composed of a high strength polyethylene film coated on one side with a layer of rubberized asphalt adhesive and interwound with a disposable release sheet. An embossed, slip resistant surface is provided on the polyethylene.
3. Color: Black
4. Membrane Thickness: 40 mil (1.02 mm) ASTM D3767 procedure A (Section 9.1)
5. Elongation Membrane: 250% ASTM D412 (Die C modified)
6. Low Temperature Flexibility: Unaffected @ -20°F (-29°C) ASTM D1970.
7. Adhesion to Plywood: 3.0 lbs/in. width (525 N/m) ASTM D903
8. Permeance (max) 0.05 Perms (2.9 ng/m2s Pa) ASTM E96
9. Material Weight Installed (Max): 0.3 lb/ft2 (1.3 kg/m2) ASTM D461.
10. Primer: Water-based per manufacturer's recommendations.

2.5 RIDGE VENTS

A. Flexible Ridge Vent: Manufacturer's standard, compression-resisting, three-dimensional, open-nylon or polyester-mat filter bonded to a nonwoven, nonwicking, geotextile fabric cover.

1. Basis-of-Design Product: Subject to compliance with requirements, provide GAF Cobra Rigid Vent 3 Exhaust Vent for Roof Ridge or comparable product by one of the following or approved equal:

a. Air Vent, Inc.; Gibraltar Industries, Inc.
b. Benjamin Obdyke Incorporated
c. GAF
d. Owens Corning

2. Minimum Net Free Area: 18 sq in/lin ft.
3. Width: 11.5 Inches.

2.6 ACCESSORIES

A. Asphalt Roofing Cement: ASTM D4586/D4586M Type II, asbestos free.

B. Elastomeric Flashing Sealant: ASTM C920, Type S, Grade NS, one-part, non-sag, elastomeric polymer sealant; of class and use classifications required to seal joints and remain watertight; recommended in writing by manufacturer for installation of flashing systems.

C. Roofing Nails: ASTM F1667, aluminum, stainless steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum **0.120-inch-** diameter, sharp-pointed, with a **3/8- to 7/16-inch-** diameter flat head and of sufficient length to penetrate **3/4 inch** into solid

wood decking or extend at least **1/8 inch** through sheathing less than **3/4 inch** thick.

1. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

D. Underlayment Nails: Aluminum, stainless steel, or hot-dip galvanized-steel wire nails with low-profile metal or plastic caps, **1-inch-** minimum diameter.

1. Provide with minimum **0.0134-inch-** thick metal cap, **0.010-inch-** thick power-driven metal cap, or **0.035-inch-** thick plastic cap; and with minimum **0.083-inch-** thick ring shank or **0.091-inch-** thick smooth shank of length to penetrate at least **3/4 inch** into roof sheathing or to penetrate through roof sheathing less than **3/4 inch** thick.

2.7 METAL FLASHING AND TRIM

A. Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item unless otherwise specified in this Section or indicated on Drawings.

1. Apron Flashings: Fabricate with lower flange a minimum of 5 inches over and 4 inches beyond each side of downslope asphalt shingles and 6 inches up the vertical surface.
2. Step Flashings: Fabricate with a headlap of **2 inches** and a minimum extension of 4 inches over the underlying asphalt shingle and up the vertical surface.
3. Cricket and Backer Flashings: Fabricate with concealed flange extending a minimum of 18 inches beneath upslope asphalt shingles and 6 inches beyond each side of chimney and 6 inches above the roof plane.
4. Counterflashings: Fabricate to cover 4 inches of base flashing measured vertically; and in lengths required so that no step exceeds 8 inches and overall length is no more than 10 feet.

    a. Provide metal receivers for installation.

5. Drip Edges: Fabricate in lengths not exceeding 10 feet with minimum **2-inch** roof-deck flange and **1-1/2-inch** fascia flange with **3/8-inch** drip at lower edge.
6. Vent-Pipe Flashings: ASTM B749, Type L51121, at least **1/16 inch** thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least **4 inches** from pipe onto roof.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored and that provisions have been made for flashings and penetrations through asphalt shingles.
3. Verify that vent stacks and other penetrations through roofing are installed and securely fastened.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

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

3.2 INSTALLATION OF UNDERLAYMENT MATERIALS

A. Comply with asphalt shingle and underlayment manufacturers' written installation instructions and with recommendations in NRCA's "The NRCA Roofing Manual: Steep-Slope Roof Systems" applicable to products and applications indicated unless more stringent requirements are specified in this Section or indicated on Drawings.

B. Self-Adhering Ice and Water Membrane, Polymer-Modified Bitumen Sheet: Install, wrinkle free, on the entirety of the roof deck where asphalt shingles are called out.

3.3 INSTALLATION OF METAL FLASHING AND TRIM

A. Install metal flashings and trim to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."

1. Bed flanges of metal flashings using asphalt roofing cement or elastomeric flashing sealant.

B. Apron Flashings: Extend lower flange over and beyond each side of downslope asphalt shingles and up the vertical surface.

C. Step Flashings: Install with a headlap of **2 inches** and extend over underlying shingle and up the vertical face.

1. Install with lower edge of flashing just upslope of, and concealed by, butt of overlying shingle.

2. Fasten to roof deck only.

D. Cricket and Backer Flashings: Install against roof-penetrating elements extending concealed flange beneath upslope asphalt shingles and beyond each side.

E. Counterflashings: Coordinate with installation of base flashing and fit tightly to base flashing. Lap joints a minimum of **4 inches** secured in a waterproof manner.

1. Install in reglets or receivers.

F. Rake Drip Edges: Install over underlayment materials and fasten to roof deck.

G. Eave Drip Edges: Install below underlayment materials and fasten to roof deck.

H. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

3.4 INSTALLATION OF ASPHALT SHINGLES

A. Install asphalt shingles in accordance with manufacturer's written instructions and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

B. Install starter strip along lowest roof edge, consisting of an asphalt shingle strip at least 7 inches wide with self-sealing strip face up at roof edge.

1. Extend asphalt shingles 1/2 inch over fasciae at eaves and rakes.
2. Install starter strip along rake edge.

C. Install first and remaining courses of laminated asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

D. Install first and remaining courses of three-tab-strip asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.

E. Fasten asphalt shingle strips with a minimum of six roofing nails, but not less than the number indicated in manufacturer's written instructions for roof slope and design wind speed indicated on Drawings and for warranty requirements specified in this Section.

1. Locate fasteners in accordance with manufacturer's written instructions.
2. Where roof slope is less than 4:12, hand seal self-sealing asphalt shingles to improve the shingles' positive bond by applying asphalt roofing cement spots between course overlaps after nailing the upper course.
3. When ambient temperature during installation is below 50 deg F, hand seal self-sealing asphalt shingles by applying asphalt roofing cement spots between course overlaps after nailing the upper course.

F. Ridge Vents: Install continuous ridge vents over asphalt shingles in accordance with

manufacturer's written instructions. Fasten with roofing nails of sufficient length to penetrate sheathing.

G. Hip and Ridge Shingles: Maintain same exposure of cap shingles as roofing-shingle exposure. Lap cap shingles at ridges to shed water away from direction of prevailing winds.

1. Fasten with roofing nails of sufficient length to penetrate sheathing.
2. Fasten ridge cap asphalt shingles to cover ridge vent without obstructing airflow.

END OF SECTION 07 3113

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Ethylene-propylene-diene-terpolymer (EPDM) roofing system.
2. Accessory roofing system materials.
3. Electronic leak-detection (ELD) materials.

B. Section contains the installation of sound-absorbing insulation strips in ribs of acoustical steel roof deck. Sound-absorbing insulation strips are furnished under Section 053100 "Steel Decking."

C. Related Requirements:

1. Section 053100 "Steel Decking" for roof deck panels[**and sound-absorbing insulation strips**].
2. Section 061000 "Rough Carpentry for wood nailers, curbs, and blocking[**and for wood-based, structural-use roof deck panels**].
3. Section 061600 "Sheathing" for wood-based, structural-use roof deck panels.
4. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
5. Section 077100 "Roof Specialties" for [**premanufactured copings**][**and**][**roof edge fasciae**][**gravel stops**][**reglets**][**roof edge flashings**][**counterflashings**].
6. Section 077129 "Manufactured Roof Expansion Joints" for premanufactured roof expansion-joint assemblies.
7. Section 079200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
8. Section 221423 "Storm Drainage Piping Specialties" for roof drains.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.

B. Shop Drawings: Include roof plans, sections, details, and attachments to other work, including the following:

1. Layout and thickness of insulation.

2. Base and sheet flashings and membrane termination details.
3. Flashing details at penetrations.
4. Tapered insulation layout, thickness, and slopes.
5. Roof plan showing orientation of roof deck and orientation of roofing membrane, fastening spacings, and pattern for corner, perimeter, and field-of-roof locations.
6. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
7. Crickets, saddles, and tapered edge strips, including slopes.
8. Tie-in with adjoining wall system air barrier.

C. Wind-Uplift-Resistance Submittal: For roofing system, indicating compliance with wind-uplift performance requirements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates:

1. Performance Requirement Certificate: Signed by roofing membrane manufacturer, certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

a. Submit evidence of complying with specified performance requirements.

2. Special Warranty Certificate: Signed by roofing membrane manufacturer, certifying that all materials supplied under this Section are acceptable for special warranty.

B. Qualification Data: For roofing system Installer.

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system.

B. Certified statement from existing roofing system manufacturer stating that existing roof warranty has not been affected by the Work performed under this Section.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, certified, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed in accordance with manufacturer's written

installation instructions and warranty requirements.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty to include all components of roofing system, such as substrate board,,vapor retarder, roof insulation, fasteners, adhesives, cover board,roofing membrane, base flashing sheet, ballast,,walkways, and other components of roofing system.
2. Warranty Period: 20 years from Date of Substantial Completion.

B. Roofing System Installer's Warranty: Submit Roofing System Installer's warranty, on warranty form at end of this Section, signed by Roofing System Installer, covering the Work of this Section, including all components of roofing system, such as substrate board,,vapor retarder, roof insulation, fasteners, adhesives, cover board,roofing membrane, base flashing sheet, ballast,,walkways and other components of roofing system.

1. Warranty Period: Two years from Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing system and base flashings to withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and flashings to remain watertight.

1. Accelerated Weathering: Roofing membrane to withstand 2000 hours of exposure when tested in accordance with ASTM G152, ASTM G154, or ASTM G155.
2. Impact Resistance: Roofing membrane to resist impact damage when tested in accordance with ASTM D3746/D3746M, ASTM D4272/D4272M, or the Resistance to Foot Traffic Test in FM Approvals 4470.

B. Material Compatibility: Roofing system materials to be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing membrane manufacturer based on testing and field experience.

C. Wind-Uplift Resistance: Design roofing system to resist the following wind-uplift pressures when tested in accordance with FM Approvals 4474, UL 580, or UL 1897:

D. Energy Performance: Roofing system to have an initial solar reflectance index (SRI) of not less than 0.70 and an emissivity of not less than 0.75 when tested in accordance with CRRC S100.

E. Exterior Fire-Test Exposure: Class B; for application and roof slopes indicated; when tested by a qualified testing agency in accordance with ASTM E108 or UL 790.

1. Identify products with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated.

1. Identify products with appropriate markings of applicable testing agency.

2.2 ETHYLENE-PROPYLENE-DIENE-TERPOLYMER (EPDM) ROOFING SYSTEM

A. EPDM Roofing Membrane Sheet: ASTM D4637/D4637M, Type II, scrim or fabric internally reinforced, EPDM sheet with factory-applied seam tape.

1. Thickness: 75 mils, nominal.
2. Exposed Face Color: Black.

2.3 ACCESSORY ROOFING SYSTEM MATERIALS

A. General: Accessory materials as recommended in writing by roofing membrane manufacturer for intended use and compatible with other roofing system components.

1. Adhesive and Sealants: Comply with VOC limits of authorities having jurisdiction.

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesives: 80 g/L.
f. PVC Welding Compounds: 510 g/L.
g. Other Adhesives: 250 g/L.
h. Single-Ply Roof Membrane Sealants: 450 g/L.
i. Nonmembrane Roof Sealants: 300 g/L.
j. Sealant Primers for Nonporous Substrates: 250 g/L.
k. Sealant Primers for Porous Substrates: 775 g/L.

B. Base and Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as roofing membrane.

C. Protection Sheet: As recommended in writing by roofing membrane manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Asphalt-Coated, Glass-Fiber-Mat, Venting Base Sheet: ASTM D4897/D4897M, Type II; nonperforated, asphalt impregnated, fiberglass reinforced, with mineral granular patterned surfacing on bottom surface.

F. Prefabricated Pipe Flashings: As recommended in writing by roofing membrane manufacturer.

G. Roof Vents: As recommended in writing by roofing membrane manufacturer.

1. Size: Not less than **4-inch** diameter.

H. Bonding Adhesive: Roofing membrane manufacturer's standard, water based.

I. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

J. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

K. Seaming Material: Factory-applied seam tape, width as recommended by manufacturer.

L. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

M. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

N. Metal Termination Bars: Manufacturer's standard, predrilled stainless steel or aluminum bars, approximately **1 by 1/8 inch** thick; with anchors.

O. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roofing system components to substrate; tested for required pullout strength, and acceptable to roofing membrane manufacturer.

P. Safety Accessories: Roofing membrane manufacturer's standard yellow seaming tape for designating safety perimeters and rooftop hazards.

Q. Miscellaneous Accessories: As recommended in writing by roofing membrane manufacturer.

2.4 SUBSTRATE BOARD

A. Fiber-Reinforced Gypsum Roof Board: ASTM C1278/C1278M, cellulosic-fiber reinforced, water-resistant gypsum board.

1. Thickness: 5/8 inch.

2.5 ROOF INSULATION AND ACCESSORIES

A. General: Preformed roof insulation boards manufactured or approved by roofing membrane manufacturer, approved for use in [**FM Approvals' RoofNav**][**SPRI's "Directory of Roof Assemblies"**] listed roof assemblies.

B. Tapered Insulation: Provide factory-tapered insulation boards.

1. Material: Match roof insulation.
2. Minimum Thickness: **1/4 inch**.
3. Slope:

a. Roof Field: 1/4 inch per foot unless otherwise indicated on Drawings.
b. Saddles and Crickets: 1/2 inch per foot unless otherwise indicated on Drawings.

C. General: Roof insulation accessories as recommended in writing by insulation manufacturer for

intended use and compatibility with other roofing system components.

1. Insulation Adhesive: Insulation manufacturer's standard adhesive formulated to attach roof insulation to substrate,and to another insulation layer as follows:

    a. Modified asphaltic, asbestos-free, cold-applied adhesive.
    b. Bead-applied, low-rise, one-component or multicomponent urethane adhesive.
    c. Full-spread, spray-applied, low-rise, two-component urethane adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION OF ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING SYSTEM, GENERAL

A. Install roofing system materials and components in accordance with roofing system manufacturer's written installation instructions, SPRI's "Directory of Roof Assemblies" assembly requirements, and FM Global Property Loss Prevention Data Sheet 1-29.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

C. Install roofing membrane and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing system.

D. Substrate-Joint Penetrations: Prevent adhesives from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.2 INSTALLATION OF EPDM ROOFING MEMBRANE

A. Install roofing membrane over roof area for adhered application method in accordance with roofing system manufacturer's written installation instructions.

B. Unroll roofing membrane and allow it to relax before installing.

C. Start installation in presence of roofing system manufacturer's technical personnel.

D. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

E. Adhered Application: Apply bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply to splice area of roofing membrane.

    1. In addition to adhering, mechanically fasten roofing membrane securely at terminations, penetrations, and perimeter of roof area.

F. Adhesive Seam Installation: Clean both faces of splice areas and apply splicing cement.

1. Firmly roll side and end laps of overlapping roofing membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.
3. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

G. Tape Seam Installation: Clean and prime both faces of splice areas and apply splice tape.

1. Firmly roll side and end laps of overlapping roofing membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

H. Factory-Applied Seam Tape Installation: Clean and prime surface to receive tape.

1. Firmly roll side and end laps of overlapping roofing membrane to ensure a watertight seam installation.
2. Apply lap sealant and seal exposed edges of roofing terminations.

I. Repair tears, voids, and lapped seams in roofing membrane that do not comply with requirements.

J. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal roofing membrane in place with clamping ring.

K. Adhere protection sheet over roofing membrane at locations indicated.

3.3 INSTALLATION OF BASE AND SHEET FLASHINGS

A. General: Install and adhere base and sheet flashings and preformed flashing accessories to substrates in accordance with roofing system manufacturer's written installation instructions.

B. Apply bonding adhesive to substrate and underside of flashings at required rate and allow to partially dry. Do not apply to seam area of flashings.

C. Flash penetrations and field-formed inside and outside corners.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping flashings to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of terminations.

E. Terminate and seal top of flashings and mechanically anchor to substrate through termination bars.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to inspect substrate conditions, surface preparation, and installation of roofing membrane, flashings, protection, and drainage components, and to furnish reports to Architect.

B. Perform the following tests:

1. ELD Testing: Testing agency surveys entire roof area and flashings to locate discontinuities in the roofing membrane using ELD in accordance with ASTM D7877 and ASTM D8231.

    a. After testing, repair areas of discontinuities, repeat tests, and make further repairs until roofing and flashing installations are contiguous.

        1) Cost of retesting is Contractor's responsibility.

    b. Testing agency to prepare survey report indicating locations of initial discontinuities, if any.

C. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion, in presence of Architect, and to prepare inspection report.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

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.

3.5 ROOFING SYSTEM INSTALLER'S WARRANTY

A. WHEREAS _____ of _____, herein called the "Roofing System Installer," has performed roofing and associated Work on the following Project:

1. Owner: State of Maryland - Department of General Services.
2. Owner Address: 301 West Preston St., Baltimore, MD 21201.
3. Building Name/Type: Smallwood State Park.
4. Building Address: 2750 Sweden Point Road Marbury, Maryland 20658.
5. Area of Work: Grinder House.
6. Acceptance Date: _____.
7. Warranty Period: Five years from date of Substantial Completion.
8. Date of Substantial Completion: _____.

B. AND WHEREAS Roofing System Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said Work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing System Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period Roofing Installer will, at Roofing System Installer's own cost and expense, make or cause to be made such repairs to or replacements of said Work as are necessary to correct faulty and defective work and as are necessary to maintain said Work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to Work and other parts of the building, and to building contents, caused by:

a. lightning;
b. fire;
c. vapor condensation on bottom of roofing; and
d. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When Work has been damaged by any of foregoing causes, Warranty will be null and void until such damage has been repaired by Roofing System Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing System Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of Work.
4. During Warranty Period, if Owner allows alteration of Work by anyone other than Roofing System Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty will become null and void on date of said alterations, but only to the extent said alterations affect Work covered by this Warranty. If Owner engages Roofing System Installer to perform said alterations, Warranty will not become null and void unless Roofing System Installer, before starting said Work, will have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate Work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty will become null and void on date of said change, but only to the extent said change affects Work covered by this Warranty.
6. Owner will promptly notify Roofing System Installer of observed, known, or suspected leaks, defects, or deterioration and will afford reasonable opportunity for Roofing System Installer to inspect Work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing System Installer on said Work and will not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty will not operate to relieve Roofing System Installer of responsibility for performance of original Work in accordance with requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this _____ day of _____, _____.

1. Authorized Signature: _____.
2. Name: _____.
3. Title: _____.

END OF SECTION 075323

SECTION 07 6200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Formed wall sheet metal fabrications, trim and flashings.
2. Prefinished Metal Gutters and Hangers.
3. Prefinished Metal Downspouts.
4. Prefinished Metal Snowguards.
5. Metal Chimney Chase Cover

B. Related Requirements

1. Section 061000 "Rough Carpentry"
2. Section 073113 “Asphalt Shingles”

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing and trim.

1. Plans, elevations, sections, and attachment details.
2. Fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
3. Identification of material, thickness, weight, and finish for each item and location in Project.
4. Details for forming, including profiles, shapes, seams, and dimensions.
5. Details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Details of termination points and assemblies.
7. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
8. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
9. Details of special conditions.
10. Details of connections to adjoining work.
11. Formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

1.3 INFORMATIONAL SUBMITTALS

Product certificates.
A. Sample warranties

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Entity that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
2. Protect stored sheet metal flashing and trim from contact with water.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.6 COORDINATION

A. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copings tested according to SPRI ES-1

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

A. Aluminum Sheet: Coil-coated sheet, ASTM B209/B209M, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Kynar Finish:

a. Two-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

3. Color: #57 Dark Bronze

2.3 PREFINISHED METAL HALF-ROUND GUTTERS & HANGERS

A. Provide prefinished half-round gutters, hangers and end caps as indicated in the drawings.

1. Size: 4” or otherwise as indicated in the Drawings.
2. Material: Aluminum
3. Finish: Kynar, Double Sided Finish - #57 Dark Bronze

2.4 PREFINISHED METAL ROUND DOWNSPOUTS

A. Provide prefinished round downspouts, standoffs and brackets as indicated in the drawings.

1. Size: 3” Round or otherwise as indicated in the Drawings.
2. Material: Aluminum
3. Finish: Kynar, Double Sided Finish - #57 Dark Bronze

2.5 PREFINISHED METAL SNOWGUARDS

A. Provide snowguard-pad style gusseted snowguards in 2 rows, staggered as indicated in the Drawings from the following basis of design manufacturer or approved equal:

1. Alpine Snowbird PD-400F Round Pad Style (fluer de lis)
2. Material: Aluminum
3. Finish: Kynar, Double Sided Finish - #57 Dark Bronze

2.6 METAL CHIMNEY CHASE COVER

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. K&M Sheet Metal
   b. Approved equal

2. Material: Kynar Galvalume steel
3. Material Thickness: 24 Guage
4. Color: Dark Bronze
5. Size: To fit existing size of individual chimney
6. Seal Collars and Seams (standard)
7. No flue holes

2.7 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

2.8 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

C. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

D. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

E. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

F. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.

2.9 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

B. Drip Edges: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

C. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

D. Counterflashing: Shop fabricate interior and exterior corners. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

E. Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat

seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

6. Coat concealed side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
7. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

8. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
9. Use lapped expansion joints only where indicated on Drawings.

B. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

C. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 07 9200 "Joint Sealants."

3.2 WALL FLASHING INSTALLATION

General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

A. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 04 2000 "Unit Masonry."

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07 6200

SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
Urethane joint sealants.
Mildew-resistant joint sealants.
Latex joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
Joint-sealant manufacturer and product name.
Joint-sealant formulation.
Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

Field-Adhesion-Test Reports: For each sealant application tested.

Sample Warranties: For special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

Product Testing: Test joint sealants using a qualified testing agency.

1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

B. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
Conduct field tests for each kind of sealant and joint substrate.
Arrange for tests to take place with joint-sealant manufacturer's technical representative present.

a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

2. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
When joint substrates are wet.
Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period for Silicones: 20 years from date of Substantial Completion.
Warranty Period for Urethanes: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

VOC Content: Sealants and sealant primers shall comply with the following:

1. Architectural sealants shall have a VOC content of 250 g/L or less.
Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

Silicone, Nonstaining, S, NS, 100/50, T, NT: Nonstaining, single-component, nonsag, plus 100 percent and minus 50 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 100/50, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 790.
Pecora Corporation; 890.
Sika Corporation, Construction Products Division; SikaSil-C990.
Tremco Incorporated; Spectrem 1.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; DOW CORNING® 756 SMS BUILDING SEALANT or Dow Corning® 795 Silicone Building Sealant.
Pecora Corporation; 864NST.
Tremco Incorporated; Spectrem 2.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

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

a. BASF Construction Chemicals, LLC, Building Systems; Sonalastic TX1.
Pecora Corporation; Dynatrol I-XL.
Tremco Incorporated; Dymonic.

B. Urethane, M, NS, 50, T, NT: Multicomponent, nonsag, plus 50 percent and minus 50 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 50, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Polymeric Systems, Inc.; PSI-270.
Tremco Incorporated; Dymeric 240 FC.

2.4 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Corning Corporation; 786-M White.
GE Construction Sealants; SCS1700 Sanitary.
Tremco Incorporated; Tremsil 200.

2.5 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, provide one of the following:

a. BASF Construction Chemicals, LLC, Building Systems; Sonolac.
Pecora Corporation; AC-20.
Sherwin-Williams Company (The); 850A.
Tremco Incorporated; Tremflex 834.

2.6 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

Cylindrical Sealant Backings: ASTM C 1330, Type B (bicellular material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.
Masonry.
Unglazed surfaces of ceramic tile.

2. Remove laitance and form-release agents from concrete.

Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.
Glass.
Porcelain enamel.
Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint- sealant bond; do not allow spillage or migration onto adjoining surfaces.

Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

Do not stretch, twist, puncture, or tear sealant backings.

Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

B. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
Completely fill recesses in each joint configuration.
Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

C. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
Provide recessed joint configuration of recess depth and at locations indicated on Drawings according to Figure 8C in ASTM C 1193.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

D. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

a. Perform 4 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

a. Whether sealants filled joint cavities and are free of voids.
Whether sealant dimensions and configurations comply with specified requirements.
Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.

Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints at roofing and other flashing locations, where indicated.

1. Joint Sealant: Urethane, S, NS, 25, NT.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Construction joints in cast-in-place concrete.
Control and expansion joints in unit masonry.
Joints between different materials listed above.
Perimeter joints between materials listed above and frames of doors, windows, and louvers.
Control and expansion joints in ceilings and other overhead surfaces.
Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 100/50, NT.

Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.

Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:

a. Isolation joints in cast-in-place concrete slabs.
Control and expansion joints in tile flooring.
Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, M, NS, 50, T, NT.
Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
Tile control and expansion joints.
Vertical joints on exposed surfaces of unit masonry.
Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.
Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

a. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
Gypsum board surfaces.
Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.
Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
Tile control and expansion joints where indicated.
Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 9200

SECTION 08 1433- STILE AND RAIL WOOD DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior stile and rail wood doors
2. Interior stile and rail wood doors.

Priming stile and rail wood doors.
Factory fitting wood doors to frames and factory machining for hardware.
Light frames and glazing installed in stile and rail wood doors.

B. Related Sections:

Division 08 Section "Glazing" for glass view panels in stile and rail wood doors.
Division 08 Sections "Door Hardware" for door hardware for stile and rail wood doors and wood frames.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. Forestry Stewardship Council (FSC) - Guidelines for environmentally certified wood doors.

Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
Scientific Certification Systems (SCS) - Certified Products Standards.
UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
United States Green Building Council (USGBC).
Window and Door Manufacturers Association - WDMA I.S.6-A Industry Standard for Architectural Stile and Rail Doors.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.6-A classifications. Include factory finishing specifications as applicable.

Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the wood door supplier in order to prepare the doors and frames to receive the finish hardware items.

Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
Indicate dimensions and locations of cutouts.
Indicate requirements for veneer matching.
Indicate doors to be factory finished and finish requirements.
Indicate fire protection ratings for fire rated doors.

B. Samples for Initial Selection: For each species and finish required.

Corner sections of doors, 8 by 10 inches, with door faces and edges representing actual materials to be used.

a. Provide samples for each species of veneer and solid lumber required.
Finish veneer faced door samples with same materials proposed for factory finished doors.

C. Warranty: Sample of special warranties.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

Mark each door on top rail with opening number used on Shop Drawings.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1. Temperature and Relative Humidity Requirements: Relative humidity to be 25 to 55 percent; temperature 60 to 80 degrees F (15.6 to 27.7 degrees C). Maintain required temperature and relative humidity in spaces where products will be installed for a minimum of 24 hours before, during, and after installation as recommended by manufacturer.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form signed by manufacturer, installer, and contractor in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.

2. Warranty Period for Exterior Stile and Rail Doors: Two (2) years according to manufacturer's written warranty from date of Substantial Completion.

3. Warranty Period for Interior Stile and Rail Doors: Five (5) years according to manufacturer's written warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STILE AND RAIL DOOR CONSTRUCTION - GENERAL

A. WDMA I.S.6-A Grade for Transparent Finish: Premium. Assemble doors, including components, with minimum WDMA Type II adhesives.

WDMA I.S.6-A Grade for Opaque Finish: Custom. Assemble doors, including components, with minimum WDMA Type II adhesives.

WDM I.S.6-A Industry Standard for Architectural Stile and Rail Doors

AWI Architectural Woodwork Quality Standards and AWI Manual of Millwork

Raised-Panel Thickness: Manufacturer’s standard, but not less than 1-5/8 inches (41 mm) for 2-1/4 inch (57 mm) thick doors, 1-1/8 inches (29 mm) for 1-3/4 inch (44 mm) thick doors, and 3/4 inches (19 mm) for 1-3/8 inch (35 mm) thick doors.

Flat-Panel Thickness: Manufacturer’s standard, but not less than 1-1/8 inches (29 mm) for 2-1/4 inch (57 mm) thick doors, 5/8 inches (16 mm) for 1-3/4 inch (44 mm) thick doors, and 1/4 inch (6 mm) for 1-3/8 inch (35 mm) thick doors.

Recycled Content: Provide MDF cores with minimum 80 percent recycled content; provide mineral cores with minimum 20 percent recycled content.

Composite Wood Doors: Made with binders containing no added urea formaldehyde resins.

2.2 STILE AND RAIL DOORS FOR FINISH - EXTERIOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:

1. Trustile
2. Algoma Hardwoods, Inc.
3. Eggers Industries.

The Maiman Company.

B. Exterior Solid Core Doors:

1. Stile and Rail Construction: Veneered, minimum 1/16” before sanding; structural engineered core; edgebands same species as face veneer.

Panel Designs: As Indicated in the Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

Grade: Premium

Finish: Opaque

Door Construction:
Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber].
Raised-Panel Construction: Veneered, wood-based panel product.

2. Wood Species for Opaque Finish: Manufacturer's standard mill option species and cut for stiles and rails; with panels of same species or wood-based composite materials.
3. Size, Layout and Thickness: As indicated on Drawings.

2.3 STILE AND RAIL DOORS FOR OPAQUE FINISH - INTERIOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:

1. Trustile
2. Algoma Hardwoods, Inc.
3. Eggers Industries.

The Maiman Company.

B. Interior Solid Core Doors:

1. Stile and Rail Construction: Veneered, structural composite lumber or veneered edge- and end-glued lumber.

Panel Designs: As Indicated in the Drawings. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review
Raised-Panel Construction: Shaped, medium-density fiberboard.
Flat-Panel Construction:

a. Veneered, with closed grain hardwood veneer on wood-based panel product. Medium-density fiberboard.

2. Wood Species for Opaque Finish: Manufacturer's standard mill option species and cut for stiles and rails; with panels of same species or wood-based composite materials.

Size, Layout and Thickness: As indicated on Drawings.

2.4 RATED STILE AND RAIL DOOR FOR OPAQUE FINISH – INTERIOR (CLOSET BELOW STAIR)

A. Manufacturers or approved equal:

Vintage Millwork + Restoration, 34 S Vintage Road, Paradise, PA 17562, 717-407-5880
Trustile
Any approved equal manufacturer

45 minute rated door with laminated wood stile and rail panel design as indicated on drawings, decorative stile and rail construction per above sections.
Frame is required to be rated for 45 minute rated door, clad with wood to match other door frames

2.5 EXTERIOR WOOD FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:

1. Trustile
2. Algoma Hardwoods, Inc.

Eggers Industries
The Maiman Company.

B. Non-Rated and 20 Minute Fire Rated Wood Door Frames: Frames, complete with transom and sidelite frames: solid lumber close grained hardwood for opaque finish.

C. Wood species for Opaque Finishes: Manufacturer's standard mill option paint grade species.

Frame Profiles: As indicated on Drawings.

2.6 INTERIOR WOOD FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers or approved equal:

1. Trustile
2. Algoma Hardwoods, Inc.

The Maiman Company.

B. Non-Rated and 20 Minute Fire Rated Wood Door Frames: Frames, complete with transom and sidelite frames, solid lumber close grained hardwood for opaque finish.

C. Wood species for Opaque Finishes: Manufacturer's standard mill option paint grade species.

Frame Profiles: As indicated on Drawings.

2.7 FABRICATION

A. Fabricate stile and rail wood doors in sizes indicated.

Fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with requirements in NFPA 80 for fire rated doors.

B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.

1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.

2.8 FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including machining for hardware that is not surface applied, before finishing.

B. Doors for Opaque Finish: Shop apply one coat of wood primer as specified in Division 09 Section "Painting" to faces, edges, and tops and bottoms of doors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.

Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.

1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

B. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated. Do not trim stiles and rails in excess of limits set by manufacturer or as permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold. Bevel non-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.

Comply with NFPA 80 for fire rated doors.

C. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

Replace doors that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1433

SECTION 08 5200 – WOOD CLAD WINDOWS

1.1 SUMMARY

A. Section includes aluminum-clad wood windows and wood doors.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, hardware, and finishes for wood windows.

B. Shop Drawings: For wood windows and doors.

1. Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.

C. Product Samples: For wood windows and components required, prepared on Samples of size indicated below:

1. Exposed Finishes: 2 by 4 inches.
2. Exposed Hardware: Full-size units.

D. Product Schedule: For wood windows. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each type of wood window, for tests performed by a qualified testing agency.

C. Field quality-control reports.

D. Sample Warranties: For manufacturer's warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to wood window manufacturer for installation of units required for this Project.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure to meet performance requirements.
b. Structural failures including excessive deflection, water leakage, and air infiltration.
c. Faulty operation of movable sash and hardware.
d. Deterioration of materials and finishes beyond normal weathering.
e. Failure of insulating glass.

2. Warranty Period:

a. Window: 10 years from date of Substantial Completion.
b. Glazing Units: 10 years from date of Substantial Completion.
c. Aluminum-Cladding Finish: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain wood windows from single source from single manufacturer.

2.2 WINDOW PERFORMANCE REQUIREMENTS

A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Window Certification: WDMA certified with label attached to each window.

B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:

1. Minimum Performance Class: CW.
2. Minimum Performance Grade: 50.

C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.35 Btu/sq. ft. x h x deg F.

D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.30.

2.3 WOOD WINDOWS

A. Aluminum-Clad Wood Windows:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Marvin Ultimate Single Hung G2 Series or comparable product by one of the following or approved equal:

a. JELD-WEN, Inc.
b. Kolbe Windows & Doors
c. Pella Corporation
d. Sierra Pacific Windows; Sierra Pacific Industries

B. Operating Types: Provide the following operating types in locations indicated on Drawings:

1. Single hung.

C. Certified Wood: Wood products shall be certified as "FSC Pure" or "FSC Mixed Credit" according to FSC STD-01-001 and FSC STD-40-004.

D. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than **1/32 inch** deep by **2 inches** wide; water-repellent preservative treated.

1. Exterior Finish: Aluminum-clad wood.

a. Aluminum Finish: Manufacturer's standard fluoropolymer two-coat system with fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight and complying with AAMA 2605.
b. Exposed Unfinished Wood Surfaces: Pine.
c. Color: As selected by Architect from manufacturer's full range.

2. Interior Finish: Manufacturer's standard factory painted finish.

a. Exposed Surfaces: Painted pine.
b. Color: As selected by Architect from manufacturer's full range.

3. Exterior Frame Accessories

a. Window sill extension: BOD Marvin Ultimate A1450
b. Brick mold: BOD Marvin Ultimate A898

E. Glass: Clear annealed glass, ASTM C1036, Type 1, Class 1, q3.

1. Kind: Fully tempered When within 24 inches of a door or 18 inches of a floor, or as indicated on drawings.

F. Insulating-Glass Units: ASTM E2190.

1. Glass: ASTM C1036, Type 1, Class 1, q3.

a. Tint: Clear.

2. Simulated Divided Lites: 7/8” with black spacer bar
3. Filling: Fill space between glass lites with Argon
4. Low-E Coating: Low E2

G. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.

H. Hardware, General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with adjacent materials; designed to smoothly operate, tightly close, and securely lock windows, and sized to accommodate sash weight and dimensions.

1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.

I. Hung Window Hardware:

1. Counterbalancing Mechanism: Complying with AAMA 902, concealed, of size and capacity to hold sash stationary at any open position.
2. Locks and Latches: Allow unobstructed movement of the sash across adjacent sash in direction indicated and operated from the inside only.
3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis to facilitate cleaning exterior surfaces from the interior.

J. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.

K. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

2.4 ACCESSORIES

A. Dividers (False Muntins): Provide divider grilles in designs indicated for each sash lite.

1. Quantity and Type: Three per sash, two permanently located at exterior and interior lites and one permanently located between insulating-glass lites.
2. Material: Manufacturer's standard.
3. Pattern: As indicated on Drawings.

4. Profile: As selected by Architect from manufacturer's full range.
5. Color: As selected by Architect from manufacturer's full range.

2.5 INSECT SCREENS

A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.

1. Type and Location: Full, inside for project-out, Full, outside for double-hung sashes.

B. Aluminum Frames: Manufacturer's standard aluminum alloy complying with SMA 1004 or SMA 1201. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet.
2. Finish for Interior Screens: Baked-on organic coating in color selected by Architect from manufacturer's full range.
3. Finish for Exterior Screens: Matching color and finish of cladding.

C. Aluminum Wire Fabric: **18-by-16** mesh of **0.011-inch-** diameter, coated aluminum wire.

1. Wire-Fabric Finish: Charcoal gray.

2.6 FABRICATION

A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.

B. Glaze wood windows in the factory.

C. Weather strip each operable sash to provide weathertight installation.

D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify rough opening dimensions, levelness of sill plate, and operational clearances.

C. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure weathertight window installation.

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

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E2112.

B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.

B. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.

1. Keep protective films and coverings in place until final cleaning.

C. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Protect window surfaces from contact with contaminating substances resulting from construction operations. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written instructions.

END OF SECTION 08 5200

SECTION 087100 - DOOR HARDWARE

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. Mechanical door hardware

B. Related Sections:

1. Division 01 "General Requirements" sections for, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Section 06100 Rough Carpentry
3. Section 062023 Interior Finish Carpentry
4. Section 072900 Joint Sealants for sealant requirements applicable to threshold installation specified in this section.
5. Section 081433 Stile and Rail Wood Doors

1.03 SUBMITTALS

A. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Samples for Initial Selection: For each type of exposed finish.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.
4. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.

b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
c. Indicate complete designations of each item required for each opening, include:
    1) Door Index: door number, heading number, and Architect's hardware set number.
    2) Quantity, type, style, function, size, and finish of each hardware item.
    3) Name and manufacturer of each item.
    4) Fastenings and other pertinent information.
    5) Location of each hardware set cross-referenced to indications on Drawings.
    6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    7) Mounting locations for hardware.
    8) Door and frame sizes and materials.
    9) Degree of door swing and handing.
    10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

5. Key Schedule: Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

B. Informational Submittals:

1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
2. Provide Product Data: Include warranties for specified door hardware.

1.04 Closeout Submittals:

1. Maintenance Data: For each type of door hardware to include in maintenance manuals.
2. Schedules: Final door hardware, and, keying schedule.

1.05 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. For door hardware: DHI certified AHC or DHC.
   b. Can provide installation and technical data to Architect and other related subcontractors.
   c. Can inspect and verify components are in working order upon completion of installation.
   d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
5. Where possible supply all components for a single door from a single manufacturer to ensure matching finishes. If not possible to source from a single manufacturer, provide sample finishes for all components to ensure matching finishes.

B. Certifications:

1. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

F. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.07 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.08 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
   a. Exit Devices: Two years from date of Substantial Completion.
   b. Manual Closers: 10 years from date of Substantial Completion.

1.09 MAINTENANCE

A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer’s recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with “Metal Doors and Frames”, “Flush Wood Doors”, “Stile and Rail Wood Doors” to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Ives 5BB series

2. Acceptable Manufacturers and Products or approved equal:
   a. Hager BB1191/1279 series
   b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
6. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
7. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins

2.04 MORTISE LOCKS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage L9000 series
2. Acceptable Manufacturers and Products or approved equal:
   a. Sargent 8200 series
   b. Corbin-Russwin ML2000 series

B. Requirements:

1. Provide mortise locks conforming to ANSI/BHMA A156.13 Series 1000, Grade 1, and UL Listed for 3-hour fire doors.
2. Indicators: Where specified, provide indicator window measuring a minimum 2-3/5-inch x 3/5 inch with 180-degree visibility. Provide messages color-coded using ANSI Z535 Safety Red with full text and/or symbols, as scheduled, for easy visibility. When applicable allows for lock status indication on both sides of the door.
3. Provide locks manufactured from heavy gauge steel, containing components of steel with a zinc dichromate plating for corrosion resistance.
4. Provide lock case that is multi-function and field reversible for handing without opening case. Cylinders: Refer to "KEYING" article, herein.

5. Provide locks with standard 2-3/4 inches (70 mm) backset with full 3/4 inch (19 mm) throw stainless steel mechanical anti-friction latchbolt. Provide deadbolt with full 1-inch (25 mm) throw, constructed of stainless steel.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim. Provide electrified options as scheduled in the hardware sets. Where scheduled, provide switches and sensors integrated into the locks and latches.
7. Lever Trim: Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
   a. Lever Design: Athens

2.05 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product or approved equal:
   a. Schlage ND series

2. Acceptable Manufacturers and Products or approved equal:
   a. Sargent 11-Line
   b. Corbin-Russwin CL3100 series

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
   a. Lever Design: Athens

2.06 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage Everest 29 S

2. Acceptable Manufacturers and Products or approved equal:

a. Best Preferred Patented
b. Yale Keymark

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
   a. Patented Open: cylinder with interchangeable core with open keyway.
3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.07 KEYING

A. Scheduled System:

1. New factory registered system:
   a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
   a. Replaceable Construction Cores.
      1) Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         a) 3 construction control keys
         b) 12 construction change (day) keys.
      2) Owner or Owner's Representative will replace temporary construction cores with permanent cores.
2. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
   d. Identification:

1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
2) Identification stamping provisions must be approved by the Architect and Owner.
3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.
1) Permanent Control Keys: 3.
2) Master Keys: 6.
3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
4) Key Blanks: Quantity as determined in the keying meeting.

2.08 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Telkee

2. Acceptable Manufacturers or approved equal:
   a. HPC
   b. Lund

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
   a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
   b. Provide hinged-panel type cabinet for wall mounting.

2.09 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4050A series

2. Acceptable Manufacturers and Products or approved equal:

a. Falcon SC70A series
b. Yale 4400 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with cast aluminum cylinder.
3. Closer Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter heat-treated pinion journal and full complement bearings.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and all weather requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and back check.
7. Pressure Relief Valve (PRV) Technology: Not permitted.
8. Provide stick on templates, special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.10 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers or approved equal:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.

2.11 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers or approved equal:
   a. Rixson
   b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

2.12 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers or approved equal:
   a. Burns
   b. Trimco

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.13 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers or approved equal:
   a. National Guard
   b. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.14 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers or approved equal:
   a. Burns
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.15 FINISHES

A. FINISH: BHMA 643E/716 (US11); EXCEPT:

1. Door Closers: Powder Coat to Match.
2. Weatherstripping: Dark Bronze Anodized Aluminum.
3. Thresholds: Extruded Architectural Bronze, Oil-Rubbed

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Lock Cylinders:

1. Install construction cores to secure building and areas during construction period.
2. Replace construction cores with permanent cores as indicated in keying section.

3. Furnish permanent cores to Owner for installation.

J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.

M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

   1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
   2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets: Basis-of-Design on the following:

107160 OPT0361095 Version 1

Legend:
Link to catalog cut sheet

Hardware Group No. 01

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		F643E/716	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50RD ATH		643e	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		US10B	IVE
1	EA	OH STOP	90S		643E/716	GLY
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	DOOR SWEEP	8197D		D	ZER
1	EA	THRESHOLD	SEE DRAWINGS			

Hardware Group No. 02

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		F643E/716	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50RD ATH		643e	SCH
1	EA	OH STOP	90S		643E/716	GLY
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		US10B	IVE
1	EA	GASKETING	488SBK PSA		BK	ZER
1	EA	DOOR SWEEP	8197D		D	ZER
1	EA	THRESHOLD	SEE DRAWINGS			

Hardware Group No. 03

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		F643E/716	IVE
1	EA	CLASSROOM LOCK	ND70RD ATH		643e	SCH
1	EA	SMOKE SEAL/GASKETING	488S		BK	PSA

Hardware Group No. 04

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		F643E/716	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR	L9040 07A 09-544 OS-OCC		643e	SCH
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		US10B	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS		695	IVE
1	EA	OH STOP	90S		643E/716	GLY
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 05

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		F643E/716	IVE
1	EA	STOREROOM LOCK	ND80RD ATH		643e	SCH
1	EA	OH STOP	90S		643E/716	GLY
1	EA	SURFACE CLOSER	4050A REG OR PA AS REQ		695	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		US10B	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 07

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		F643E/716	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50RD ATH		643e	SCH
1	EA	OH STOP	90S		643E/716	GLY
3	EA	SILENCER	SR64		GRY	IVE

END OF SECTION

SECTION 08 9119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fixed extruded-aluminum louvers.

1.2 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).

C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).

D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.

F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
2. Show mullion profiles and locations.

C. Samples: For each type of metal finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

B. Windborne-debris-impact-resistance test reports.

C. Sample Warranties: For manufacturer's special warranties.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 WARRANTY

A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain fixed and operable louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

A. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 FIXED EXTRUDED-ALUMINUM LOUVERS

A. Horizontal Drainable-Blade Louver, Extruded Aluminum:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cesco Products; MESTEK, Inc.
b. Metal Form Manufacturing LLC; United Enertech Corp.
c. Ruskin; Air Distribution Technologies, Inc.; Johnson Controls, Inc.
d. United Enertech Corp.

2. Basis-of-design is Ruskin ELF375DX
3. Louver Depth: 4”
4. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
5. Mullion Type: Hidden.
6. Louver Performance Ratings:

a. Free Area: 54% (min 50%)
b. Point of Beginning Water Penetration: at .01 oz/sq. ft. is 873 fpm (266 m/min)

7. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louver.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Insect screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

1. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames at corners with clips.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:

1. Insect Screening, Aluminum: 18-by-16 mesh, 0.012-inch wire.

2.5 MATERIALS

A. Aluminum Extrusions: ASTM B221, Alloy 6063-T5, T-52, or T6.

B. Aluminum Sheet: ASTM B209, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use tamper-resistant screws for exposed fasteners unless otherwise indicated.
2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.

D. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

E. Indigenous Materials: Products shall be manufactured within 500 miles of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.

2.6 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
2. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

F. Provide subsills made of same material as louvers for recessed louvers.

G. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.7 ALUMINUM FINISHES

A. Finish louvers after assembly.

B. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 9119

SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
Tile backing panels.

B. Related Requirements:

Section 09 3013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Recycled Content: Provide gypsum panel products with minimum 80 percent recycled content, including recycled content face paper; provide steel with at least 25 percent post-consumer recycled content.

Regional Content: Provide gypsum board manufactured and of primary raw materials extracted or recovered within 500 mile radius of Project Site; provide at least 25 percent of steel manufactured and of primary raw materials extracted or recovered within 500 mile radius of Project Site.

Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
Long Edges: Tapered.

B. Gypsum Ceiling Board: ASTM C 1396

1. Thickness: ½ inch
Manufactured in accordance with ICC-ES AC417

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
Long Edges: Tapered.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch.
Long Edges: Tapered.
Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. C-Cure; C-Cure Board 990.
CertainTeed Corp.; FiberCement BackerBoard.
Custom Building Products; Wonderboard.
FinPan, Inc.; EZ Backer.
James Hardie Building Products, Inc.; Hardiebacker.
National Gypsum Company, Permabase Cement Board.
USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.
Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by the following or approved equal:

a. Fry Reglet Corp.
Gordon, Inc.
Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

Joint Tape:

1. Interior Gypsum Board: Paper.

Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
Tile Backing Panels: As recommended by panel manufacturer.

B. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

2. Fill Coat: For second coat, use setting-type, sandable topping compound.

Finish Coat: For third coat, use setting-type, sandable topping compound.
Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.

C. Joint Compound for Tile Backing Panels:

1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate. VOC content not to exceed 50 g/L.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following or approved equal:

a. Grabber Construction Products; Acoustical Sealant GSC.
Pecora Corporation; AC-20 FTR.
Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
USG Corporation; SHEETROCK Acoustical Sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

Form control and expansion joints with space between edges of adjoining gypsum panels.

Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.

Fit gypsum panels around ducts, pipes, and conduits.

Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

B. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.

Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

2. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

Fastening Methods: Fasten base layers and face layers separately to supports with screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.4 APPLYING TILE BACKING PANELS

Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.

LC-Bead: Use at exposed panel edges.
U-Bead: Use where indicated.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

Prefill open joints, rounded or beveled edges, and damaged surface areas.

Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

Level 2: Panels that are substrate for tile.

Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

2. Level 5: Where indicated on Drawings.

a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

B. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

SECTION 093013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
1. Porcelain tile.
2. Stone thresholds.
3. Uncoupling membrane.

B. Related Requirements:
1. Section 092900 "Gypsum Board" for glass-mat, water-resistant backer board.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:
1. Each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.
3. Stone thresholds.
4. Uncoupling membrane and joint seaming membrane

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.

1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.3 TILE PRODUCTS

A. Ceramic Tile Type: Unglazed porcelain floor tile FLR-5.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
      a. Mosa; Global Collection/Globalgrip

   2. Certification: Tile certified by the Porcelain Tile Certification Agency.
   3. Face Size: 6x6 inch
   4. Thickness: 0.28 inch.
   5. Face: flat, matt with square edges.
   6. Dynamic Coefficient of Friction: slip resistance R value (10), slip resistance A
   7. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer’s full range, basis-of-design, plain Sienna, color code 76260
   8. Finish: smooth (V)
   9. Grout Color: As selected by Architect from manufacturer's full range.
   10. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
      a. Base for Thinset Mortar Installations: straight

B. Ceramic Tile Type: glazed ceramic wall tile B-3 / W-CT.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide the following:
      a. Daltile, Classic Color Wheel Collection

   2. Certification: Tile certified by the Porcelain Tile Certification Agency.
   3. Face Size: 4x4 inch
   4. Thickness: 5/16 inch.
   5. Face: Glossy
   6. Shade Variation: V1:Low
   7. Tile Color, Glaze, and Pattern: As selected by Architect from manufacturer’s full range, basis-of-design, Elemental Tan 0166 or Urban Putty 0161
   8. Grout Color: As selected by Architect from manufacturer's full range.

2.4 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

   1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.

B. Marble Thresholds: ASTM C 503/C 503M, with a minimum abrasion resistance of 10 according to ASTM C 1353 or ASTM C 241/C 241M and with honed finish.

   1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.5 UNCOUPLING MEMBRANE

A. General: Manufacturer's standard product that complies with ANSI A118.10 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
   1. The uncoupling membrane shall provide air space between the tile and the substrate to allow independent movement between the two and limit the transfer of stresses.

B. Corrugated Polyethylene Membrane: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring fleece on the underside; 3/16-inch nominal thickness.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Schluter Systems L.P.; DITRA.
   2. This product shall be installed with unmodified dry-set mortar.

C. Waterproofing Seaming Membrane: Polyethylene faced on both sides with fleece webbing; 0.004-inch nominal thickness.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Schluter Systems L.P.; KERDI-BAND Seams and Corners.
   2. Where a waterproof floor is indicated or required, all seams in the uncoupling membrane and floor/wall transitions must be sealed with waterproofing seaming membrane using unmodified thin-set mortar.

2.6 SETTING MATERIALS

A. Unmodified Dry-Set Mortar (Thinset): ANSI A118.1.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonsal American, an Oldcastle company.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
      e. Summitville Tiles, Inc.
      f. TEC; H.B. Fuller Construction Products Inc.

   2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.1.

B. Modified Dry-Set Mortar (Thin Set): ANSI A118.4; 450 psi bond strength, minimum.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bonsal American; an Oldcastle company.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
      e. Summitville Tiles, Inc.
      f. TEC; H. B. Fuller Construction Products Inc.

   2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
   3. Provide prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.
   4. For wall applications, provide nonsagging mortar.

2.7 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Bonsal American; an Oldcastle company.
   b. Custom Building Products.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.
   e. Summitville Tiles, Inc.
   f. TEC; H. B. Fuller Construction Products Inc.

2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients.
3. Polymer Type: Liquid-latex form for addition to prepackaged dry-grout mix.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Bonsal American, an Oldcastle company; Grout Sealer.
   b. Custom Building Products; Grout and Tile Sealer.
   c. Summitville Tiles, Inc.; SL-15, Invisible Seal.
   d. TEC, H. B. Fuller Construction Products Inc.; Grout Guard Penetrating Grout Sealer.

C. Metal Edge Strips: Finishing and edge-protection profile for tile edges on walls & floors:
1. Basis-of-design: Schluter Systems:
   a. Cove base: DILEX-HKU
   b. Wall caps: JOLLY

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
    a. Tile floors in wet areas.
    b. Tile floors consisting of tiles 8 by 8 inches or larger.
    c. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Glazed Wall Tile: 1/8 inch.
   2. Porcelain Tile: 1/8 inch.

H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

J. Install uncoupling membrane and waterproofing seaming membrane in accordance with manufacturer’s written technical installation instructions included with packaged materials.
   1. Setting mortar shall be compatible with sheet membranes and approved by manufacturer.

K. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:
   1. Ceramic Tile Installation: TCNA F128; uncoupling membrane, with waterproofed joints, and thinset mortar.
      a. Thinset Mortar: Unmodified dry-set mortar.
      b. Grout: High-performance unsanded grout.

B. Interior Wall Installations, Metal Studs or Furring:

   1. Ceramic Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.
      a. Thinset Mortar: Modified dry-set mortar direct to backer board.
      b. Grout: High-performance unsanded grout.

END OF SECTION 093013

SECTION 09 6400 - WOOD FLOORING, PATCHING AND RESTORATION

1.1 SUMMARY

Section Includes:

Field-finished wood flooring

Related Sections:

06 0312 - Historic Wood Repair

1.2 ACTION SUBMITTALS

A. Samples: For each exposed product and for each color and texture specified.

B. Product data for proposed finish system, installation accessories and fasteners.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Allow wood to acclimate to conditioned interior environment before installing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Wood finishes and adhesives applied within the building interior: Comply with Section 01 8119 Indoor Air Quality Requirements.

A. Hardwood Flooring: Comply with NWFA A500 for species, grade, and cut.

Certification: Provide flooring that carries NWFA grade stamp on each bundle or piece.

2.2 FIELD-FINISHED WOOD FLOORING

Engineered Wood Flooring: Kiln dried to 6 to 9 percent maximum moisture content; tongue and groove and end matched; with backs channeled.

Manufacturers:

a. Hurst Hardwoods (https://www.hursthardwoods.com)
b. Almanac Hardwood (https://www.almanachardwood.com/)
c. Any approved supplier with an equivalent product

Grade and Species: Select New Heart Pine
2. Cut: Plain Sawn
3. Thickness: 3/4 inch.
4. Face Width: 5 1/8”
5. Lengths: Random-length strips complying with applicable grading rules, minimum 6' lengths..

Urethane Finish System: Complete water-based system of compatible components that is recommended by finish manufacturer for application indicated.

Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

a. Bona US Inc.
Basic Coatings, Inc.
b. Dura Seal.

6. Basis-of-Design Product: Bona Traffic HD
Ingredients: Water, Polymeric resins, and amorphous silica.Basic Coatings, Inc.
a. Color: Milky white (wet
b. Clarity: Clear and colorless when dry
c. pH: 7.9
d. Solids: 34 percent (with hardener
e. Density: 8.70 lbs per gal (1.04 s.g
f. US Regulatory VOC Compliant: less than 150 g/L (with hardener)
g. Coefficient of Friction: Greater than or equal to 0.5
h. Gloss Level (60 degrees): Commercial Satin: 15 to 20 percent

Floor Sealer: Per manufacturer’s recommendation for complete water-based system.
7. Finish Coats: Per manufacturer’s recommendation for complete water-based system.

Wood Filler: Compatible with finish system components and recommended by filler and finish manufacturers for use indicated. If required to match approved Samples, provide pigmented filler.

2.3 ACCESSORY MATERIALS

Leveling and Patching Compound:

1. Latex-modified, hydraulic-cement-based formulation approved by wood flooring manufacturer and to comply with applicable recommendations in NWFA's "Installation Guidelines”, to achieve flush floor transition as detailed in drawings

2. Gyp crete or cementitious product approved by flooring manufacturer and to comply with applicable recommendations in NWFA's "Installation Guidelines”, to achieve flush floor transition as detailed in drawings

B. Thresholds and Saddles: To match wood flooring. Tapered on each side.

C. Cork Expansion Strip: Composition cork strip.

PART 3 - EXECUTION

3.1 PREPARATION

Concrete Slabs:

Apply Class 1, impermeable topside fluid applied vapor barrier to existing slab and new concrete patches

Level and patch using compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

1. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

B. Wood Subfloors

Level and patch using compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

1. Remove coatings, including curing compounds, and other substances on substrates that are incompatible with installation adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

Broom or vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Concrete Floors

1. Inspect preparation of slab per specification above, confirming installation of fluid applied membrane

2. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch.

B. Wood Floors

1. Inspect existing subfloor and sleepers for soundness and reuse. Where subfloor and sleepers are damaged, warped or unusable for new installation, provide and install new subfloor as required.

2. Subfloor: Install according to requirements in Section 06 1000 "Rough Carpentry" and Section 06 1600 "Sheathing."

3. Provide expansion space at walls and other obstructions and terminations of flooring of not less than 3/4 inch.

C. Engineered-Wood Flooring: Float wood floor on slip paper as recommended by flooring manufacturer and NWFA standards and recommendations for each subfloor condition

3.3 FIELD FINISHING

Machine-sand flooring to remove offsets, ridges, cups, and sanding-machine marks that are noticeable after finishing. Vacuum and tack with a clean cloth immediately before applying finish.

Comply with applicable recommendations in NWFA's "Installation Guidelines."

Fill to match existing.

A. Fill and repair wood flooring defects.

B. Apply floor-finish materials in number of coats recommended by finish manufacturer for application indicated, but not less than one coat of floor sealer and three finish coats. Apply floor-finish in manner and method as recommended by manufacturer.

1. For water-based finishes, use finishing methods recommended by finish manufacturer to minimize grain raise.

Protect wood flooring before finishing.

C. Do not cover wood flooring after finishing until finish reaches full cure, and not before seven days after applying last finish coat.

3.4 PROTECTION

Protect installed wood flooring during remainder of construction period with covering of heavy kraft paper or other suitable material. Do not use plastic sheet or film that might cause condensation.

Do not move heavy and sharp objects directly over kraft-paper-covered wood flooring. Protect flooring with plywood or hardboard panels to prevent damage from storing or moving objects over flooring.

END OF SECTION 09 6400

SECTION 09 9113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Finish coatings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT PRODUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Benjamin Moore & Co.
2. PPG Paints; PPG Industries, Inc.
3. Sherwin-Williams Company (The)
4. Valspar; a brand of The Sherwin-Williams Company

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

C. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by topcoat manufacturer for use in paint system and on substrate indicated.

D. VOC Content: For field applications, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 50 g/L.
3. Dry-Fog Coatings: 150 g/L.

4. Primers, Sealers, and Undercoaters: 100 g/L.
5. Rust-Preventive Coatings: 100 g/L.
6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

E. Colors: As selected by Architect from manufacturer's full range.

F. Sheen: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and Concrete Masonry Units): 12 percent.
4. Wood: 15 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is dry and sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.

G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

I. Aluminum Substrates: Remove loose surface oxidation.

J. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view, and remove sanding dust.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

A. Apply paints in accordance with manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
4. Paint entire exposed surface of window frames and sashes unless finish is factory-applied.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with

paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Steel and Iron Substrates: Miscellaneous

1. Latex over Latex Primer System:

a. Prime Coat: Exterior, latex steel primer.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Exterior latex paint, semigloss.

B. Dressed Wood Substrates: Wood trim, Architectural woodwork, wood doors and wood board soffits:

1. Latex over Latex Primer System:

a. Prime Coat: Exterior, latex wood primer.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Exterior latex paint, semigloss.

C. Fiberglass Substrates: Column wraps

1. Latex over Latex Primer System:

    a. Prime Coat: Exterior, latex primer for fiberglass.
    b. Intermediate Coat: Exterior, latex, matching topcoat.
    c. Topcoat: Exterior latex paint, low sheen.

D. Exposed Lumber Substrates:

1. Latex over Latex Primer System:

    a. Prime Coat: Exterior, latex wood primer.
    b. Intermediate Coat: Exterior, latex, matching topcoat.
    c. Topcoat: Exterior latex paint, semigloss.

E. Brick:

1. Latex over Latex Permeable Primer System. Complete system to be vapor permeable:

    a. Prime Coat: Exterior, latex brick primer.
    b. Intermediate Coat: Exterior latex matching topcoat.
    c. Topcoat: Exterior latex paint, low sheen.

END OF SECTION 09 9113

SECTION 09 9123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Primers.
2. Water-based finish coatings.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for shop priming metal fabrications.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 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. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.5 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT PRODUCTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, or approved equal:

1. Benjamin Moore
2. Sherwin Williams
3. PPG Architectural Coatings

B. Source Limitations: Obtain each paint product from single source from single manufacturer.

C. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

D. Material Emissions and Pollutant Control: Not less than 85 percent of field-applied paints and coatings that are inside the weatherproofing system shall comply with either of the following:

1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.

2. VOC content shall not exceed limits of authorities having jurisdiction and the following:

    a. Flat Coatings: 50 g/L.
    b. Nonflat Coatings: 100 g/L.
    c. Nonflat - High-Gloss Coatings: 150 g/L.
    d. Dry-Fog Coatings: 150 g/L.
    e. Industrial Maintenance Coatings: 250 g/L.
    f. Pretreatment Wash Primers: 420 g/L.
    g. Primers, Sealers, and Undercoaters: 100 g/L.
    h. Recycled Coatings: 250 g/L.
    i. Rust-Preventive Coatings: 250 g/L.

E. Colors: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.

F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer.

G. Aluminum Substrates: Remove loose surface oxidation.

H. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 INSTALLATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and

similar hinged items to match exposed surfaces.

4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

    a. Equipment, including panelboards and switch gear.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Tanks that do not have factory-applied final finishes.
    h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

    a. Equipment, including panelboards.
    b. Uninsulated metal piping.
    c. Uninsulated plastic piping.
    d. Pipe hangers and supports.
    e. Metal conduit.
    f. Plastic conduit.
    g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    h. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
3. Allow empty paint cans to dry before disposal.
4. Collect waste paint by type and deliver to recycling or collection facility.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates:

1. Institutional Low-Odor/VOC Latex System A:

a. Prime Coat: Water-based rust-inhibitive primer.
b. Intermediate Coat: Interior, latex, matching topcoat.
c. Topcoat: Interior, latex, institutional low odor/VOC, low sheen.

B. Exposed Wood Framing:

1. Latex over Latex Primer System:

a. Prime Coat: Interior latex primer for wood.
b. Intermediate Coat: Interior, latex, matching topcoat.
c. Topcoat: Interior, latex, eggshell.

C. Finish Carpentry: Wood trim, Doors, Windows, Fireplace Surrounds.

1. Latex over Latex Primer System:

a. Prime Coat: Interior latex primer for wood.
b. Intermediate Coat: Interior, latex, matching topcoat.
c. Topcoat: Interior, latex, semigloss.

D. Gypsum Board and Plaster Substrates

1. Latex over Latex Primer System:

a. Prime Coat: Interior latex primer for gypsum board.
b. Intermediate Coat: Interior, Latex matching topcoat.
c. Topcoat: Interior, latex, eggshell.

E. Brick:

1. Latex over Latex, Permeable Primer System:

a. Prime Coat: Exterior, latex brick primer.
b. Intermediate Coat: Exterior latex matching topcoat.
c. Topcoat: Exterior latex paint, low sheen.

END OF SECTION 09 9123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes transparent finish for salvaged log ceiling ties

1. Waterborne finishes.

1.2 RELATED SECTIONS

A. Section 06 0312 – Historic Wood Repair

1.3 ACTION SUBMITTALS

A. Product Data:

1. For each type of product.
2. Include preparation requirements and application instructions.
3. Indicate VOC content.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of exposed finish.

C. Samples for Verification: Sample for each type of finish system and in each color and gloss of finish required on representative samples of actual wood substrates.

1. Size: 8 inches square, or, 8 inches long.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

D. Product List: Cross-reference to finish system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

E. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
3. Environmental Product Declaration: For each product.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

1.5 MOCKUPS

A. Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and, to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.

a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft.**.
b. Other Items: Architect will designate items or areas required.

2. Final approval of stain color selections will be based on mockups.

a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply finishes only when temperature of surfaces to be finished and ambient air temperatures are between **50 and 95 deg F**.

B. Do not apply finishes when relative humidity exceeds 85 percent, at

temperatures of less than **5 deg F** above the dew point, or to damp or wet surfaces.

C. Do not apply exterior finishes in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Source Limitations: Obtain each coating product from single source from single manufacturer.

2.2 TRANSPARENT FINISHING FOR SALVAGED LOG CEILING TIES

A. Varnish, Interior, Water-Based, Clear, Satin: Water-based clear satin coating for interior wood.

1. Manufacturers: Subject to compliance with requirements, or approved equal:

   a. Benjamin Moore & Co.
   b. PPG Paints; PPG Industries, Inc.
   c. Sherwin-Williams Company (The)

2. Gloss and Sheen Level: Manufacturer's standard low-sheen finish.

B. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

C. Emissions Requirements: Field-applied paints and coatings that are inside the weatherproofing system shall comply with the following:

1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting

performance of the Work.

B. Maximum Moisture Content of Exterior Wood Substrates: 15 percent, when measured with an electronic moisture meter.

C. Maximum Moisture Content of Interior Wood Substrates: 10 percent, when measured with an electronic moisture meter.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with finish application only after unsatisfactory conditions have been corrected.

1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Logs are meant to retain all of their historic markings including white ghosting from plaster and lathe. Logs are not to be sanded or scrubbed with any wash that will remove the history of the log. Logs are to be carefully brushed or cleaned with mild compressed air to remove dust in preparation for finish.

3.3 APPLICATION

A. Apply finishes according to manufacturer's written instructions.

1. Use applicators and techniques suited for finish and substrate indicated.
2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces.
3. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD-FINISH-SYSTEM SCHEDULE

A. Original log ceiling rafters

1. Water-Based Varnish System WD-01:

a. Prime Coat: Water-based varnish matching topcoat.
b. Intermediate Coat: Water-based varnish matching topcoat.
c. Topcoat: Varnish, water based, clear, satin.

END OF SECTION 099300

SECTION 101423 – PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

Section Includes:

Panel signs.
1. ADA Room Identification Signage.

1.2 ACTION SUBMITTALS

Product Data: For each type of product.

Shop Drawings: For panel signs.

Include fabrication and installation details and attachments to other work.
1. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
2. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
3. Include diagrams for power, signal, and control wiring including any electrical connections.

Samples: For each exposed product and for each color and texture specified.

1.3 WARRANTY

Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.2 PANEL SIGNAGE TYPES & LOCATIONS SCHEDULE

1. Provide Room Identification Panel Signage with Raised Braile Characters for the following locations:

First Floor: STORAGE, WC, MECH

Second Floor: OFFICE, OFFICE, STORAGE, STORAGE

2. Provide code-compliant Exit Pathway Panel Signage with Raised Braile Characters for the following locations:

FRONT DOOR, SIDE DOOR

3. Provide additional signage as noted in the drawing set, including but not limited to the following locations:

FIREPLACES

2.3 PANEL SIGNS

Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

Laminated Polycarbonate-Sheet Sign: Polycarbonate face sheet laminated to each side of phenolic base sheet to produce composite sheet.
- a. Surface-Applied, Raised Graphics: Applied polymer characters Braille.
- b. Subsurface Graphics: Reverse halftone or dot-screen image.

Sign Panel Perimeter: Finish edges smooth
- c. Edge condition at vertical and horizontal edges: Square cut
- d. Corner Condition in Elevation: As indicated on drawings
- e. Finish and Color: As selected by Architect from manufacturer's full range.

Mounting: Manufacturer's standard method for substrates indicated.

2.4 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, Type UVF (UV filtering).

Polycarbonate Sheet: Coated, mar-resistant, UV-stabilized polycarbonate, with coating on both sides.

2.5 ACCESSORIES

Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:

Use concealed fasteners and anchors unless indicated to be exposed.
1. Sign Mounting Fasteners:
   - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.

B. Adhesive: As recommended by sign manufacturer.

Adhesives shall have a VOC content of 50 g/L or less.

Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.6 FABRICATION

General: Provide manufacturer's standard sign assemblies according to requirements indicated.

Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.

1. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections and dress exposed and contact surfaces.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.

B. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

C. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

PART 3 - EXECUTION

3.1 INSTALLATION

General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

1. Install signs so they do not protrude or obstruct according to the accessibility standard.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

Mounting Methods:

Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.

a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.

b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

END OF SECTION 10 1423

SECTION 10 2800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.

Washroom Mirror

B. Related Sections:

Section 09 3000 "Ceramic Tiling" for ceramic toilet and bath accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.

Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
Material and finish descriptions.
Features that will be included for Project.
Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.

Identify products using designations indicated.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

A. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Doors and Panels shall be 1" thick, constructed of two sheets of stretcher leveled quality stainless steel formed and bonded under pressure with a non-toxic adhesive to a resin-impregnated, sound deadening full-face honeycomb core.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings, as specified below or comparable product by one of the following or approved equal:

1. Bobrick Washroom Equipment, Inc.
Bradley Corporation.
Kimberly-Clark Professional
Tork / SCA.
Cintas Corporation

Refer to drawings for Toilet Accessory Schedule.

2. Towel/Waste Combo Unit: Bobrick B-43944

3. Coat Hook: Bobrick B-9542

4. Mirror: Bobrick B-290 2436 Series Welded Frame, 24”x36”

5. Hand Soap Dispenser: Bobrick B-2013

6. Horizontal & Vertical Grab Bars: Bobrick B-9806

7. Toilet Tissue Dispenser, Twin Roll: Bobrick B-9547

8. Sanitary Napkin Disposal: Bobrick B-270

2.3 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 2800

SECTION 10 4416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Sections:

Section 10 4413 "Fire Extinguisher Cabinets."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

Provide fire extinguishers approved, listed, and labeled by FMG.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

Failures include, but are not limited to, the following:

Failure of hydrostatic test according to NFPA 10.
a. Faulty operation of valves or release levers.

Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.

Basis-of-Design Product: Subject to compliance with requirements, provide Larsen MP-10 or comparable product by one of the following or approved equal:

Amerex Corporation.
a. Ansul Incorporated; Tyco International Ltd.
b. Badger Fire Protection; a Kidde company.
c. Buckeye Fire Equipment Company.
d. Fire End & Croker Corporation.
e. J. L. Industries, Inc.; a division of Activar Construction Products Group.
f. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

Basis-of-Design Product: Subject to compliance with requirements, provide Larsen standard bracket 546 or comparable product by one of the following or approved equal:

Amerex Corporation.
a. Ansul Incorporated; Tyco International Ltd.
b. Badger Fire Protection; a Kidde company.
c. Buckeye Fire Equipment Company.
d. Fire End & Croker Corporation.
e. J. L. Industries, Inc.; a division of Activar Construction Products Group.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

Orientation: As directed by the Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

Remove and replace damaged, defective, or undercharged fire extinguishers.

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

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

Mounting Brackets: Install in fire extinguisher cabinet.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION 10 4416

SECTION 11 4510 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Refrigeration appliances.
Microwave appliances.

B. Related Sections:

1. Division 15 Section "Plumbing Fixtures" for kitchen sinks, and faucets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, dimensions, furnished accessories, and finishes for each appliance.

B. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of appliance, from manufacturer.

Warranties: Sample of special warranties.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

Source Limitations: Obtain residential appliances from single source.

Regulatory Requirements: Comply with the following:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period except as qualified below:

1. Warranty Period: Two (2) years from date of Substantial Completion.

B. Microwave Oven: Full warranty including parts and labor for on-site service on the magnetron tube.

Refrigerator/Freezer, Sealed System: Full warranty including parts and labor for on-site service on the product.

1. Warranty Period for Sealed Refrigeration System: Two (2) years from date of Substantial Completion.

Warranty Period [for Other Components: Two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MICROWAVE OVENS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Amana; a division of Whirlpool Corporation.
BOSCH Home Appliances.
KitchenAid; a division of Whirlpool Corporation.
LG Appliances.

B. Microwave Oven:

1. Basis of Design: GE GCST09n1WSS- Stainless Steel
Dimensions:

a. Width: 19 inches .
Depth: 14 1/2 inches.
Height: 11 1/2 inches

2. Capacity: 0.90 cu. ft..
Electric Power Supply: 120 V, 60 Hz,
Controls: Digital panel controls and timer display.
Other Features: Turntable.
Material: Stainless steel

2.2 REFRIGERATOR/FREEZERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following or approved equal:

1. Amana; a division of Whirlpool Corporation.
General Electric Company (GE).
KitchenAid; a division of Whirlpool Corporation.
LG Appliances.
Maytag; a division of Whirlpool Corporation.
Sears Brands LLC (Kenmore).
Whirlpool Corporation.

B. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on bottom and external water dispenser and complying with:

1. Basis-of-Design Product: Fisher&Paykel Series 5 Contemporary Series RF135BDLUX4N
Type: Freestanding.
Feature: External Water Dispenser
Dimensions:

a. Width: 23 5/8 inches.
Depth: 27 1/4 inches.
Height: 72 7/8 inches

2. Storage Capacity:

a. Refrigeration Compartment Volume: 7.79.
Freezer Volume: 3.72 cu. ft.
Shelf Area: Two adjustable glass shelves, 1 fixed

3. General Features:

a. Door Configuration: Overlay.
Separate touch-pad temperature controls for each compartment.

4. Refrigerator Features:

a. Interior light in refrigeration compartment.

5. Freezer Features: freezer compartment(s) .

a. Automatic defrost.

6. Energy Performance, ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product labeling program.
Front Panel(s): Stainless steel.
Appliance Color/Finish: Black

2.3 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.

Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.

Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.

Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

Utilities: See Divisions 15 and 16 for plumbing and electrical requirements.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's

appliance-performance parameters.
Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
Operational Test: After installation, start units to confirm proper operation.
Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.

C. An appliance will be considered defective if it does not pass tests and inspections.

Prepare test and inspection reports.

END OF SECTION 11 4510

SECTION 12 2413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manual-operated roller shades with single rollers.

B. Related Sections:
   1. Section 06 1000 – Rough Carpentry
   2. Section 09 2900 – Gypsum Board

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

   1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of shadeband material, signed by product manufacturer.

B. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
1. Basis-of-Design Manufacturer: MechoShade Systems, Inc.
2. Draper, Inc.
3. Levolor
4. Approved Equal

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED, SINGLE-ROLLER SHADES

A. Products for Manual Shades:
1. Basis-of-Design: UrbanShade by MechoShade Systems, Inc.
2. Clutch-Operated FlexShade by Draper, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, sill mounted.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than 10 lb or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.

F. Shadebands:
1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
a. Type: Exposed with endcaps.
b. Color and Finish: As selected by Architect from manufacturer's full range.

G. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.

a. Shape: L-shaped.
b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Endcap Covers: To cover exposed endcaps.

3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.3 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Type: PVC-coated polyester.
a. ThermoVeil 1500 Series (MechoShade).
3. Weave: Basketweave.
4. Openness Factor: 3 percent.

5. Color: As selected by Architect from manufacturer's full range.

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain motor-operated roller shades.

END OF SECTION 12 2413

SECTION 123661 – SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Quartz surfacing for:

1. Countertops.
2. Other interior applications as shown on Drawings.

B. Related Sections:

1. Section 064020 - Architectural Woodwork

1.03 ACTION SUBMITTALS

A. Product Data:

1. Quartz Surfacing: Submit manufacturer’s product data, sample warranty form, and fabrication and installation instructions.
2. Accessories: Submit manufacturer’s product data and installation instructions.

B. Shop Drawings: Show field-verified dimensions, quartz surfacing dimensions, locations and dimensions of cutouts, required locations of support and blocking members, edge profiles, and installation details and methods. Identify colors and finishes.

C. Samples:

1. Samples for Color Approval: Submit two (2) samples 4 x 4 inches (250 x 250 mm) of each color and finish selected.
2. Stone Adhesive: Submit two (2) samples of an adhesive joint for each color quartz surfacing selected. Show color match of adhesive.

1.03 INFORMATIONAL SUBMITTALS

A. Fabricator Qualifications: Submit evidence of fabricator’s qualifications.

B. Closeout Submittals: Submit completed warranty form.

C. Maintenance Data: For simulated stone and quartz agglomerate material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Packaging, Shipping, Handling, and Unloading: Observe manufacturer’s recommendations and handle in manner to prevent breakage or damage. Brace parts if necessary. Transport in the near-vertical position with finished face toward finished face. Do not allow finished surfaces to rub during shipping or handling.

B. Storage and Protection: Store in racks in near-vertical position. Prevent warpage and breakage. Store inside away from direct exposure to sun. Store between 25 and 130 ºF (-4 and 54 ºC). Store with

finished face toward finished face.

1.05 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Qualifications: Manufacturer shall be ISO 9002 and ISO 14001 certified.

B. Acceptable Manufacturer or approved equal:

1. Wilsonart Quartz
2. Caesarstone
3. Cambria
4. Approved Equivalent

2.02 QUARTZ SURFACING

A. Composition: 93 percent crushed quartz aggregate combined with resins and pigments and fabricated into slabs using a vacuum vibro-compaction process.

B. Dimensions:

1. Thickness: Nominal 3/4 inch (20 mm) and As shown on Drawings.
2. Size: Slabs shall be not less than 56.5 x 120 inches (1.44 x 3.05 m) to minimize number of joints in installation.

C. Identification: Material shall be labeled with batch number and imprinted on back with manufacturer’s identifying mark.

D. Performance:

1. Flexural Strength: 7,420 psi, ASTM C880.
2. Compressive Strength: ASTM C-170
    a. Dry: 10,430 psi average.
    b. Wet: 11,265 psi average.
3. Izod Impact Strength: 0.361ft. lbs./inch of notch average; ASTM D256.
4. Bond Strength: 205 psi; ASTM C482 modified.
5. Modulus of Rupture: 2,110 average, ASTM C99.
6. Mohs Hardness: 6.5-7.5; scratch test.
7. Absorption: 0.022%; ASTM C97.
8. Stain and Acid Resistance: Not affected; ASTM D2299.
9. Surface Burning Characteristics: Flame spread = 10, smoke density = 195; ASTM E84.
10. Thermal Shock Resistance: Passes 5 cycles, 75°F-295°F; ASTM C484.

11. Coefficient of Thermal Expansion: $1.36x10^{-5}$ inch per °F.; ASTM C531.

12. Weathering Resistance: Not affected after seven days in 1% sulfuric acid; ASTM C217.

13. Freeze-Thaw Resistance: No visible damage or discoloration after 25 cycles (-45°C to 23°C); S.L.P. with ASTM C62 as guide.

14. Wear Resistance: 36.12 gram average; ASTM C501, tested with 1 kg. load, 1000 cycles at 70 r.p.m.

E. Color and Finish:

1. As selected by the Architect from the manufacturer's full range - *FINAL SELECTION TBD.*

a. Polished Surface shall have gloss greater than or equal to 35% at 50º

F. Exposed Edges and Corners:

1. Countertops:

a. Edges: Square single layer thick.

b. Outside Corners: Square.

2.03 ACCESSORIES

A. Mounting Adhesives:

1. Provide structural-grade silicone or epoxy adhesives of type recommended by manufacturer for application and conditions of use.

2. Acceptable Silicone Manufactures or approved equal:

a. Dow Corning.

b. GE Sealants and Adhesives.

c. Approved equivalent

3. Acceptable Epoxy Manufacturers or approved equal:

a. Akemi North America.

b. Bonstone Material Corporation.

c. Tenax USA.

4. Provide spacers, if required, of type recommended by adhesive manufacturer.

B. Stone Adhesive:

1. Provide epoxy or polyester adhesive of type recommend by manufacturer for application and conditions of use.

2. Acceptable Manufacturers or approved equal:

a. Akemi North America.

b. Bonstone Material Corporation.

c. Tenax USA.

3. Color: Adhesive which will be visible in finished work shall be tinted to match quartz surfacing.

C. Fasteners Grout Hardware: .

D. Joint Sealants:

1. Clear silicone sealant of type recommended by manufacturer for application and conditions of use.

2. Provide anti-bacterial type in toilet and bath rooms, food preparation areas, and .

3. Acceptable Manufactures or approved equal:

a. Dow Corning.

b. GE Sealants and Adhesives.

E. Solvent: Product recommended by adhesive manufacturer to clean surface of quartz surfacing to assure adhesion of adhesives and sealants.

F. Cleaning Agents: Non-abrasive, soft-scrub type kitchen cleansers.

2.04 FABRICATION

A. Fabricator: Firm shall have five years experience fabricating architectural stone and shall have water-cooled cutting tools. Firm shall be authorized in writing by manufacturer.

B. Shop Assembly: Observe proper safety procedures and comply with manufacturer’s instructions.

C. Layout: Layout joints as shown on Drawings. to minimize joints and to avoid L-shaped pieces of quartz surfacing.

D. Inspect Material:

1. Inspect material for defects prior to fabrication.

2. Color Match: Materials throughout Project shall be from the same batch and shall bear labels with same batch number. Visually inspect materials to be used for adjacent pieces to assure acceptable color match. Inspect in lighting conditions similar to those on Project.

3. Variation in distribution of aggregates in quartz surfacing which are within manufacturer’s tolerances is not a defect.

E. Tools: Cut and polish with water-cooled power tools.

F. Cutouts:

1. Cutouts shall have 3/8 inches (10 mm) minimum inside corner radius. Inside corners shall be reinforced in an acceptable manner to prevent cracking.

2. Where edges of cutout will be exposed in finished work, polish edges.

3. If the remaining material outside a cutout is less than three inches (76 mm) wide, reinforce area by laminating it with a strip of quartz surfacing.

G. Laminations: Laminate layers of quartz surfacing as required to create built-up edges, trim, and other areas requiring additional thickness.

PART 3 - EXECUTION

3.01 ACCEPTABLE INSTALLER

A. Installer: Firm shall have five years experience installing architectural stone.

3.02 EXAMINATION

A. Site Verification:

1. Verify dimensions by field measurements prior to fabrication.

2. Verify that substrates supporting quartz surfaces are plumb, level, and flat to within

1/16 inch in ten feet (1.6 mm in 3000 mm) and that necessary supports and blocking are in place.

3. Base Cabinets: Cabinet units shall be securely fixed to adjoining units and back wall.

B. Inspect finished surfaces for damage. Do not install until damage materials have been repaired in an acceptable manner or replaced.

3.03 PREPARATION

A. Protect finished surfaces against scratches. Apply masking where necessary. Guard against grit, dust, and other trades.

3.04 INSTALLATION

A. Install materials in accordance to manufacturer's recommendations. Lift and place to avoid breakage.

B. Preliminary Installation and Adjustment: Position materials to verify that materials are correctly sized and prepared. Make necessary adjustments.

1. If jobsite cutting, grinding, or polishing is required, use water-cooled tools. Protect jobsite and surfaces against dust and water. Perform work away from installation site if possible.

2. Allow gaps for expansion of not less than 1/16 inch (1.5 mm) per five feet when installed between walls or other fixed conditions.

C. Permanent Installation:

1. After verifying fit, remove quartz surfacing from position, clean substrates of dust and contamination, and clean quartz surfacing back side and joints with solvent.

2. Apply sufficient quantity of mounting adhesive in accordance with adhesive manufacturer's recommendations to provide permanent, secure installation.

3. Spacing of mounting adhesive shall not exceed:

a. Horizontal Surfaces: inches (mm) on center.

b. Vertical Surfaces: _ inches (_ mm) on center; provide temporary shims until adhesive cures.

4. Fasteners Grout Hardware: .

5. Install surfacing plumb, level, and square and flat to within 1/16 inch in ten feet (1.6 mm in 3000 mm).

D. Joints:

1. Joints Between Adjacent Pieces of Quartz Surfacing:

a. Joints shall be flush, tight fitting, level, and neat.

b. Securely join with stone adhesive. Fill joints level with quartz surfacing. c. Clamp or brace quartz surfacing in position until adhesive sets.

2. Joints Between Backsplashes and Countertops and Around Tub and Shower Enclosures:

Seal joints with silicone sealer.

3.05 REPAIR

A. Repair or replace damaged materials in a satisfactory manner.

3.06 CLEANING

A. Remove masking and excess adhesives and sealants. Clean exposed surfaces.

3.07 PROTECTION

A. Protect surfacing from damage by other Sections.

END OF SECTION 123661

SECTION 22 0101 - PLUMBING GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all plumbing work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 22.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Plumbing work of this project includes, as a brief general description, the following:

1. Demolition and new plumbing work as indicated on the drawings

F. See Division 01 for requirements related to limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, the following options apply to Division 22 specifications.

1. Products specified by reference standards or by description only: Any product meeting those standards or description.
2. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

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a. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
b. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

3. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article "Substitutions," below for substitutions.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 22 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

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C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate plumbing work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor’s responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

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E. The Contractors' assistants shall include a competent foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers’ and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor’s name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. All exclusively electrical items furnished as items associated with plumbing items but not specifically described in the plumbing item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the plumbing item by identification specification paragraph.
5. Product data sheets shall be 8.5-inch by 11-inch cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

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1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

   a. Contract drawings.
   b. Specifications
   c. Addenda
   d. Change orders and other modifications to the Contract
   e. Reviewed shop drawings, product data, and samples

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

   a. Manufacturer's name and product model and number
   b. Product options, substitutions, or alternates utilized
   c. Changes made by addenda and modifications

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

   a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
   b. Field changes of dimension and detail.
   c. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Lubrication charts: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.

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a. Include the following:

(1) Types of lubricants required
(2) Locations of lubrication points
(3) Frequency of lubrication.

b. Provide one extra set of lubrication charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals.

3. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
4. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
5. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
6. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
7. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.
8. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. Significant design criteria, including pump curves and similar performance charts.
b. List of plumbing equipment, including operating weight of each.
c. Parts list for each plumbing fixture, faucet, and pump, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for plumbing equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
g. Valve charts, including locations of flow fittings.

9. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data for plumbing systems.
b. Photocopies of certificates.
c. Photocopies of warranties and guarantees.
d. Test reports: Copies of the results of all tests required under all sections of specifications.

10. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
11. Submit final volumes revised, within ten days after final inspection.

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1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA).
4. International Energy Conservation, Fire, Fuel Gas, Mechanical, and Plumbing Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Federal Specifications (FS)
2. Military Specification (MS)
3. Military Standards (Mil. Std.)
4. Air Conditioning, Heating, and Refrigeration Institute (AHRI)
5. Air Movement and Control Association (AMCA)
6. Associated Air Balance Council (AABC)
7. American Association State Highway and Transportation Officials (AASHTO)
8. American National Standards Institute (ANSI)
9. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10. ASME International (ASME)
11. American Society for Testing and Materials (ASTM)
12. American Society of Sanitary Engineering (ASSE)
13. American Water Works Association (AWWA)
14. International Code Council (ICC)
15. Manufacturer's Standardization Society of the Valve and Fittings Industry Inc. (MSS)
16. National Electrical Code, NFPA 70 (NEC)
17. National Electrical Manufacturer's Association (NEMA)
18. National Fire Protection Association (NFPA)
19. National Fuel Gas Code, NFPA 54
20. National Sanitary Foundation (NSF)
21. National Standard Plumbing Code (NSPC)
22. The Occupational Safety and Health Act (OSHA)
23. Piping and Drainage Institute (PDI)
24. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
25. Underwriters Laboratory Inc. (UL)

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26. Maryland Occupational Safety and Health Act (MOSHA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Maintain the area and return it to its original condition at project completion.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

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1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.

B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

PART 2 - PRODUCTS

Not used.

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PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to more than one section of Division 22.

B. Equipment installation requirements.

C. Basic material and equipment required for the plumbing piping work.

D. Identification of plumbing systems and equipment.

E. Cleaning and painting.

F. Backboards for piping specialties.

G. Treated wood lumber.

H. Operating instructions.

I. Piping tests.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 22 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 22 0101.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME A 13.1: Scheme for the Identification of Piping Systems
2. ASME B 31.9: Building Services Piping

B. American Society of Testing and Materials

1. ASTM B 32: Standard Specification for Solder Metal
2. ASTM B 88: Standard Specification for Seamless Copper Water Tube
3. ASTM B 813: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
4. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
5. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
6. ASTM E 548: Standard Guide for General Criteria Used for Evaluating Laboratory Competence

C. American Welding Society

1. AWS D1.1: Structural Welding - Steel

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2. AWS D10.9: Specification for Qualification of Welding Procedures and Welders for Piping and Tubing

D. NSF

1. NSF/ANSI 61: Drinking Water System Components - Health Affects

1.4 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominale, nominal pipe size in millimeters, in accordance with the metric system for construction, Systeme Internationale (SI).

D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on use of the particular manufacturer's products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of welding and brazing procedures proposed for each piping system in the project.
2. Shop drawings of backboards for piping specialties.

B. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

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C. Test reports: Field test results for each piping system as specified in Part 3 below.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

B. Product NSF/ANSI 61 certified products where in contact with the domestic water supply.

C. Welding procedures and operator qualifications for structural welding: AWS D1.1, Structural Welding Code Steel, electric arc process.

D. Brazing, and soldering procedures and operator qualifications for building systems piping:

1. ASME B31.9, Building Services Piping.
2. Copper Development Association “Copper Tube Handbook.”
3. Safe Drinking Water Act.

E. UL label:

1. Electrical control panels, equipment, materials and devices provided or installed as work of Division 23 shall be UL listed and shall bear a UL label.
2. Equipment, including custom assemblies, shall be listed and labeled as an assembly.
3. If a UL label is not available, the item shall be tested and labeled by a qualified nationally recognized testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC).
4. Provide testing, if required, without addition to the contract sum.

F. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

G. Products shall contain no urea-formaldehyde content.

PART 2 - PRODUCTS

2.1 GENERAL

A. General piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 22.

B. Equipment that uses or processes date and time data to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 PIPING MATERIALS

A. Soldering materials:

1. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.

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a. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent.

(1) Equal to “Silvabrite 100” manufactured by Engelhard Corporation.

b. Tin, copper, bismuth, and silver.

(1) Equal to “Oatey Silver” manufactured by Oatey.

2. Flux:

a. Meeting the requirements of ASTM B 813 and NSF 61 certified.
b. Equal to Oatey H-2095.

B. Threaded pipe joint materials:

1. Pipe jointing compound:

a. Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.
b. For sanitary piping overhead of food storage, preparation, and serving and dining areas: Litharge and glycerin.

2. Pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, “Teflon.”

2.3 IDENTIFICATION DEVICES AND MATERIALS

A. Stenciling materials:

1. Stencils: Manufactured standard stencils prepared for required applications, conforming to ASME A 13.1 for color and size of legend letters, including arrows showing direction of flow.
2. Paint: Exterior type enamel, colors conforming to ASME A 13.1, or black.

B. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

C. Valve tags: Brass, 1.5 inch (40 mm) in diameter with black-filled numbers not less than 0.25 inch (6 mm) high, complete with brass attachment chains.

D. Ceiling identification tags: Laminated plastic with adhesive back, engraved black letters on white background, minimum 0.5 inch (15 mm) wide and length as required for 0.375 inch (10 mm) high letters for name of concealed device and number.

2.4 MATERIALS FOR BACKBOARDS FOR PIPING SPECIALTIES

A. Backboards: Marine plywood: BS-1080, Veneer Grade A/B, moisture-resistant, spruce-pine-fir multiple ply, 5-ply minimum, pressure-treated construction, 0.563-inch (14-mm) thick minimum

B. Supports: Fiber reinforced plastic (FRP) composite structural shapes: ASTM D 635 and E 84, Pultruded FRP structural shapes, non-corrosive, flame retardant, thermosetting polyester resin, composite factory-fabricated shapes for assorted assemblies and field erection.

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1. Ultimate tensile strength: 30,000 psi (207 MPa).
2. Modulus of elasticity: 2.8 x 10^6 psi (19,300 MPa).
3. Specific gravity: 1.6 to 1.75.
4. Density: 0.062 to 0.070 pounds/cubic inch (1.72 to 1.94 grams/cubic centimeter).
5. Flame spread: ASTM E 84 Class A, 25 maximum.
6. Color: Yellow.
7. Shapes and sizes as required to support the load, and in accordance with minimum sizes indicated on the drawings
8. Acceptable manufacturers or approved equal:

    a. Bedford Reinforce Plastics Company
    b. Composites USA, Inc.
    c. Liberty Pultrusions, Inc.
    d. Strongwell Corporation
    e. Structural Fiberglass, Inc.

C. Fasteners: Corrosion-resistant and suitable for secure anchorage into wall behind backboards.

2.5 TREATED WOOD LUMBER

A. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.

PART 3 - EXECUTION

3.1 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

    1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic and do not indicate all fittings or offsets in pipe, all access panels, or all specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No pipe shall be run below the head of a window or door.

D. Equipment and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

F. Provide installations compliant with NFPA 70.

3.2 EQUIPMENT INSTALLATION

A. Prepare for installation:

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1. Coordinate work to assure that any required recesses for equipment are correct.
2. Examine areas and conditions where equipment will be installed for rough in locations, compliance with installation requirements and tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
3. Visually check equipment. Replace any damaged components prior to installation.
4. Remove temporary devices used for equipment transport.
5. Assemble equipment that is not assembled in the factory.

B. Install equipment:

1. Set equipment plumb and level.
2. Install such that labels and safety instructions are clearly visible.
3. Drawings show the general arrangement of piping, ductwork, conduit and other elements. Coordinate elements to allow access doors to open fully, allow access to removable access panels or casing panels, maintain clearances in front of control panels and electrical components required by the NFPA 70, and maintain the manufacturer's recommended service clearances.
4. Install components inside of equipment enclosures such that they are serviceable when access panels are removed.
5. Extend grease fittings to accessible locations.
6. Install piping hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment. Support equipment independently from piping.
7. Support:

    a. Floor-mounted equipment:

        (1) Securely fasten in place with connections to wall and floor.
        (2) Provide supplemental structure as required.
        (3) Provide a concrete equipment foundation where indicated. Comply with requirements of Section 22 0529.

    b. Suspended equipment: Securely hang from structure above. Comply with requirements of Section 22 0529. Provide 0.5 inch (12.5 mm) minimum diameter threaded rods.
    c. Wall-mounted equipment: Securely fasten to wall with metal fasteners, anchors, brackets, sleeves or other devices recommended by the equipment manufacturer. Provide blocking where required.
    d. Curb-mounted and rail-mounted equipment: Securely fasten to curb and provide flashing to make the installation weather tight. Comply with requirements of Section 22 0506.
    e. Structural frame-mounted equipment: Securely fasten to structural frame.
    f. Equipment mounted at grade: Securely fasten to structural foundation. See drawings for details of construction of structural foundation.
    g. Coordinate supports so they do not interfere with access to other equipment that requires service.
    h. Provide vibration isolation where required.

8. Snugly fit equipment to architectural finishes in finished spaces unless otherwise indicated.
9. Connect associated piping, power, controls, and other associated systems.
10. Conceal associated piping and electrical connections in finished spaces unless otherwise indicated.

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11. In rooms without ceilings or other finishes to conceal piping, and electrical connections, arrange these elements to provide a neat and finished appearance.
12. Install dielectric pipe fittings at connections where dissimilar metals are joined.
13. Coordinate with installation of building automation system controls.
14. Install equipment with a safety listing or certification as required to comply with their listing or certification requirements.

C. Install and wire items furnished with equipment:

1. Install control devices, accessories, and appurtenances furnished loose with equipment.
2. Wire devices furnished with equipment that are not factory-wired.

    a. Comply with requirements in Division 26.
    b. Comply with requirements in NFPA 70.
    c. Comply with the manufacturer's installation requirements.

D. Prepare equipment for use:

1. Clean equipment and repair any damaged finishes. Remove paint splatters, dirt, and debris. Repair damaged finish to match original finish.
2. Adjust tension on belts.
3. Lubricate equipment.
4. Adjust equipment packaged controls to put the system into operation as intended.
5. Start up and operate equipment in accordance with manufacturer's instructions.
6. Verify smooth rotation and proper direction of rotation of motors.
7. Test controls, unit operation, and safety devices. Replace any failed components and retest.
8. Provide equipment identification.

3.3 PIPE INSTALLATION

A. Install pipe exposed to view parallel to building lines and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing.

B. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.

C. Remove burrs resulting from cutting pipe or from any other operation.

D. Provide for expansion and contraction of piping and connections so that no breakage or excessive strain will occur. Provide anchors and guides of approved design where shown on drawings and where necessary to allow for proper expansion and contraction. At the time of installation, expansion loops shall be cold sprung to one-half of the calculated expansion.

E. Pipe connection flexibility:

1. Connect domestic hot water risers and branch connections to mains with at least five pipe fittings, including tee in main.
2. Connect domestic hot water risers and branch connections to equipment and fixtures with at least four pipe fittings, including tee in riser.
3. Connect mains and branch connections to equipment and fixtures with at least four pipe fittings, including tee in main.
4. Connections shall be arranged so that movement in piping due to expansion and contraction will not transmit excessive force to equipment or fixtures.

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F. Install unions or flanges in the piping at each item of equipment, solenoid valve, central thermostatic mixing valve, and appliance, so as to provide easy removal of the equipment, valve, or appliance.

G. Pitch water piping so that air in the system can be properly vented. Provide shutoff valves where necessary to isolate parts of system for repairs without draining the entire system.

H. Interface with other products:

1. Where pipe is provided through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.
2. Waterproofing and dampproofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or dampproofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

I. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

J. Threaded connections:

1. Cut threads full and clean.
2. Apply specified pipe joint compound or tape on male threads only.
3. Where piping is installed in crawl spaces and tunnels, cover exposed threads with rust-inhibitive paint. Apply after joints have been assembled and tested.

K. Copper tubing installation:

1. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.
2. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.
3. Provide dielectric fittings between copper and steel piping to prevent electrolysis.
4. Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.

3.4 IDENTIFICATION

A. General: Do not apply identification until insulation and finish painting work is complete.

B. Equipment:

1. Stencil equipment with minimum two-inch (50-mm) -high letters or provide identification tags. Clearly identify function, equipment served, and area served.
2. Firmly fasten each identification tag to its appropriate piece of equipment with drive screws, sheet metal screws, or rivets. Do not interfere with operation of, or damage the item being marked.

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C. Piping:

1. Mark by stenciling.
2. Mark to identify service with arrows showing direction of flow. Apply markings near building walls where pipes enter or leave an accessible space and in intermediate locations so that markings are no more than 30 feet (9 m) apart. They shall be readily visible to a person standing on the floor.
3. Fully identify all piping installed as work of the project.
4. Mark pipe with letters of height and with colors as required by OSHA and conforming to ASME A 13.1.
5. Identify every thermometer, gauge, and control device.
6. Provide valve tags for all valves except shutoff valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.

D. Ceiling identification tags: Provide on the access door or, in suspended ceilings, on the ceiling support adjacent to the unit.

1. Valves: Identify with the same number shown on the valve tag.

3.5 CLEANING AND PAINTING

A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Items furnished with manufacturer’s prime coat.
2. Mechanical rooms (including but not limited to boiler, chiller, and air-handling unit rooms):

a. Insulation and uninsulated steel: Piping, pumps, tanks, and vessels.
b. Hangers and supports.

3. Piping exposed in finished spaces, insulated and uninsulated.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer’s finish.

E. Paint systems in mechanical rooms: Paint piping with conforming to ASME A 13.1.

1. Galvanized steel: One coat of primer recommended for galvanized surfaces and one coat of glossy alkyd enamel.
2. Ferrous metal: One coat of primer recommended for ferrous metal and one coat of glossy alkyd enamel.
3. Items protected with rust-inhibitive primer: Finish coat of compatible glossy enamel.

F. Paint systems for exposed piping: Primer compatible with the substrate, whether steel, galvanized steel, insulation jacket, or other material; one coat or two, if required to cover, to match adjacent surfaces in color and texture.

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3.6 BACKBOARDS FOR PIPING SPECIALTIES

A. Provide wall-mounted backboards, sizes and locations as indicated on the drawings, for mounting piping specialties. Assembly shall consist of plywood board, FRP supports, and fasteners.

3.7 TREATED WOOD LUMBER

A. Provide wood-preservative-treated lumber where wood members are required as detailed on the drawings and in the following applications:

1. Cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
2. Sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

3.8 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate all the plumbing systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of all systems and equipment.

1. Instructions by manufacturer’s technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions, for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

3.9 PIPING TESTS

A. Hydrostatic testing:

1. Notify Owner in writing at least 24 hours prior to the test.
2. Test before pipes are concealed or insulated.
3. Piping may be tested in sections as the work progresses.
4. Provide fluid, pumps, valves, and gages required for testing.
5. Where water is used as the test fluid, provide ambient temperature water and provide means to avoid freezing. Drain and dispose of test fluid when testing is concluded.
6. Isolate equipment and expansion tanks during test.
7. Isolate or remove any components with a pressure rating below the required test pressure.
8. Brace and support piping during the test, so that no movement, displacement, or damage results from the application of the test pressure.

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9. Provide a pressure relief valve, set at a pressure no more than one-third higher than test pressure, to protect against damage caused by expanding liquid or other source of overpressure during test.
10. Replace piping or fittings found defective with new material.
11. Sanitary piping tests:

    a. Before connection of the plumbing fixtures, and before connection to the sewer, cap or plug all new sanitary and storm drainage piping systems of the building.
    b. Test following the methods of testing required by the plumbing code, and no less than the duration and pressures required in the Schedule of Piping Systems Tests.
    c. Where pipes are in trenches, leave the trenches open until the completion of the test.

12. Air conditioning condensate piping tests:

    a. Before connection of condensate producing HVAC equipment, cap or plug all new air conditioning condensate drain piping systems of the building.
    b. Test following the methods of testing required by the plumbing code, and no less than the duration and pressures required in the Schedule of Piping Systems Tests.
    c. Where pipes are in trenches, leave the trenches open until the completion of the test.

13. Documentation of tests: Prepare a test report for each portion of piping tested, identified by service, material, location, and pipe size. Include these items:

    a. Date of test.
    b. Starting and completion times.
    c. Initial test pressure.
    d. Final test pressure.
    e. Problems or leaks detected.
    f. Corrective actions taken.
    g. Record of successful completion of testing.
    h. Name, title, and signature of person conducting test.

14. Piping Systems Test Schedule:

System	Test Pressure psig (kPa)	Duration	Allowable Drop	Medium
Domestic water service & exterior water piping	150 (1030)	4 Hours	None	Water
Domestic water piping (cold, hot, tempered, & recirculated)	125 (860)	4 Hours	None	Water
Air conditioning condensate drain piping	4.3 (30)**	4 Hours	None	Water
Sanitary waste piping	4.3 (30)**	4 Hours	None	Water

** Where piping is above food service area, test pressure shall be 11 psig (76 kPa).

END OF SECTION

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SECTION 22 0501 - EXCAVATION AND FILL FOR PLUMBING WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for plumbing work underground inside the building and extending five feet beyond exterior building walls.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 22 0101.

B. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.
3. Storm drainage piping: Section 22 1413.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft (2700 kN-m/cu m).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of, and proposed detailed trenching plan.

B. Product data:

1. Warning tape
2. Seed and mulch

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

B. Underground warning tape: Polyethylene 0.004 inch (0.102 mm) thick for metallic lines, and for non-metallic lines polyethylene both sides with metallic lining, six inches (152 mm) wide.

1. Colors: In accordance with APWA and AASHTO standards.
2. Markings: Repeated continuously along the entire length, legend appropriate for line being identified.

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C. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination. Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top. Only strains of Kentucky Bluegrass found adaptable to Maryland shall be acceptable.

D. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (BGE Miss Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the Architect.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where piping is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

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3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Water piping: 42 inches (1067 mm).
2. Sewer lines: Elevations shown on drawings.

C. Trenches shall be of necessary depth and width for the proper laying of pipe with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of pipe on undisturbed soil at every point along its entire length, except for bell holes and for the proper sealing of the pipe joints.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Architect and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

F. Excavation for manholes and similar structures shall be sufficient to leave a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

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B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Plumbing systems backfill:

1. Backfill and compact in six-inch (150-mm) layers up to spring line of the pipe. The installations shall then be inspected and tested.
2. Following inspection, backfill in six-inch (150-mm) layers, each compacted, until the pipe has a cover of not less than one foot (305 mm). Place the remainder of the backfill material in the trench in eight-inch (200-mm) compacted layers.
3. Excavations improperly backfilled shall be reopened, then refilled and compacted to the required grade and compaction, and smoothed off.
4. Open trenches across roadways or other areas to be paved shall be backfilled as specified above, except that the entire depth of trench shall be backfilled in six-inch (150-mm) layers, and each layer shall be mechanically compacted.
5. Completed work shall have uniform graded surface, in accordance with the surface and grade indicated on the drawings.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of plumbing piping.

3.7 SEEDING

A. Seed disturbed grass areas at the rate of 5 pounds (2.27 kg) per 1000 sq. ft. (92.9 sq. m), with the seed mix specified.

B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 0.25 inch (6 mm). Sow half of the seed in one direction and the rest at right angles.

C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of March 1st to May 1st or August 15 to October 15 unless otherwise approved in writing.

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3.8 MULCHING

A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 2 tons per acre (4483 kg per hectare) so as to provide a loose depth of not less than 2 inches (50 mm).

B. Wet down mulch, unless a heavy rain wets it, to the Architect's satisfaction, immediately after application.

3.9 RESURFACING

A. Resurface sidewalks, roads, streets, and other paved areas as work of this section, matching the construction and finish of adjacent paving.

END OF SECTION

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SECTION 22 0502 - SLEEVES AND PLATES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves.

B. Sealing materials.

C. Escutcheon plates.

D. Mechanical penetration seals.

1.2 SUBMITTALS

A. Product data: Sleeves, sealing materials, escutcheon plates, and mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Sleeves without water stops:

1. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.
2. Copper sleeves: Type L, ASTM B 88 hard drawn.
3. Plastic sleeves: Schedule 40 PVC, ASTM D 1785.

B. Sleeves with water stops:

1. Cast-iron sleeves with water stops: Extra heavy, equal to product of U.S. Pipe Co. with water stop and ends as shown on the drawings.

2.2 SEALING MATERIALS

A. Waterproof sealant:

1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below:

a. High-performance, moisture cured, 1-component, polyurethane-based, non-sag, elastomeric sealant. Use a primer for applications required by the manufacturer.
b. Basis of design: Sika Corporation “Sikaflex - Ia.”

B. Grout: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout, 5000 psi (34.5 MPa), 28-day compressive strength.

2.3 ESCUTCHEON PLATES

A. Floor, wall, and ceiling escutcheon plates for existing piping: Stamped or cast brass with chrome finish and set screw, split and tabbed.

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B. Floor, wall, and ceiling escutcheon plates for new piping: Stamped or cast brass with chrome finish and set screw.

2.4 MECHANICAL PENETRATION SEALS

A. Mechanical penetration seals:

1. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.
2. Basis of design: PSI “Link-Seal Modular Seals” or Calpico Sealing Link “LINX”.

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Provide sleeves for bare piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs. Sleeves for insulated piping shall be large enough to pass piping and insulation.

B. Sleeve materials:

1. Penetrations in non-fire-rated interior construction:

a. Provide steel sleeves for penetrations of steel, cast iron, and insulated piping.
b. Provide copper sleeves for penetrations of uninsulated copper tubing and piping.
c. Provide plastic or steel sleeves for penetrations of plastic piping.
d. Plastic piping and sleeves are not permitted in ceiling spaces used as HVAC system plenums, or in shafts used for building HVAC air distribution.
e. Plastic sleeves are not permitted for penetrations of masonry construction.
f. A core drill may be provided in cast concrete walls in lieu of a sleeve.

2. Penetrations in exterior walls and foundations, masonry or concrete:

a. Provide cast iron sleeves with water stops in new cast concrete walls.
b. A core drill may be provided in cast concrete walls in lieu of a sleeve.
c. Provide steel sleeves in masonry walls.

C. Sleeve projection:

1. Sleeves through typical walls and partitions: Flush with finished surfaces.
2. Sleeves through floors:

a. Typical floors: Extend 0.375 inch (10 mm) above finished floor.
b. Finish neat and level.
c. Provide anchor clips to prevent sleeves from being loosened and knocked down.

3.2 INSTALLING SEALING MATERIALS

A. Penetrations in non-fire-rated interior construction:

1. Seal exterior of sleeve to wall or floor being penetrated:

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a. Provide grout where sleeves penetrate concrete or masonry.
b. Provide waterproof sealant or wall construction materials where sleeves penetrate gypsum board walls.

2. Sealant between sleeve interior and pipe or pipe insulation:

a. Typical applications: Seal spaces between sleeves and pipe, or between sleeves and pipe insulation, with mineral wool.
b. Kitchens and food service areas: Seal space between sleeves and pipe, or between sleeves and pipe insulation, with waterproof sealant and finish even with sleeve.

3.3 INSTALLING ESCUTCHEON PLATES

A. Exposed piping passing through interior walls, partitions, floors, and ceilings shall be fitted with plates of size and depth to conceal sleeves. Secure plates firmly in place with set screws.

3.4 INSTALLING MECHANICAL PENETRATION SEALS

A. Penetrations in exterior masonry or concrete walls and foundations:

1. Above grade: Mechanical penetration seal, at outside face of wall.
2. Below grade:

a. Mechanical penetration seal, at outside face of wall.

END OF SECTION

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SECTION 22 0504 - PLUMBING DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Demolition.

B. Disposal.

C. Protection

1.2 RELATED SECTIONS

A. Demolition: Section Division 02.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Extent and location of demolition is indicated on the drawings.

B. Comply with demolition and disposal requirements of Division 02.

C. Perform demolition operations expeditiously and in accordance with accepted practice and applicable building code provisions. Perform demolition operations neatly and with the least possible disturbance to the building.

D. If, in the course of the work, workers encounter a material they suspect to be hazardous:

1. Promptly notify the Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

E. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during demolition operations.

F. Demolish, remove, demount, and disconnect inactive and obsolete piping, fittings, specialties, equipment, ductwork, controls, fixtures, insulation, and associated appurtenances.

1. Piping and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch (25 mm) below the finished surface.
2. Remove materials above accessible ceilings.
3. Drain and cap items to remain behind finished surfaces.
4. Patch and repair surface materials as required in Division 01 and Section 22 0101.

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G. Remove supports, hangers, anchors, and fasteners associated with piping and equipment being removed.

3.2 DISPOSAL

A. Dispose of equipment and materials removed, and other waste material, as work progresses.

B. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily as a minimum.

3.3 PROTECTION

A. Protect existing materials that will remain. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Provide and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Keep standby patching materials on hand to patch and maintain protection as required. Remove protection and barriers after demolition operations are complete.

C. Ensure weathertightness at all times. Prevent the entry of dust or water.

END OF SECTION

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SECTION 22 0506 - FLASHINGS AND ROOFTOP SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing vent flashing.

1.2 SUBMITTALS

A. Shop drawings: Flashing assemblies showing compatibility with roof membrane, insulation, and slope.

B. Product data: Each type of manufactured unit, accessory, and accessory material.

1.3 SEQUENCING

A. Coordinate installation of flashings with roof structure and membrane. Penetrations shall not damage weathertightness.

PART 2 - PRODUCTS

2.1 FLASHINGS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified product, or comparable product by another manufacturer.

B. Flashing for plumbing vents on sloped roofs:

1. Base size 15 by 15 inch (380 by 380 mm); weight of lead, 4 lbs (1.8 kg per 0.09 sq. m); angle of roof as shown on the drawings. Flashing shall be formed to fit over top of pipe and in one continuous piece down to roof.
2. Basis of design: Oatey Flashings type “Hi Collar Lead Flashing”

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Extend plumbing vents 8 inches (205 mm) above finished roof. Tightly seal clamp devices to vent. Space between vent hub and pipe shall be lightly sealed to allow piping movement.

B. Flashing and counterflashing shall be provided as specified in Division 07.

C. Where dissimilar metals would contact each other, coat them with a protective coating compatible with adjacent materials.

END OF SECTION

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SECTION 22 0509 - PLUMBING EXPANSION SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pre-charged bladder-type expansion tank for potable water system.

B. Pre-charged bladder-type potable water well tank.

1.2 RELATED SECTIONS

A. Demonstration, training, and equipment installation: Section 22 0500.

B. Equipment hangers and supports: Section 22 0529.

C. Piping: Section 22 1116.

1.3 SUBMITTALS

A. Product data: Each type of expansion tank, including all accessories.

B. Certification that products comply with NSF/ANSI 61.

1.4 QUALITY ASSURANCE

A. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified and scheduled products, or comparable products by one of the following or approved equal:

1. Expansion tanks:

a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell and Gossett Domestic Pump Div of ITT
d. Taco
e. Wessels

2.2 EXPANSION TANK FOR POTABLE WATER

A. Provide type, size, configuration, capacity, and current characteristics indicated on the drawings.

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B. Pressurized bladder type tank, containing impermeable bladder which separates the air cushion from the system water. Operating temperature: 240 degrees F maximum. Pre-charge to manufacturer's standard pressure.

C. Shell: Welded steel, constructed, tested and stamped in accordance with ASME BPV for Unfired Pressure Vessels for a working pressure of 125 psi. Lined with protective coating.

D. Bladder: Butyl rubber, flexible but not stretchable under working conditions, removable for inspection.

E. FDA approval: Wetted components FDA-approved materials.

F. Supports: For horizontal or vertical support on concrete equipment foundation, as diagramed on the drawings.

G. Basis of design: Taco PAX model number scheduled on the drawings.

2.3 WELL PRESSUIRZED TANK FOR POTABLE WATER

A. Pressurized bladder type tank, containing impermeable bladder which separates the air cushion from the system water. Operating temperature: 240 degrees F maximum. Precharge to manufacturer's standard pressure.

B. Shell: Welded steel, constructed, tested and stamped in accordance with ASME BPV for Unfired Pressure Vessels for a working pressure of 125 psi. Lined with protective coating.

C. Bladder: Heavy Duty Butyl rubber, flexible but not stretchable under working conditions, removable for inspection.

D. FDA approval: Wetted components FDA-approved materials.

E. Size and capacity: Shown on the drawings.

F. Supports: For horizontal or vertical support on concrete equipment foundation, as diagramed on the drawings.

G. Basis of design: Amtrol Well-X-Trol WX model number scheduled on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment as indicated on the drawings. Comply with requirements in Section 22 0500.

A. Provide a concrete equipment foundation (housekeeping pad) and install the equipment on that foundation. Comply with requirements in Section 22 0529.

B. Verify air pressure in the bladder is equal to the minimum expected system pressure at the tank based on the incoming service pressure and the tank location. Adjust pressure as needed.

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3.2 OPERATING INSTRUCTIONS

A. As specified in Section 22 0500, provide operating instructions.

END OF SECTION

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SECTION 22 0513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Motor capacitors: Division 26.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Pumps:

1. Domestic water pumps: Section 22 1123.

1.4 REFERENCES

A. NEMA MG 1: Motors and Generators.

B. NEMA MG 11: Energy Management Guide for Selection and Use of Single-Phase Motors.

C. UL 508: Industrial Control Equipment.

1.5 DEFINITIONS

A. Energy efficient motor: Motor meeting the nominal and minimum efficiency levels listed for its horsepower and speed in Table 12-10 of NEMA MG 1.

B. Nominal efficiency: Efficiency as defined in Table 12-8, Efficiency Levels, in NEMA MG 1, and identified on the motor nameplate.

1.6 SUBMITTALS

A. Product data:

1. Motors and drives not provided with equipment: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lugs, and coatings.
2. Motor capacitors.

B. Wiring diagrams required for the proper installation of plumbing equipment.

C. Submit product data which verifies compliance with ASHRAE 90.1 or provide certified performance ratings by a qualified independent testing agency.

D. Certifications:

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1. Actual motor power factor for each motor, certified test results for each motor proposed for use on this project.
2. Field test showing corrected power factor, if required.

1.7 QUALITY ASSURANCE

A. UL label: As specified in Section 22 0500, Common Work Results for Plumbing.

B. Actual motor power factor shall be tested and certified by an independent testing laboratory.

C. Plumbing equipment shall meet the energy performance requirements of ASHRAE 90.1.

1.8 REGULATORY REQUIREMENTS

A. Motors shall conform to the requirements of NEMA MG1 and applicable portions of the National Electric Code (NEC, NFPA 70).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OR APPROVED EQUAL

A. Motors:

1. A.O. Smith
2. Baldor Electric Co.
3. Marathon
4. Rockwell
5. Siemens
6. Toshiba International

B. Motor capacitors:

1. ABB Power Distribution
2. Commonwealth Sprague
3. General Electric

2.2 BASIC MOTOR REQUIREMENTS

A. Capacity: Each motor shall have sufficient capacity and torque to start, accelerate, and operate the machine it drives without exceeding the motor nameplate rating at the speed specified, or at any speed and load which may be obtained by the drive actually furnished.

B. Starting: Each automatically controlled motor shall be capable of starting as frequently as the control sequence may demand. Motors not automatically controlled shall be capable of making no fewer than 4 starts per hour.

C. Ratings: Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees C.

D. Phase: Unless otherwise indicated, motors one-half horsepower and larger shall be polyphase and motors smaller than one-half horsepower shall be single-phase motors.

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E. Motor construction:

1. ODP (open drip-proof) NEMA design B construction:

a. Motors for pumps, unless specified otherwise.

F. Efficiency: The term “energy efficient” is defined in the article “Definitions” in Part 1 above.

1. Single-phase motors, alternating-current fractional horsepower, rated 1/20 to 1 horsepower, 250 volts or less: NEMA MG 11, types and efficiencies selected for their applications.

2.3 SINGLE-PHASE MOTORS

A. Permanent split-capacitor or split-phase type.

B. Bearings: Sealed, pre-lubricated ball bearings.

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.

2.4 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Brushless direct current (DC) variable speed motor supplied with alternating current, with a permanent magnet with near zero rotor losses, permanently-lubricated ball bearings, electronic commutation, designed for synchronous rotation, and at least 70% efficient at all operating speeds.

B. As a minimum, the motor shall include the following features:

1. Integrated controller / invertor that operates the wound stator and senses rotor position to electronically commutate the stator.
2. Thermal overload protection.
3. Built-in soft start and soft speed change ramps.
4. Inductors to minimize harmonic distortion and line noise.
5. Designed to overcome reverse rotation without affecting life expectancy.
6. Include a pulse width modulating (PWM) controller for either manual or DDC controlled motor speed adjustment down to 25 percent of full speed. The manual PWM controller shall be field adjustable with a standard screwdriver. The remote PWM shall be capable of receiving a 0-10Vdc analog signal from a DDC controller provided by the controls contractor, as indicated or required by other sections of DIV 23 specifications.
7. Software for motor control as indicated or described in other DIV 22 specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount direct-connected motors securely and in accurate alignment. The drive shall be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

B. Mount capacitors shipped separately beside motor connection box as required. Connect in accordance with the requirements of Division 26, Electrical.

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1. Test units at full rated load after the installation of the motor capacitors and submit reports.

3.2 OPERATING INSTRUCTIONS

A. As specified in Section 22 0500, provide operating instructions.

END OF SECTION

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SECTION 22 0523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Shutoff valves.

B. Check valves.

C. Hose connections.

D. Drain valves.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

B. Piping systems:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.
3. Storm drainage piping: Section 22 1413.

C. Automatic water temperature control valve for domestic hot water: Section 22 1119.

1.3 REFERENCES

A. ASME B16.10: Face-to-Face and End-to-End Dimensions of Valves.

B. ASME B16.34: Valves - Flanged, Threaded, and Welding End.

1.4 SUBMITTALS

A. Product data: For each type of valve. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

B. Certification that products comply with NSF/ANSI 61.

C. Maintenance data: For inclusion in operation and maintenance manual specified in Division 01 and Section 22 0101. Include manufacturer's instructions for adjusting, servicing, disassembling, and repairing.

D. Valve charts: Furnish valve charts typed on 8.5 by 11-inch (216 by 279-mm) bond paper, showing locations of all manual and automatic control valves, and flow meters. Include:

1. Number
2. Location
3. Service
4. Function
5. Area served

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E. Valve numbering system shall be approved by the Owner prior to final submittal. Place one copy of approved chart in a plastic envelope and mount on wall where directed. Provide another copy for each of the Operating and Maintenance Manuals.

1.5 QUALITY ASSURANCE

A. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

B. Ferrous valves shall conform to ASME B16.10 and B16.34 for dimension and design criteria.

C. Copper alloy valves (brass and bronze) shall have no more than 15 percent zinc in the alloy.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Shutoff valves:

1. Ball valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following or approved equal:

a. Apollo Valves
b. Milwaukee Valve Co.
c. NIBCO
d. Stockham Valve & Fittings
e. Victaulic Company of America
f. Walworth Co.
g. Watts Regulator Co.

B. Check valves:

1. Check valves: Subject to compliance with requirements, provide the specified NIBCO valve, or comparable product by one of the following or approved equal:

a. Combination Pump and Valve Co.
b. Mueller Steam Specialty
c. NIBCO
d. Victaulic Company of America

C. Hose connections: Subject to compliance with requirements, provide the specified Zurn valves, or comparable products by one of the following or approved equal:

1. Jay R. Smith
2. Crane Co.
3. Josam Manufacturing Co.
4. Woodford Manufacturing Co.
5. Zurn

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D. Drain valves: Subject to compliance with requirements, provide the specified NIBCO valves, or comparable products by one of the following or approved equal:

1. Apollo Valves
2. Milwaukee Valve Co.
3. NIBCO
4. Stockham Valve & Fittings
5. Victaulic Company of America
6. Walworth Co.
7. Watts Regulator Co.

2.2 SHUTOFF VALVES

A. Ball valves:

1. Valves NPS 0.25 (DN 8) through NPS 2 (DN 50:

a. 600 psi CWP, two-piece silicon bronze alloy body, full port, blowout-proof stem, PTFE seats, stainless steel ball and stem, extension handle for use in insulated piping, threaded or soldered ends.
b. Basis of design: NIBCO T-685-66-LF or S-685-66-LF.

2.3 CHECK VALVES

A. Center-guided, spring-loaded silent-action type check valves:

1. Valves NPS 0.5 (DN 15) through NPS 2 (DN 50):

a. 250 psi CWP, silicone bronze body, PTFE disk, stainless steel stem and spring, threaded or soldered ends.
b. Basis of design: NIBCO T-480-Y-LF or S-480-Y-LF.

2.4 HOSE CONNECTIONS

A. Exterior wall hydrants (with locked cover):

1. Non-freeze type.
2. ASSE 1019 hydrant with integral anti-siphon backflow preventer.
3. Automatic drain.
4. Flush-mount, bronze casing, copper interior parts; stainless steel housing, locking hinged polished nickel bronze cover marked "water."
5. Provide operating rod of length to match wall thickness, provide wall clamp.
6. Pressure Rating: 125 psig (860 kPa).
7. Ceramic disc half turn valve.
8. Key-operated. Key that unlocks cover operates hydrant.
9. NPS 0.75 (DN 20) inlet.
10. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.
11. Basis of design: Zurn Z-1320XL.

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2.5 DRAIN VALVES

A. Drain valves:

1. Provide with supplemental ASSE 1011 backflow preventer.
2. Full-port, two-piece ball valve, bronze body, bronze ball, replaceable PTFE seats and seals, vinyl-covered steel handle, threaded or soldered inlet, threaded cap with brass chain. Provide extension handles where used in insulated piping. Remove handle where valve is accessible to the public.
3. Pressure rating: 600-psig (4137-kPa).
4. NPS 0.75 (DN 20) inlet.
5. NPS 0.75 (DN 20) ASME B1.20.7 garden-hose thread outlet.
6. Basis of design: NIBCO T-585-80-LF-HC or T-585-80-LF-HC.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install valves to be readily accessible for operation and maintenance, and with ample clearance for turning handles or operators.

B. For valves in inaccessible locations, provide access doors as specified in a related section.

C. Identify valves as specified in Section 22 0500, Common Work Results for Plumbing.

1. Provide tags for all valves except stop valves on individual fixtures or equipment where their function is obvious, or where the fixture or equipment is immediately adjacent. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
2. Provide ceiling identification tags where valves are above an accessible suspended ceiling. Number shall correspond to tag number.

3.2 INSTALLING SHUTOFF VALVES

A. Install shutoff valves for water piping where indicated:

3.3 INSTALLING CHECK VALVES

A. Provide center-guided, spring-loaded silent-action type check valves in domestic water lines.

3.4 INSTALLING HOSE CONNECTIONS

A. Wall hydrants: Provide wall hydrants where indicated. In finished areas, locate units so that domestic water connection is concealed inside adjoining partition or furred space.

B. Drain valves: Provide drain valve at every low point of a water system, and where indicated.

3.5 INSTALLING DRAIN VALVES

A. Provide drain valve at every low point of a water system, and where indicated.

END OF SECTION

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SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.

B. Trapeze pipe hangers.

C. Metal framing systems.

D. Insulation protection.

E. Fasteners.

F. Equipment foundations and supports.

1.2 RELATED SECTIONS

A. Plumbing Piping Insulation: Section 22 0719.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B31.9: Building Services Piping.

B. ASTM International

1. ASTM A 36: Standard Specification for Carbon Structural Steel
2. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
4. ASTM A 563: Standard Specification for Carbon and Alloy Steel Nuts
5. ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
6. ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
7. ASTM C 552: Standard Specification for Cellular Glass Thermal Insulation
8. ASTM F 594: Standard Specification for Stainless Steel Nuts
9. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

C. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

D. Metal Framing Manufacturer’s Association

1. MFMA-4: Metal Framing Standards Publication
2. MFMA-103: Guidelines for the Use of Metal Framing

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E. Manufacturer's Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 DEFINITIONS

A. Hot Systems: Maximum operating (service) temperatures 120 degrees F (49 degrees C) and above.

B. Ambient Systems: Maximum operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

C. Cold Systems: Maximum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data:

1. Provide manufacturer's literature showing compliance with specifications for each type of hanger, framing system, support, fastener and accessory materials.
2. Provide a schedule of piping types and sizes and associated pipe hanger types.
3. Provide a schedule of building attachment types and associated attachment hardware.
4. Provide a schedule of pipe types and sizes and proposed hanger spacing and support rod diameters.
5. Provide manufacturer's recommended pipe hanger spacing criteria for stainless steel piping.
6. For supports used as components of fire protections systems, include certification of listing and label as required in "Quality Assurance" below.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Qualifications of welders: As specified in Section 22 0500, Common Work Results for Plumbing.

B. Hangers and supports used as components of fire protection systems shall:

1. Comply with NFPA 13.
2. Be listed and labeled by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OR APPROVED EQUAL

A. Pipe hangers:

1. Anvil International
2. Carpenter and Paterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. PHP Systems/Design

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B. Metal framing systems:

1. Anvil International
2. Cooper Industries
3. Hydra-Zorb
4. PHD Manufacturing, Inc.
5. PHP Systems/Design
6. Unistrut

C. Pipe covering protection shields:

1. Anvil International
2. Carpenter and Patterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. Pipe Shields, Inc.
7. Rilco Manufacturing Co., Inc.

2.2 PIPE HANGERS AND SUPPORTS

A. General: Comply with requirements of MSS SP-58.

B. Hangers and clamps:

1. Typical interior applications: Galvanized steel or factory painted.
2. For use with uninsulated copper pipe: Copper plated.

C. Trapeze pipe hanger: MSS SP-58, Type 59, shop-fabricated or field-fabricated pipe support assembly made from structural carbon-steel shapes with pipe saddles and U-bolts to secure piping on top of hanger.

D. Supplemental materials:

1. Threaded rod: Continuously threaded.

a. Zinc-plated or galvanized carbon steel for indoor applications.
b. Stainless steel for outdoor and corrosive applications.

2. Nuts and washers: Provide the same material used for threaded rods (ASTM A 563 for steel, ASTM F 594 for stainless steel).
3. Structural carbon-steel shapes: ASTM A 36.
4. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

E. Metal framing systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of channels, nuts, bolts, structural connections, accessories, fittings, and other manufactured components.
2. Standard: Comply with MFMA-4 for factory-fabricated components for field assembly.
3. Channels: Continuous slotted galvanized steel channel with inturned lips, width selected for applicable load criteria.

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4. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Metal framing system pipe clamps:

    a. Galvanized steel clamp pipe support with elastic stop nut, and hex head machine screw, and manufactured to connect to metal framing system channels.
    b. For insulated piping: Clamp shall have friction tape on inside of clamp surface, manufactured to connect to pipe clamp insulating insert over pipe.
    c. For uninsulated piping: Clamp shall have an integral molded thermoplastic elastomer clamping insert on inside of clamp surface, manufactured to connect to uninsulated pipe.

F. Insulation protection:

1. Pipe covering protection shield:

    a. Shield: Galvanized steel, meeting the requirements of MSS SP-58 Type 40. Provide with alignment ridges when used in conjunction with pipe hanger.
    b. Structural insulation insert: Structural insulation insert to form the insulation for the lower half of, or the entire pipe circumference Provide ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength; or ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength. Insert thickness shall match adjacent piping insulation thickness.

2. Pipe covering protection saddle:

    a. Saddle: Steel, meeting requirements of MSS SP-58 Type 39
    b. Insulation insert: Insulating material located in the space between saddle and pipe.

3. Pipe clamp insulating insert:

    a. Insulating insert material: Closed-cell, sponge or expanded rubber, ASTM C 534, Type I for tubing material, with integral supports constructed from non-compressive closed cell material, single piece construction with self-adhesive closure strips. Insert thickness shall match adjacent piping insulation thickness. If insulation thickness is not available, provide maximum available thickness and seal insulation vapor barrier at thickness transition.
    b. Insulation protection jacket: Aluminum or stainless steel, bonded to insulation insert.
    c. Insulating insert and jacket shall cover entire circumference of pipe.
    d. Basis of design: Armacell “Armafix” insulating inserts.

2.3 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer’s stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors “Red Head.”

B. Fasteners to drywall or cavity wall construction:

1. Toggle bolts with hollow wall drive anchors or nylon anchors as required.

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2. Basis of design: ITT Phillips Anchors “Red Head” toggle bolts.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

2.4 CONCRETE AND GROUT

A. Concrete:

1. Concrete shall be no less than 3000-psi (25,000 kPa) strength.
2. Reinforcement: 6 by 6 inch (150 by 150 mm) welded steel wire fabric, ASTM A 1064.

B. Grout:

1. Premixed, non-shrink grout consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi (48,000 kPa) in 28 days.
2. Provide grout by one of the following manufacturers or approved equal:

a. Sonneborn-Rexnord “Sonogrout”
b. L&M Construction Chemical Company “Crystex”
c. US Grout Corporation “Five-Star Grout”

PART 3 - EXECUTION

3.1 GENERAL

A. Provide hangers and supports in accordance with schedules at the end of this section, as modified by specifications for each location and type.

B. Comply with MSS SP-58. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a hanger location to multiple locations in the structure to get support from an appropriate location or to increase the strength of the connection to the structure.

E. Support horizontal piping from above with hangers and threaded rod where possible, unless otherwise indicated.

F. Secure vertical piping at stack bases.

G. Riser support:

1. Support pipe risers through floor slabs with riser clamps.
2. Where pipe sleeves or associated water dams are not capable of accepting the weight of the piping, provide supplemental supports to transfer the weight of the piping to the structure.
3. Provide additional supports as needed not to exceed scheduled maximum vertical support spacing.

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H. Provide hanger sizes to allow for continuous insulation for insulated piping systems.

I. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

J. Support groups of small piping along a structural wall using a metal framing system secured to the wall.

K. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

P. Trapeze pipe hangers: Provide where required for grouping of parallel runs of horizontal piping.

1. Weld steel according to AWS D-1.1.
2. Hang with threaded rods. Size threaded rods in accordance with MSS SP-58.
3. Design trapeze pipe hangers and supports based on supported load plus a 50 percent minimum safety factor.
4. Hanger spacing shall not exceed the requirements for the smallest pipe in the rack.
5. Hanger spacing shall not exceed 6 feet (1.8 m) where hung from wood.

Q. Metal framing systems: Provide where required for grouping of parallel runs of piping, and support together on field-assembled strut systems. Comply with MFMA-103 for metal framing system selections and applications.

R. Where piping penetrates metal studs within metal stud partitions, provide polymer inserts manufactured for the purpose to isolate piping and insulation from the metal stud material.

3.2 BUILDING ATTACHMENTS

A. Attaching to concrete slabs and composite slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from concrete slabs or composite slabs. Where approved, provide mechanical expansion anchors and steel bolts or rods.

B. Attaching to wood construction:

1. Trusses: Follow roof truss manufacturers' recommendations for attachment locations, loads, spacing, and methods of attachment.

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2. Joists: Provide MSS SP-58 Type 34 side beam connectors.

3.3 INSTALLING CAST-IRON PIPING

A. Support piping within 18 inches (460 mm) of each horizontal joint in addition to satisfaction of maximum hanger spacing. Where there are multiple joints in a 4 foot (1.2 m) section, supports may be provided at every other joint.

B. Support piping at changes in direction.

C. Where pipe is supported by hangers more than 18 inches (460 mm) long, provide lateral support at a maximum interval of 40 feet (12.2 m) with sway bracing.

D. Secure closet bends, traps, and similar items against movement in any direction.

3.4 INSTALLING EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Provide lateral bracing, to prevent swaying.

B. Provide minimum four-inch (100-mm) -high concrete foundations (housekeeping pads) or as indicated on drawings, reinforced with welded-wire fabric, for floor-mounted equipment and where indicated. Anchor concrete foundations by dowels inserted into the floor slab.

C. Unless otherwise specified, provide concrete foundations, bolts, sleeves, and appurtenances as work of the section where the supported equipment is specified and in accordance with the requirements of Division 03.

D. Equipment shall be properly aligned and leveled, and grouted where necessary. Support piping independently of equipment and so as not to cause a strain or thrust.

E. Coordinate exact size, configuration and location of equipment, foundations, and supports using approved shop drawings of equipment.

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3.5 PIPING HANGER AND SUPPORT SCHEDULES

A. Hanger and support types (insulated cold and ambient applications): Applications include, but are not limited to, domestic cold water and insulated sanitary and storm water systems.

HANGERS & SUPPORTS FOR INSULATED COLD AND AMBIENT APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Types 1 & 40	Clevis hanger & pipe covering protection shield.	NPS 0.5 (DN 15) through NPS 2 (DN 50)
Type 59 (with combination insulating insert and insulation protection shield)	Trapeze pipe hanger with pipe saddles & U-bolts (with combination insulating insert and insulation protection shield).	NPS 0.5 (DN 15) through NPS 4 (DN 100)
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37 (with combination insulating insert and insulation protection shield)	Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor (with combination insulating insert and insulation protection shield).	All sizes where supported from floor or a concrete support pier.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 8 (DN 200)
Risers		
Type 8	Riser clamp.	All sizes

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B. Hanger and support types (insulated hot applications): Applications include, but are not limited to domestic hot water and domestic hot water return systems.

HANGERS & SUPPORTS FOR INSULATED HOT APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Types 1 & 40	Clevis hanger & pipe covering protection shield.	NPS 0.5 (DN 15) through NPS 2 (DN 50)
Type 59 (with combination insulating insert and insulation protection shield)	Trapeze pipe hanger with pipe saddles & U-bolts (with combination insulating insert and insulation protection shield).	NPS 0.5 (DN 15) through NPS 4 (DN 100)
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37 (with combination insulating insert and insulation protection shield)	Adjustable pipe stanchion saddle with U-bolt and floor flange anchored to floor (with combination insulating insert and insulation protection shield).	All sizes where supported from the floor or a concrete support pier. Use only where no significant horizontal pipe movement is anticipated.
Types 41 & 39	Adjustable roller support & pipe covering protection saddle (cast-iron roll and sockets, steel roll rod, supported from below with threaded rods).	All sizes where supported from racks, fixed structural supports, or brackets where vertical adjustment is required.
Types 44 & 39	Roller chair & pipe covering protection saddle (Cast-iron roll, steel roll rod, steel chair, bolts, and hex nuts).	All sizes where supported from racks, fixed structural supports, or brackets where vertical adjustment is not required.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 6 (DN 150)
Risers		
Type 8	Riser clamp.	All sizes

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C. Hanger and support types (uninsulated applications): Applications include, but are not limited to uninsulated storm water, sanitary, and vent systems.

HANGERS & SUPPORTS FOR UNINSULATED APPLICATIONS		
MSS SP-58 Classification	Description	Piping Applications
Hung from Above		
Type 1	Clevis hanger	All sizes
Type 10	Adjustable swivel ring	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Type 59	Trapeze pipe hanger with pipe saddles & U-bolts.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
N/A	Metal framing system with metal framing system pipe clamps for uninsulated piping.	NPS 0.5 (DN 15) through NPS 4 (DN 100)
Supported from Below		
Type 37	Adjustable pipe stanchion saddle with U-bolt, with floor flange and base anchored to floor.	All sizes where supported from the floor or a concrete support pier.
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	NPS 0.5 (DN 15) through NPS 8 (DN 200)
Risers		
Type 8	Riser clamp.	All sizes

D. Minimum threaded rod sizes: Provide at least the following minimum rod diameters for single rods supporting a single pipe hanger.

Pipe Size	Minimum Rod Diameter
NPS 2 (DN 50) and below	0.375 inches (10 mm)
NPS 2.5 and NPS 3 (DN 65 and DN 75)	0.5 inches (15 mm)
NPS 4 and NPS 5 (DN 100 and DN 125)	0.625 inches (16 mm)

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E. Maximum hanger and support spacing for pressurized piping:

1. Provide additional hangers or supports for concentrated loads such as flanges, valves, expansion compensators, fittings, and other specialties.
2. Horizontal spacing schedule:

Pipe Size	Copper Piping
NPS 0.75 (DN 20) and below	5 feet (1.5 m)
NPS 1 (DN 25)	6 feet (1.8 m)
NPS 1.25 (DN 32)	7 feet (2.1 m)

3. Vertical spacing schedule:

Copper Piping
10 feet (3 m)

F. Maximum hanger and support spacing for metal gravity piping:

1. Provide additional hangers or supports for concentrated loads such as fittings, and other specialties.
2. Horizontal spacing schedule:

Pipe Size	Copper DWV Tubing
1.5 inches (40 mm)	8 feet (2.4 m)

3. Vertical spacing schedule:

Copper DWV Tubing
10 feet (3 m)

END OF SECTION

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SECTION 22 0700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in “Related Sections.”

1.2 RELATED SECTIONS

A. Plumbing piping insulation: Section 22 0719.

B. Plumbing equipment insulation: Section 22 0716.

1.3 REFERENCES

A. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Concealed insulation shall include work:

1. Above ceilings.
2. Where furred in and in pipe chases.

B. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

C. Unconditioned areas: Areas outside of the insulated envelope.

D. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state, county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

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1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers' wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in “Related Sections.”

PART 3 - EXECUTION

Not Used.

END OF SECTION

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SECTION 22 0716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing equipment insulation for the equipment listed in the insulation thickness and material schedule at the end of this section.

1.2 RELATED SECTIONS

A. Definitions and general insulation requirements: Section 22 0700.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for flexible elastomeric insulation materials

a. ASTM C 534: Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer’s name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer’s instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installer qualifications: Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store rigid insulation products so as to protect them from breakage.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OR APPROVED EQUAL

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article “Product Options” in Section 22 0101.

B. Flexible elastomeric insulation:

1. Aeroflex USA
2. Armacell LLC
3. K-Flex USA
4. Rubatex

C. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac

2.2 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric sheet insulation: Closed-cell, sponge- or expanded-rubber materials, ASTM C 534, Type II, with vapor barrier facing.

B. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, and aluminum, and compatible with service temperatures.
2. Basis of design: Foster 85-75 “Drion”.

C. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications.
2. Basis of design: Armacell “WB Armaflex” latex enamel.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1.

2.3 FIELD-APPLIED GLASS CLOTH

A. Glass cloth: Woven Glass-Fiber Fabric: MIL-C-20079H. Type I, plain weave, 8 ounces per square yard (270 grams per square meter).

B. Glass Cloth Tape: Type II, Class 3, 4.5 ounces per square yard (150 grams per square meter).

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C. Lagging finish coating:

1. Washable, abrasion-resistant, indoor insulation coating for canvas and glass lagging cloth.
2. Basis of design: Foster 30-36 “Sealfas”.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide insulation in accordance with the Insulation Thickness and Material Schedule at the end of this section, as modified by specifications for each location and type.

B. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

C. Insulate equipment as specified, except equipment with factory-applied insulation.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

E. 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.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with least number of joints practical.

H. Stagger joints.

I. Install insulation continuously around anchor attachments.

J. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

3.2 INSTALLING FLEXIBLE ELASTOMERIC INSULATION (COLD SURFACES)

A. Insulate equipment surface.

B. Insulate flanges, bolts, and accessories. Provide removable insulation sections to cover flanges, bolts, accessories, and parts of equipment which must be opened or removed periodically for maintenance, such as vessel covers, manholes, hand holes, cleanouts, and associated fasteners. Provide supports for removable sections as needed.

C. Do not insulate the following. Bevel and seal insulation edges:

1. Testing agency labels and stamps.
2. Manufacturer’s nameplates and data plates.

D. Secure insulation with a full coating of adhesive.

E. Stagger joints between layers.

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F. Cut, score, or miter insulation to fit contours of equipment.

G. Seal breaks and punctures with tape.

H. Fill voids with small pieces of insulation applied with adhesive on all sides to maintain continuous vapor barrier.

I. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.

J. 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.

K. Finish insulation with two coats of lagging finish coating with glass cloth and tape embedded between coats. Overlap glass cloth seams a minimum of 2 inches (50 mm).

3.3 SCHEDULES

A. Insulation thickness and material schedule:

INSULATION THICKNESS AND MATERIAL SCHEDULE			
Application	Fluid Temperature Range	Insulation Type	Minimum Insulation Thickness
Storage Tanks and Pressure Tanks for fluids below ambient temperature (1)	--	Flexible Elastomeric	Two Layers 0.75-inch (19 mm) Each Layer 1.5-inch (38 mm) Total
Water Softeners	--	Flexible Elastomeric	Two Layers 0.75-inch (19 mm) Each Layer 1.5-inch (38 mm) Total
(1) - Applications with fluids below ambient temperature include but are not limited to domestic cold water, chilled domestic water, storm water, and air-conditioning condensate.			

END OF SECTION

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SECTION 22 0719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Plumbing piping insulation for the interior piping systems listed in the minimum insulation thickness schedule at the end of this section.

B. Plumbing piping insulation for the exterior piping systems.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Painting: Division 09.

C. Definitions and general insulation requirements: Section 22 0700.

D. Pipe hangers and protection shields: Section 22 0529.

E. Lavatory piping insulation: Section 22 4200.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for mineral fiber insulation materials

a. ASTM C 449: Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
b. ASTM C 547: Mineral Fiber Pipe Insulation.
c. ASTM C 553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
d. ASTM C 1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

2. Standards for flexible elastomeric insulation materials

a. ASTM C 534: Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

3. Standards for all insulation materials

a. ASTM C 450: Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
b. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

4. Standards for field applied jackets and accessories

a. ASTM C 1729: Standard Specification for Aluminum Jacketing for Insulation

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b. ASTM D 1784: Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
c. ASTM B 209: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer's name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer's instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article "Product Options" in Section 22 0101.

B. Mineral fiber insulation:

1. CertainTeed Corporation.
2. Johns Manville
3. Knauf Insulation
4. Manson Insulation
5. Owens-Corning

C. Flexible elastomeric insulation:

1. Aeroflex USA
2. Armacell LLC
3. K-Flex USA
4. Rubatex

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D. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac

2.2 MINERAL FIBER INSULATION MATERIALS

A. Mineral fiber preformed pipe insulation: Glass fibers bonded with a thermosetting resin, ASTM C 547 Type I, with factory-applied ASJ-SSL jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. ASJ-SSL jacket:

1. All service jacket with self-sealing lap.
2. White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.
3. Complying with ASTM C 1136, Type I.

C. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, pressure sensitive, complying with ASTM C 1136; 3 inch (75 mm) width. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

D. Mineral fiber blanket insulation: Glass fibers bonded with a thermosetting resin, ASTM C 553, Type IV, without facing. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Mineral fiber preformed fitting and valve covers: Glass fibers bonded with a thermosetting resin, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

F. Mineral fiber insulation adhesive:

1. Solvent free, low VOC, water-based adhesive designed for bonding mineral fiber insulation to steel or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 85-60 “Quick-Tack”.

G. Mineral fiber insulation vapor barrier mastic:

1. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 30-65 “Vapor-Fas”.

H. Insulating cement: Mineral fiber cement with a hydraulic-setting binder, conforming to ASTM C 449. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

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2.3 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric preformed pipe insulation: Closed-cell, sponge- or expanded-rubber, ASTM C 534, Type I for tubular materials. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Flexible elastomeric preformed fitting and valve covers: Closed-cell, sponge- or expanded-rubber, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

C. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 85-75 “Drion”.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Armacell “WB Armaflex” latex enamel.

2.4 FIELD-APPLIED JACKETS

A. Polyvinyl chloride (PVC) jacket:

1. Jacket material: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Color: White
3. Adhesive: As recommended by jacket material manufacturer. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Fitting covers: Manufacturer’s factory-fabricated fitting covers made from the same material, finish, and thickness as the jacket, suitable to the size of fittings and thickness of insulation. Provide factory fabricated fitting covers for elbows, tees, flanges, unions, reducers, end caps, valves, and other fittings. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
5. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket and fitting covers with acrylic adhesive; suitable for indoor and outdoor applications, 2 inch (50 mm) width, 6 mil (0.15 mm) thickness. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

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2.5 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Fabric-reinforcing mesh:

1. Woven Glass-Fiber Fabric: Approximately 2 ounces per square yard (68 grams per square meter) for covering pipe and pipe fittings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide interior piping insulation in accordance with the Minimum Insulation Thickness Schedule for Interior Applications at the end of this section, as modified by specifications for each location and type.

B. Provide field applied jackets in accordance with the Field-Applied Jacket Schedule at the end of this section, as modified by specifications for each location and type.

C. Provide mineral fiber insulation unless otherwise indicated.

D. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer's printed instructions.

E. Maintain a continuous vapor barrier on systems that convey fluid at below-ambient temperatures, including the following applications:

1. Domestic cold water piping
2. Air-conditioning condensate piping

F. Where a continuous vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

G. Installation at pipe hangers:

1. Insulation shall be continuous through hangers for all piping systems.
2. Install pipe covering protection shields with thickness of structural insulation inserts equal, under load, to that of adjoining insulation.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
5. Shields and structural insulation inserts are specified in Section 22 0529, Hangers and Supports for Plumbing Piping and Equipment.

H. Where insulated piping systems pass through sleeves or openings in partitions and floors, the insulation shall be continuous through the sleeves and openings. See Firestopping specifications for coordinating insulation and firestopping.

I. Do not insulate chrome-plated piping connections to plumbing fixtures, except wheelchair-accessible lavatories shall be insulated with special insulation and finish assemblies specified in Section 22 4200.

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J. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

K. 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.

L. Install insulation with longitudinal seams at top and bottom of horizontal runs.

M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

N. Install insulation with least number of joints practical.

O. Finish installation with systems at operating conditions. Repair separations and cracking caused by thermal movement.

3.2 INSTALLING MINERAL FIBER INSULATION

A. Install insulation with factory-applied jackets as follows:

1. Cover circumferential joints with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive.
2. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap.
3. Cover circumferential joints and longitudinal seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
4. Where a continuous vapor barrier is indicated, apply vapor-barrier mastic on longitudinal seams and circumferential joints and at ends adjacent to pipe flanges and fittings.
5. Repair damaged insulation jackets by applying same jacket material over damaged areas. Extend patches at least 4 inches (100 mm) beyond damaged areas. Adhere and seal patches.

B. 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 using mineral fiber preformed fitting and valve covers whenever possible. Install preformed fittings with adhesive.
3. Where mineral fiber preformed fitting and valve covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces 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. Coat with mastic. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
4. Valves: Insulate up to and including the bonnets, stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
5. Strainers: Insulate so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover.

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6. Flanges and unions: Install preformed pipe insulation to outer diameter of flange or union. Make width of insulation section same as overall width of union or flange and bolts, plus twice the thickness of pipe insulation. Fill voids between inner circumference of flange or union insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
7. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

C. Installation of floor drain bodies that receive air-conditioning condensate and roof drain bodies:

1. Provide mineral fiber blanket insulation, 1 inch thick minimum, adhered to drain body.
2. Coat with mastic.
3. Finish with two coats of lagging finish coating with glass cloth and tape embedded between coats.

3.3 INSTALLING FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and circumferential joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Installation on fittings and flanges:

1. Install insulation over fittings and flanges with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using flexible elastomeric preformed fitting covers whenever possible. Install preformed fittings with adhesive. Tape and seal with vapor barrier coating.
3. Where flexible elastomeric preformed fitting covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
4. Flanges: Install pre-formed pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. 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. Secure insulation to flanges and tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
5. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

3.4 INSTALLING FIELD-APPLIED JACKETS

A. Installing PVC jacket:

1. Provide jacket tight to insulation.
2. Provide with 1-inch (25-mm) overlap at longitudinal seams and circumferential joints.
3. For horizontal applications, install with longitudinal seams along top and bottom of pipes.
4. Seal with manufacturer’s recommended adhesive. Apply two continuous beads of adhesive to seams and joints, one bead under the jacket lap and another finish bead along each seam and joint edge.
5. Seams and joints shall completely prevent the entrance of water.

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3.5 SCHEDULES

A. Minimum insulation thickness schedule for interior applications:

MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR APPLICATIONS (3)		
Application	Fluid Temperature Range	All Pipe Sizes
Domestic Hot Water & Domestic Hot Water Return Piping (2)	105F to 140F (40C to 60C)	1.5-inch (38 mm)
Domestic Cold or Tempered Water Piping (1)	--	1-inch (25 mm)
Air-conditioning Condensate Piping, Gravity and Pumped (1)	--	1-inch (25 mm)
(1) - Contractor's Option within partitions only: 0.5-inch (13mm) flexible elastomeric insulation. (2) - Contractor's Option within partitions only: 1-inch (25 mm) flexible elastomeric insulation for piping NPS 1.25 (DN 32) and smaller.		

B. Field-applied jacket schedule:

FIELD-APPLIED JACKET SCHEDULE	
Application	PVC Jacket
Pipe insulation exposed in mechanical rooms, penthouses, and other service areas not accessible to the public.	X

END OF SECTION

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SECTION 22 1116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Domestic cold water piping.

B. Domestic hot water piping.

C. Recirculated hot water piping.

D. Tempered water piping.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Water meter for monitoring by HVAC control system: Division 23.

1.3 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

1.4 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASME B16.24: Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500

B. American Society of Testing and Materials

1. ASTM B 75: Standard Specification for Seamless Copper Tube
2. ASTM B 88: Standard Specification for Seamless Copper Water Tube
3. ASTM B 584: Standard Specification for Copper Alloy Sand Castings for General Applications

C. National Sanitation Foundation/American National Standards Institute

1. NSF/ANSI 61: Drinking Water System Components – Health Effects

1.5 DEFINITIONS

A. Domestic water system: Potable water system for general human use, including hot and cold water supply and return.

1.6 SUBMITTALS

A. Product data: Each type of pipe and fitting included in the project.

B. Certification that products comply with NSF/ANSI 61.

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C. Certifications: Disinfection test report

D. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.7 QUALITY ASSURANCE

A. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

B. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE SUPPLIERS

A. Disinfection of domestic water system or approved equal:

1. ARC Water Treatment Company, Inc.
2. Ecolab
3. Water Chemical Services, Inc.
4. Olin Water Services

2.2 ABOVE GROUND PIPE

A. Copper: ASTM B 88, Type L hard drawn.

2.3 ABOVE GROUND FITTINGS

A. Cast or wrought fittings for copper pipe:

1. General: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.
2. Flanges: Bronze, solder type, ASME B16.24, Class 150.

2.4 UNDERGROUND PIPE AND FITTINGS

A. Copper Type K pipe and fittings:

1. Pipe: Copper tubing, ASTM B 88, Type K, hard drawn, plain end.
2. Fittings: Solder joint, cast brass, ASME B16.18, or wrought copper, ASME B16.22.

B. Abutments: Concrete, not less than three pipe diameters wide and two pipe diameters high.

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PART 3 - EXECUTION

3.1 GENERAL

A. Install domestic water piping as shown on the drawings and in accordance with the provisions of Section 22 0500, Common Work Results for Plumbing.

B. Install piping in accordance with the Schedule of Pipe Systems, Sizes, and Materials at the end of this section.

C. Provide drain valves at low points of domestic water system for drainage.

3.2 INSTALLING UNDERGROUND PIPE AND FITTINGS

A. General installation:

1. Provide electrical continuity in water service pipe joints. Provide conductivity strips, wedges, or other approved methods where required.
2. Provide a shutoff valve at the point of water service entrance.

3.3 TESTING OF DOMESTIC WATER SYSTEM

A. When domestic water piping is completed, and before strainer baskets are installed, pressure test at the pressure shown in Piping Test Table in Section 22 0500.

3.4 CLEANING OF DOMESTIC WATER SYSTEM

A. Flushing of building systems:

1. Flush domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Do not allow flushing water for piping to travel through plumbing equipment. Isolate equipment by closing isolation valves and opening bypass valves or by leaving piping disconnected from equipment.
3. Flush new piping segments as the work progresses.
4. Provide temporary domestic water and drain piping as needed. Remove when flushing is complete.
5. Drain water from the segment low point to a safe location and replace water at the same rate.
6. Continue until drain water is free from sediment, scale, rust and other foreign substances.
7. Flush every new branch of piping, for a minimum of 15 minutes after running clean.
8. Install strainer baskets.
9. Disinfect piping as described below.

B. Disinfection of building systems:

1. Disinfect domestic cold water, domestic hot water, recirculated hot water, and tempered water piping before using. Unless prescribed otherwise by the county or state health department, the method of flushing shall be as follows:
2. Provide temporary domestic water and drain piping as needed. Remove when disinfection is complete.

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3. Through a NPS 0.75 (DN 20) hose connection in the main downstream of the backflow preventer, pump in sodium hypochlorite to produce a free available chlorine residual of not less than 200 ppm. Provide plumbing connections and power for pumping chlorine into the system.
4. Fill all piping systems with chlorinated water.
5. Proceed downstream from the point of chlorine application, opening each water source for each faucet and outlet until chlorine is detected at a concentration of 200 ppm. Close each water source for each faucet and outlet when chlorine is evident at the required concentration.
6. Energize domestic water recirculation systems or provide another means of filling domestic hot water return piping with chlorinated water at a concentration of 200 ppm.
7. Retain this water in the system for at least three hours, but no more than 3.5 hours.
8. At the end of the retention period, verify that no less than 100 ppm of chlorine are present at the most remote end of the system.
9. Open all faucets and outlets and flush all piping until the chlorine residual in the water is less than 1 ppm.
10. Obtain a representative water sample from the system for analysis by a recognized bacteriological testing laboratory.
11. If the sample tested for coliform organisms is negative, the testing organization shall submit a letter and laboratory report to the Contractor, certifying successful completion of the disinfection. Submit the letter and report.
12. If any samples tested indicate the presence of coliform organisms, repeat the entire disinfection procedure.

3.5 SCHEDULE OF PIPE SYSTEMS, SIZES AND MATERIALS

A. Pipe schedules apply to domestic cold water, domestic hot water, domestic hot water return, and domestic temper water piping.

B. Above ground piping:

	Copper Type L cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

C. Above ground water service entrance piping:

	Copper Type L cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

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D. Below ground piping:

	Copper Type K cast or wrought fittings
NPS 2.5 (DN 65) and smaller	X

END OF SECTION

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SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Backflow preventers.

B. Strainers.

C. Trap primers.

D. Water hammer arrestors (shock absorbers).

E. Thermostatic water temperature controllers.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.

B. Curbs and flashings: Section 22 0506.

C. Insulation: Section 22 0719.

1.3 REFERENCES

A. American National Standards Institute:

1. ANSI B1.20.1: Pipe Threads, General Purpose, Inch.
2. ANSI B 16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
3. ANSI Z21.22: Relief Valves for Hot Water Supply Systems.

B. American Society of Mechanical Engineers:

1. ASME A112.1.2: Air Gaps in Plumbing Systems (For Plumbing Fixtures and
2. Water-Connected Receptors).
3. ASME B16.18: Cast Copper Alloy Solder Joint Pressure Fittings.
4. ASME B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

C. American Society of Sanitary Engineering:

1. ASSE 1001: Performance Requirements for Atmospheric Type Vacuum Breakers.
2. ASSE 1010: Performance Requirements for Water Hammer Arresters.
3. ASSE 1013: Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies.
4. ASSE 1015: Performance Requirements for Double Check Backflow Prevention Assemblies.
5. ASSE 1017: Performance Requirements for Temperature Actuated Mixing Valves For Hot Water Distribution Systems.
6. ASSE 1018: Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied.

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7. ASSE 1044: Performance Requirements for Trap Seal Primer – Drainage Types and Electric Design Types.
8. ASSE 1070: Performance Requirements for Water Temperature Limiting Devices.

D. American Society for Testing and Materials:

1. ASTM B88: Standard Specification for Seamless Copper Water Tube.
2. ASTM B584: Standard Specification for Copper Alloy Sand Castings for General Applications.

E. PDI-WH 201: Water Hammer Arresters.

F. NSF/ANSI 61: Drinking Water System Components – Health Effects.

1.4 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

B. Certification that products comply with NSF/ANSI 61.

1.5 QUALITY ASSURANCE

A. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

B. Minimum working pressure: 125 psi (860 kPa) unless otherwise indicated.

PART 2 - PRODUCTS

2.1 BACKFLOW PREVENTERS

A. Acceptable Manufacturers or approved equal

1. Ames
2. Febco
3. Watts Industries
4. Zurn-Wilkins

B. Backflow preventer for domestic water service: ASSE 1015, double check valve assembly, dual check valves, test cocks, and stop valves.

2.2 STRAINERS

A. Acceptable Manufacturers or approved equal

1. Keckley
2. Mueller Steam Specialty
3. Spirax Sarco Inc.
4. Tate Andale, Inc. “Guardian”

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5. Watts Industries, Inc.

B. Minimum pressure rating: 125 psi (860 kPa)

C. Basket-type water strainers:

1. Epoxy-coated cast iron, flanged,
2. Type 304 stainless-steel screen with 1/8-inch (3-mm) perforations.
3. Basis of design: Mueller Steam Specialty No. 165. Basket:

2.3 TRAP PRIMERS

A. Pressure-differential activated trap primers:

1. Acceptable Manufacturers or approved equal:

a. Precision Plumbing Products
b. Sioux Chief Manufacturing
c. Zurn Plumbing Products

2. ASSE 1018, trap primer valves to accommodate one to four floor primer outlets. Bronze body with stainless steel Primers shall release a metered amount of water when a 10 psi (70 kPa) pressure drop is sensed in the connected water line.

a. Distribution unit: Connects directly to the primer valve with up to four 5/8 inch OD compression outlet fittings for NPS 0.5 (DN 15) copper tubing.
b. Operating range: 20 - 80 psi (138 - 552 kPa).
c. Basis of design: Precision Plumbing Products P-1 and P-2 Series trap primer valves.

B. Flow activated trap primers:

1. Acceptable Manufacturers or approved equal:

a. Mainline
b. Precision Plumbing Products

2. ASSE 1018, trap primer valves to accommodate one to four floor primer outlets. Bronze body with integral vacuum breaker. Primers shall release a metered amount of water when water flows the primer as a downstream fixture is used.

a. Distribution unit: Connects directly to the primer valve with up to four 5/8 inch OD compression outlet fittings for NPS 0.5 (DN 15) copper tubing.
b. Operating range: 20 - 80 psi (138 - 552 kPa).
c. In-line flow: 0.25 – 7 gpm (1 – 26.5 l/m).
d. Basis of design: Precision Plumbing Products Prime-Pro.

C. Trap primer piping:

1. Above grade piping exposed in bathrooms and finished areas: Chrome-plated copper tubing and fittings.
2. Above grade piping concealed or exposed in mechanical rooms or mechanical closets: Soft copper tube, ASTM B 88, Type L with ASME B16.18 cast copper or ASME B16.22 wrought copper fittings, solder joints.

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3. Piping below slabs on earth: Soft copper tube, ASTM B 88, Type K with ASME B16.18 cast copper or ASME B16.22 wrought copper fittings, solder joints.

2.4 WATER HAMMER ARRESTORS

A. Acceptable Manufacturers or approved equal:

1. MIFAB, Inc.
2. Josam Company
3. Jay R. Smith Manufacturing Company
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products

B. ASSE 1010 or PDI-WH 201 certified:

1. Construction: Metal bellows or copper tube with piston.
2. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.5 THERMOSTATIC WATER TEMPERATURE CONTROLLERS

A. Acceptable manufacturers or approved equal:

1. Bradley Corporation
2. Powers Regulator Company
3. Lawler Manufacturing Company, Inc.
4. Leonard Valve Company
5. Symmons Industries, Inc.

B. General:

1. Provide units of sizes, capacities, and piping arrangements as indicated on the drawings.
2. Construction: Copper or bronze body with corrosion-resistant interior components.
3. Minimum pressure rating: 125 psi (860 kPa).
4. Paraffin-based thermal actuation technology to sense and adjust outlet temperature with vandal-resistant locking mechanism to secure temperature setting.
5. Maximum water pressure drop at design flow rate: 10 psi (70 kPa).
6. Set units for the discharge temperatures specified below unless otherwise indicated on the drawings.

C. Master thermostatic water tempering valves:

1. ASSE 1017 listed.
2. Union and check stop at each inlet.
3. Discharge temperature adjustment range: 90 - 160 degrees F. Set at 120 degrees F.
4. Rigid bulb indicating thermometer at supply outlet; 3-inch dial graduated 30 degrees to 130 degrees F, stainless-steel, hermetically-sealed with external calibration screw.
5. Minimum controllable flow rate without recirculation: 3.0 gpm (11.4 l/m).
6. Rough bronze finish.
7. Basis of design: Powers Regulator Company "Hydroguard" LFMM430.

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PART 3 - EXECUTION

3.1 INSTALLING BACKFLOW PREVENTERS

A. Install backflow preventers in the building water supply, each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with requirements of authorities having jurisdiction.

B. Mount 48-inches (120 mm) above the floor unless otherwise noted on the drawings.

C. Install drain piping for backflow preventers, full size of drain connection, with atmospheric-vent drain connection air-gap fitting, and terminate as indicated on the drawings.

D. Do not install bypass piping around backflow preventers.

3.2 INSTALLING STRAINERS

A. Install a basket type strainer at the water service entrance.

3.3 INSTALLING TRAP PRIMERS

A. Pressure-differential activated trap primers:

1. Provide pressure-differential activated trap primers for floor drains outside of toilet rooms and where automatic trap priming systems are not indicated.
2. Install level and plumb to ensure equal flow distribution to all primer lines.
3. Connect primers to cold water lines NPS 1.5 (DN 40) and smaller.
4. Provide a domestic cold water connection with shutoff valve full size of the trap primer inlet connection.
5. Locate trap primers above the floor level of the drains they serve.
6. Locate trap primers in janitor’s closets, storage rooms, or other spaces accessible to maintenance personnel. If these locations are not possible, mount in accessible locations concealed above ceilings.

B. Flow activated trap primers:

1. Provide flow activated trap primers for floor drains near fixtures that use domestic cold water and where automatic trap priming systems are not indicated.
2. Install level and plumb to ensure equal flow distribution to all primer lines.
3. Connect primers to cold water lines NPS 1 (DN 25) and smaller. Transition to trap primer connection size if required.
4. Do not install on combination hot and cold water lines.
5. Do not install on piping leading to a drinking fountain or water cooler.
6. Provide a domestic cold water connection with shutoff valve full size of the trap primer inlet connection. Provide cold water from outlet connection to fixture.
7. Locate trap primers above the floor level of the drains they serve.
8. Locate trap primers in janitor’s closets, storage rooms, or other spaces accessible to maintenance personnel. If these locations are not possible, mount in accessible locations concealed above ceilings or, where indicated, provide chrome-plated primers below lavatories.

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C. Trap primer piping:

1. Provide trap primer piping full size of trap primer outlet connection or larger. Provide a union at the connection.
2. Provide trap primer piping concealed wherever possible.
3. Pitch piping continuously down toward drains at minimum 1.0 percent slope.
4. Connect to floor drain trap primer fittings. Transition to full size of floor drain connection.
5. Replace kinked piping.
6. Sleeve and seal piping at floor penetrations.

3.4 INSTALLING WATER HAMMER ARRESTORS

A. Size and locate water hammer arrestors as recommended by the Plumbing and Drainage Institute Standard PDI-WH 201 or ASSE 1010.

1. Install water hammer arrestors in each branch domestic water pipe (hot and cold) which feeds either a battery of fixtures or a single fixture.
2. Install water hammer arrestors upstream of quick-closure valves.
3. Install water hammer arrestor in accessible locations.

3.5 INSTALLING WATER TEMPERATURE CONTROLLERS

A. Install and connect controllers as shown on the drawings and in compliance with the manufacturer’s recommendations.

B. Adjust controllers to specified supply temperatures or as indicated on the drawings.

3.6 INSTALLING SOLENOID VALVES

A. Solenoid valves shall be line size.

B. Provide a shutoff valve and union upstream of the solenoid valve.

3.7 INSTALLING PRESSURE RELIEF VALVES

A. Install pressure relief valve in accordance with the equipment manufacturer's recommendations.

END OF SECTION

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SECTION 22 1123 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. In-line circulator pumps.

1.2 RELATED SECTIONS

A. UL label, demonstration, training, and equipment installation: Section 22 0500.

B. Motors: Section 22 0513.

C. Equipment supports: Section 22 0529.

1.3 REFERENCES

A. ASME/ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

B. ASHRAE 90.1: Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.

C. NSF/ANSI 61 - Drinking Water System Components – Health Effects.

D. Underwriters Laboratories

1. UL 508 - Standard for Industrial Control Equipment.
2. UL 778 - Standard for Motor-Operated Water Pumps.

1.4 SUBMITTALS

A. Product data: Include certified performance curves and rated capacities of selected models; shipping, installed, and operating weights; furnished specialties; and accessories for each type and size of pump specified. Indicate pumps' operating point on curves.

B. Certification that products comply with NSF/ANSI 61.

C. Certification that products comply with energy performance requirements of ASHRAE 90.1.

D. Shop drawings: Show layout and connections for pumps. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.

1. Wiring diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.

E. Maintenance data: For each pump specified, to include in maintenance manuals specified in Division 01 and Section 22 0101.

F. Certifications: Booster pump system: Written certification that each unit has been factory tested and performs as specified and scheduled.

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1.5 QUALITY ASSURANCE

A. UL label: As specified in Section 22 0500, Common Work Results for Plumbing.

B. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

C. Comply with the energy performance requirements of ASHRAE 90.1.

D. Department of Energy (DOE) compliance: Pump manufactures shall comply with US Department of Energy (DOE) energy conservation standard that pertains to applicable pumps with 1 horsepower or greater. These pumps shall be evaluated using the Pump Energy Index (PEI) that determines the efficiency rating and DOE compliance. The lower the number the higher the efficiency.

1. Pumps shall have a PEI rating of 1 or less to comply with the standard.
2. The PEI compliant rating shall appear on the pumps permanent nameplate.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Specified units are the basis for design of the project. The following listed manufacturers also provide units of acceptable quality. If units by any of these manufacturers should be proposed, verify that they meet requirements specified in Division 01 and the article "Product Options" in Section 22 0101, and submit shop drawings as specified in the “Submittals” article above.

B. In-line circulator pumps or approved equal:

1. Armstrong Fluid Technology
2. Bell and Gossett, a xylem brand
3. Crane Pumps and Systems
4. Grundfos Pumps Corporation
5. Taco Comfort Solutions

2.2 GENERAL REQUIREMENTS

A. Provide type, size, configuration, capacity, and current characteristics indicated on the drawings.

B. Motors:

1. Provide motors that meet requirements in Section 22 0513, Common Motor Requirements for HVAC Equipment.
2. Where electronically commutated motors are schedule, provide a controller with both of the following:

a. Provide with a potentiometer for adjustment of constant speed operation, field-adjustable with a screwdriver to adjust the fan speed, and low voltage input terminals to receive a control signal from the building automation system to start and stop the fan motor.

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b. Provide with low voltage input terminals to receive a control signal from the building automation system to start and stop the fan motor and control the motor speed for variable speed operation.

3. Where electronically commutated motors are schedule, and where required on the drawings, provide packaged control capable capabilities to support the sequence of operation.

C. Pumps shall comply with the DOE Energy Conservation Standard with a PEI rating of 1 or less.

2.3 IN-LINE CIRCULATOR PUMP

A. Provide a cartridge type circulator. Stainless-steel casing, composite cartridge with composite impeller, ceramic shaft, carbon bearings and EPDM seals. Provide with electrically commutated motor (ECM).

1. Basis of design: Taco Comfort Solutions Series 007e.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install equipment as indicated on the drawings. Comply with requirements in Section 22 0500.

3.2 INSTALLING IN-LINE CIRCULATOR PUMP

A. Support:

1. Support in line circulator pumps from piping.
2. Provide support for piping near the pump inlet and the pump outlet.
3. Provide hangers with sufficient capacity to support the piping and the pump.
4. Provide additional support for pump and motor where required by the manufacturer’s recommendations.

B. Provide center-guided, spring-loaded silent-action check valves in discharge piping.

C. Provide valves for pump isolation on the suction and discharge side of each pump.

D. Provide gauge taps in the piping at the inlet and outlet of each pump.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 22 0500, provide operating instructions.

END OF SECTION

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SECTION 22 1316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sanitary piping

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

B. Sanitary waste piping specialties: Section 22 1319.

1.3 REFERENCES

A. Cast iron piping standards

1. ASTM A 74: Standard Specification for Cast Iron Soil Pipe and Fittings
2. ASTM C 564: Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
3. ASTM C1540: Standard Specification for Heavy-Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings
4. CISPI 301: Standard Specification for hubless cast iron soil pipe and fittings for sanitary and storm drain, waste, and vent piping applications

B. Copper (DWV) piping standards

1. ANSI/ASME B16.29: Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fitting: DWV
2. ASME/ANSI B16.23: Cast Copper Alloy Solder Joint Drainage Fittings: DWV
3. ASTM B 306: Standard Specification for Copper Drainage Tube (DWV)

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

1.5 QUALITY ASSURANCE

A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, verify the inverts of piping to which new work is to be attached. Demonstrate to the satisfaction of the construction manager and/or Owner, that the connections to existing sanitary pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. Clean, rod, and flush existing sanitary piping as necessary to maintain gravity flow.

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PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Cast-iron hub and spigot pipe and fittings:

1. Pipe: ASTM A 74 service class
2. Neoprene gaskets joints:

a. Lifetime ASTM C 564 neoprene gasket joints
b. Basis of design: Fernco “Multi-Tite”, Tyler Pipe “Ty-seal”, or Mission Rubber “Mission-Tite.”

C. Cast-iron no-hub pipe and fittings:

1. Pipe and fittings: Cast Iron Soil Pipe Institute Standard 301.
2. Joints: Use one of the no-hub coupling options below

a. Option 1 (for use in any location):

(1) ASTM C 564 neoprene gaskets and two-piece cast-iron housing clamps and stainless-steel bolts and nuts.
(2) Basis of design: Products of MG Piping Products Company.

b. Option 2 (for use in any location):

(1) Corrugated 304 stainless-steel shields with four or six clamps and holding bolts conforming to ASTM C 1540 and rubber gasket sealing sleeves conforming to ASTM C 564
(2) Basis of design: Husky “Series 4000” coupling or Mission "Heavy Weight Series CHW" coupling.

3. Pipe and fitting restraints:

a. Provide for piping NPS 5 (DN 125) and larger
b. Factory fabricated pipe and fitting restraint assemblies rated to prevent pipe separation under fluid thrust forces up to 50 feet of head in conformance with CISPI 301.
c. Basis of design: Holdrite No. 117 No-Hub Pipe and Fitting Restraint.

D. Copper tube (DWV) pipe and fittings:

1. Pipe: copper tubing Type DWV, ASTM B 306
2. Fittings: Wrought copper drainage fittings and soldered joints conforming to ASME/ANSI B16.29 or cast-brass fittings conforming to ASME/ANSI B16.23.

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PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 0500, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

3.3 INSTALLING CAST-IRON PIPING

A. 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." Install restraint assemblies at pipe couplings and fittings for piping NPS 5 (DN 125) and larger.

3.4 INSTALLING COPPER PIPING

A. Install aboveground copper tubing according to Copper Development Association, Inc. (CDA) "Copper Tube Handbook."

3.5 INSTALLING SANITARY AND VENT PIPING

A. Make changes in direction of sanitary piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

B. In soil, waste, and vent stacks where branches occur that are smaller than stacks, provide properly sized reducing fittings.

C. Provide sanitary piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

D. Provide vent piping at a 1 percent minimum downward slope toward vertical fixture vent or toward vent stack.

E. Provide sanitary vent termination height above the finished roof level at the minimum required per the applicable plumbing code, or as directed by the building inspector.

F. Provide sanitary vent terminations a minimum of 10 feet (3 meters) away from outside air intakes, or further where indicated on drawings.

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3.6 SCHEDULES

A. Sanitary pipe installation schedule.

SANITARY PIPE INSTALLATION SCHEDULE Contractor has option where more than one x appears on a line			
MATERIAL TYPE			
Application	Cast-iron hub and spigot	Cast-iron no-hub	Copper tube (DWV)
Sanitary, exterior or below slab on earth	X		
Sanitary, concealed within walls, partitions, or ceiling space		X	X
Sanitary, interior exposed		X	X
Sanitary, accessible pipe or crawl space		X	
All information in this schedule is subject to local plumbing code and health department requirements.			

END OF SECTION

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SECTION 22 1319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Drains and cleanouts.

B. Flashing material.

1.2 RELATED SECTIONS

A. Piping: Section 22 1316.

B. Curbs and flashings: Section 22 0506.

1.3 SUBMITTALS

A. Product data: Each specialty device or equipment, with installation instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OR APPROVED EQUAL

A. General: Model numbers are provided in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by the acceptable manufacturers listed.

B. Drains and cleanouts:

1. Josam Company
2. Jay R. Smith Manufacturing Company
3. MIFAB, Inc.
4. Wade
5. Watts Drainage
6. Zurn Plumbing Products

2.2 FLOOR DRAINS AND FLOOR SINKS

A. Those installed in slabs on grade and above crawl space do not require flashing clamp devices. All others shall have flashing clamp devices.

1. Equal to the Zurn catalog numbers noted on drawings.

2.3 FLEXIBLE FLASHING

A. Polyvinyl chloride sheet, flexible, waterproof, unreinforced, 40 mil minimum thickness, intended for use as a drain flashing.

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2.4 CLEANOUTS

A. Cleanouts: Those installed in slab on grade and in slab above crawl spaces do not require membrane flashing device. All others shall have flashing devices.

B. In underfloor sanitary lines: (See Floor Finish Schedule) All units complete with adjustable floor cleanout, coated cast-iron body, and bronze threaded plug.

1. In storage areas with plain or painted concrete floors: Polished bronze light-duty top.

a. Basis of design: Zurn ZB-1400.

2. In exposed areas with plain or painted concrete floors: Polished nickel bronze light-duty top.

a. Basis of design: Zurn ZN-1400.

3. In resilient tile floors: Polished nickel bronze light-duty square top recessed for 1/8-inch tile.

a. Basis of design: Zurn ZN-1400-TX.

4. In ceramic tile floors: Polished nickel bronze light-duty square top.

a. Basis of design: Zurn ZN-1400-T.

5. In carpeted floors: Carpet marker.

a. Basis of design: Zurn Z-1400-CM.

6. In terrazzo floors: Corrosion resistant ductile-iron top with severe and heavy-duty coating.

a. Basis of design: Zurn Z-1400-DC.

PART 3 - EXECUTION

3.1 INSTALLING FLOOR DRAINS AND FLOOR SINKS

A. Where floor drains are over occupied areas, flash them with flashing specified in this section, single piece for each drain, 30 by 30 inches (762 by 762 mm) with opening cut in center to suit clamping device of drain. Adhere flashing to substrate with adhesive and secure to clamping device of drain. Ascertain that weep holes from drainage pan are open.

B. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated. See architectural plans for additional information about slopes of floors.

C. Floor drains shall be provided with cast-iron P traps with primer connections, including those discharging directly into storm drains.

D. Floor drains shall be provided with trap primers.

1. Refer to Section 22 1119, Domestic Water Piping Specialties, for trap primers.

E. Floor drains shall be covered until placed in service to prevent the entrance of any foreign matter.

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3.2 INSTALLING CLEANOUTS

A. Install cleanouts at base of each vertical, soil, waste, and vent stack, in the vertical piping.

B. Cleanouts shall be the same size as the pipe into which they are installed, except no cleanout shall be larger than NPS 4 (DN 100).

C. Install cleanouts in horizontal piping where indicated on drawings. Where cleanouts occur directly below a floor, the cleanout shall terminate with top flush with floor. Provide for the floor finish to be installed on the cleanout cover, and separated from surrounding material. Install carpet markers after carpet installation is completed. Install ceramic tile and terrazzo per manufacturer's instructions.

END OF SECTION

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SECTION 22 1413 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Air-conditioning condensate drain.

1.2 RELATED SECTIONS

A. Piping installation and testing: Section 22 0500.

1.3 REFERENCES

A. Copper Type L and M piping standards

1. ASME/ANSI B 16.18: Cast Copper Alloy Solder Joint Pressure Fittings
2. ASME/ANSI B 16.22: Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
3. ASTM B 88: Standard Specification for Seamless Copper Water Tube

1.4 SUBMITTALS

A. Product data: Each specified material and product.

B. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

A. Shop drawings:

1. Fabrication, assembly, and installation for entire air conditioning condensate system: Indicate pipe dimensions; and components and attachments to other work.
2. Coordinate drawings with other trades.
3. Include layout drawings for the entire ductwork system, drawn at the same scale as the contract drawings, except no smaller than 0.125 inch equals one foot.

1.5 QUALITY ASSURANCE

A. Cast iron pipe and fittings shall be marked with the collective trademarks of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International.

B. Prior to any new piping installation, verify the inverts of all piping to which new work is to be attached. Demonstrate to the satisfaction of the construction manager and/or Owner, that the connections to existing storm water pipes meet the intent of the contract.

C. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

D. Clean, rod, and flush existing storm water piping as necessary to maintain gravity flow.

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PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Install each type of pipe and fittings in locations required or permitted in Part 3, including the Pipe Installation Schedule at the end of the section.

B. Copper Type L and M pipe and fittings:

1. Pipe: ASTM B 88, Type L or M, hard drawn.
2. Fittings: Solder joint, cast brass, ASME B16.18; or wrought copper, ASME B16.22.

PART 3 - EXECUTION

3.1 PREPARATION

A. Connect piping as shown on the drawings. Check elevations of connection points before installing new work.

3.2 INSTALLATION, GENERAL

A. Use suitable tools and appliances for the safe and convenient handling and laying of pipe. Examine each section of pipe for defects. Do not lay any piece that is known to be defective. If any defective piece should be discovered after having been laid, remove and replace it at no change to the contract price.

B. Install piping in accordance with the Pipe Installation Schedule at the end of this section, as indicated on the drawings, and in accordance with Section 22 0500, Common Work Results for Plumbing. Materials and work shall conform to local plumbing codes and health department regulations.

C. Thoroughly clean all pipe and fittings before installing them, and keep them clean until the acceptance of the completed work. Cap or plug ends of lines to prevent debris from entering during construction.

D. Make changes in direction of storm water piping with approved sanitary fittings, Y branches, 1/8 or 1/16 bends.

E. Install all storm water piping at a 2 percent minimum downward slope in the direction of flow unless otherwise indicated.

F. Seal air-conditioning condensate drain where it passes through outside wall and provide splash block if required.

3.3 INSTALLING COPPER PIPING

A. Install aboveground copper tubing according to Copper Development Association, Inc. (CDA) "Copper Tube Handbook."

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3.4 SCHEDULES

A. Storm water pipe installation schedule.

STORM WATER PIPE INSTALLATION SCHEDULE Contractor has option where more than one X appears on a line	
MATERIAL TYPE	
Application	Copper Type L or M
Air conditioning condensate, interior NPS 1 (DN 25) and smaller	X
All information in this schedule is subject to local plumbing code and health department requirements.	

END OF SECTION

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SECTION 22 3300 - ELECTRIC DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Commercial, storage electric domestic water heaters.

1.2 RELATED SECTIONS

A. UL label, demonstration, training, and equipment installation: Section 22 0500.

B. Expansion tanks: Section 22 0509.

C. Equipment supports: Section 22 0529.

1.3 REFERENCES

A. ANSI Z21.22: Relief Valves for Hot Water Supply Systems.

B. ASHRAE 90.1: Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings.

C. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials.

D. ASTM G123-00: Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.

E. ISO 3651-2: Determination Of Resistance to Intergranular Corrosion of Stainless Steels.

F. NSF/ANSI 61: Drinking Water System Components – Health Effects.

G. UL 174: UL Standard for Safety Household Electric Storage Tank Water Heaters.

H. UL 1453: UL Standard for Safety Electric Booster and Commercial Storage Tank Water Heaters.

1.4 SUBMITTALS

A. Product data: Each type and size water heater. Include nominal capacity and pressure rating; shipping, installed, and operating weights; and specialties and accessories furnished for this project. Indicate dimensions, wall thicknesses, required clearances, method of assembly, and piping connections.

B. Certification that the water heaters and fittings comply with NSF/ANSI 61.

C. Certification that products comply with energy performance requirements of ASHRAE 90.1.

D. Include operation and maintenance instructions and parts list for each type of water heater.

1.5 QUALITY ASSURANCE

A. UL label: As specified in Section 22 0500, Common Work Results for Plumbing.

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B. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

C. Comply with the energy performance requirements of ASHRAE 90.1.

D. ASME compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled products, or comparable product by of the following or approved equal:

B. Storage domestic electric water heaters:

1. A.O. Smith Corporation
2. Hubbell
3. PVI
4. State Industries, Inc.

2.2 STORAGE ELECTRIC DOMESTIC WATER HEATER

A. Provide unit of size, input, and recovery ratings shown on the drawings.

B. Unit construction:

1. Maximum working pressure: 150 psi (1034 kPa).
2. Ball-type drain valve.
3. Listed and labeled in accordance with UL 174.
4. Control compartments for service and maintenance through front.
5. Inlet carries entering cold water to bottom of tank.

C. Performance requirements:

1. Meet or exceed the energy performance requirements of ASHRAE 90.1.

D. Tank interior:

1. All internal surfaces exposed to water protected with glass heat-fused to the steel.
2. Provide anode rods for cathodic protection.

E. Insulation: Manufacturer’s standard fiberglass or foam insulation.

F. Exterior jacket: Steel with manufacturer’s standard baked enamel finish over bonderized undercoating.

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G. ASME-rated temperature and pressure relief valve set at 125 psi (862 kPa) and 210 degrees F (98.9 degrees C) unless otherwise noted and capacity compatible with the water heater provided.

H. Heating element and controls:

1. Combination thermostat and high-temperature-limit control.
2. Copper heating elements.

I. Basis of design: A.O. Smith DEL.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide a concrete equipment foundation (housekeeping pad) and install the equipment on that foundation. Comply with requirements in Section 22 0529.

A. Plug all unused tappings.

B. Provide temperature and pressure relief valves. Extend relief valve outlet with water piping in continuous downward pitch and discharge to closest floor drain.

C. Provide vacuum relief valves.

D. Provide drain piping.

3.2 MANUFACTURER'S FIELD SERVICE

A. Provide manufacturer's startup and adjustment for water heaters.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 22 0500, provide operating instructions.

END OF SECTION

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SECTION 22 4200.01 - PLUMBING FIXTURES – WATER CLOSETS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Water closets and related components.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.

1.3 SUBMITTALS

A. Product data: For each water closet specified, including fixture, trim, fittings, accessories, appurtenances, supports, construction details, dimensions of components, and finishes.

B. Certification that products comply with NSF/ANSI 61.

C. Shop drawings:

1. A schedule of proposed water closets and trim, in the order listed in the specification.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 22 0500, Common Work Results for Plumbing.

B. Lead free requirements:

1. Potable water system components intended to dispense water for human consumption, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

C. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they meet specified requirements and are similar to the basis of design.

D. Fixtures and trim where required to be accessible to disabled people, identified in this section as “for disabled,” shall comply with requirements of the Americans with Disabilities Act (ADA) Regulations, as applicable to each type of fixture or its use.

1. Trim must meet requirements for force of operation at water pressures up to 80 psi.
2. Models must be selected and installed so that flush controls will be on the fixture’s open side.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following or approved equal.

1. Fixtures:

a. American Standard
b. Kohler Co.
c. Zurn Plumbing Products
d. Toto

2. Supplies and miscellaneous trim:

a. Brass-Craft Manufacturing Co.
b. Elkay Manufacturing Co.
c. Engineered Brass Co.
d. McGuire Manufacturing Co.
e. T & S Brass and Bronze Works, Inc.

3. Toilet seats:

a. Bemis
b. Beneke Corp.
c. Church Seats
d. Olsonite Co.
e. Sperzel Co.
f. Toto.

4. Fixture supports and carriers:

a. Josam Mfg. Co.
b. J.R. Smith
c. Zurn Plumbing Products

2.2 FLOOR-MOUNTED BOTTOM OUTLET TANK WATER CLOSETS (1.28 GPF)

A. Common requirements:

1. Fixture

a. Material: Vitreous china, white.
b. Mounting and configuration: Freestanding, floor-mounted, two-piece.
c. Bowl type: Elongated.
d. Passageway: 2.125 inches (54 mm).
e. Water connection: 0.375-inch (DN 10) compression.
f. Tank type: Dynamax tornado flushing system.

2. Bolt caps: Two chrome-plated acorn nuts, size as required.
3. Water closet supply:

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a. 0.5-inch (13 mm) by 3-inch (76 mm) long chrome-plated brass nipple, chrome-plated shallow escutcheon, 0.5-inch NPT (DN 15) inlet by 0.375-inch (DN 10) compression outlet chrome-plated multi-turn stop valve with loose key, 0.375-inch (DN 10) chrome-plated copper tube riser.
b. Basis of design: Brass-Craft SR1712DLX C.

4. Seat: White solid plastic, elongated, open front; stainless-steel hinge posts with combination self-sustaining and check hinge.

a. Basis of design: Toto SS124 with cotton finish.

B. F-1 floor-mounted bottom outlet pressurized tank water closet (1.28 gpf):

1. Application: Adult, disabled.
2. Rim height: 17 inches (432 mm) rim to floor.
3. Fixture design consumption: 1.28 gallon (4.8 L) per flushing cycle.
4. Basis of design: Toto “Aquia IV” CST446CEMG with cotton finish, 1.28 gallon (4.8 L) per flush.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide and set water closets to extent and number indicated on drawings. Water closets shall be left in first class condition, properly adjusted, cleaned and ready for operation.

B. Provide all parts, fittings, escutcheons, and appurtenances regularly required for each fixture.

C. Provide low-voltage devices and wiring for flush valves which require them to operate.

D. Provide rough-in for water closets. Coordinate elevations of water closet flush handle with rough-ins for grab bars, other wall-mounted items, and ADA clearance requirements.

E. Where water closets are specified or noted to be accessible in accordance with ADA requirements, ensure that flush controls are installed on the fixture’s open side.

F. Protect and cover water closets so they cannot be used until final work acceptance.

3.2 SETTING OF FIXTURES

A. Floor-mounted water closets:

1. Set floor outlet water closets on standard floor flanges with gaskets and cement-grout them to rest firmly and evenly on floors. Use of offset-type water closet floor flanges is not permitted.
2. Secure water closets with two bolts attaching to the floor flange. Provide bolt caps.
3. Seal the base to the floor using a clear silicone caulk.

END OF SECTION

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SECTION 22 4200.03 - PLUMBING FIXTURES - LAVATORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lavatories and trim, faucets, other fittings, and related components.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.

1.3 SUBMITTALS

A. Product data: For each lavatory specified, including fixture, trim, fittings, accessories, appurtenances, supports, construction details, dimensions of components, and finishes.

B. Certification that products comply with NSF/ANSI 61.

C. Shop drawings:

1. A schedule of proposed fixtures and trim, in the order listed in the specification.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 22 0500, Common Work Results for Plumbing.

B. Lead free requirements:

1. Potable water system components, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

C. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they meet specified requirements and are similar to the basis of design.

D. Fixtures and trim where required to be accessible to disabled people, identified in this section as “for disabled,” shall comply with requirements of the Americans with Disabilities Act (ADA) Regulations, as applicable to each type of fixture or its use.

1. Trim must meet requirements for force of operation at water pressures up to 80 psi.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following or approved equal.

1. Fixtures:

a. American Standard
b. Commercial Enameling Co.
c. Eljer
d. Kohler Co.
e. Zurn Plumbing Products

2. Faucets:

a. Chicago Faucet Co.
b. Speakman Co.
c. Kohler Co.
d. T & S Brass and Bronze Works, Inc.

3. Supplies, traps, and miscellaneous trim:

a. Brass-Craft Manufacturing Co.
b. Chicago Faucet Co.
c. Elkay Manufacturing Co.
d. Engineered Brass Co.
e. McGuire Manufacturing Co.
f. T & S Brass and Bronze Works, Inc.

4. Fixture supports and carriers:

a. Josam Mfg. Co.
b. J.R. Smith
c. Zurn Plumbing Products

2.2 WALL-MOUNTED ENAMELED CAST IRON LAVATORIES (SINGLE FAUCET HOLE)

A. Common requirements:

1. Fixture:

a. Material: Cast iron with acid-resisting white enamel.
b. Lavatory type: Rectangular, front overflow.
c. Faucet holes: Single faucet hole.
d. Mounting: Wall-mounted. Include cast-iron plate carrier connection fitting.
e. Dimensions: 21-11/16 inches x 17-3/4 inches (551 mm x 451 mm).
f. Basis of design: Kohler “ModernLife” K-77768-1.

2. Supply nipples:

a. Two brass nipples, triple-plated polished chrome of length and size as required.

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b. Basis of design: Brass-Craft.

3. Supply stops:

a. Chrome-plated angle ball valve, 0.5-inch NPT (DN 15) inlet, 0.375-inch (DN 10) female threaded compression outlet, loose key handle, and slip wall flange.
b. Basis of design: Chicago STB-21-00-AB.

4. Thermostatic mixing valve:

a. Below counter ASSE 1070 thermostatic mixing valve.
b. Brass body, adjustment cap with tamper resistant locking feature, integral inlet strainer screens, integral inlet check valves to protect against cross-flow.
c. Discharge temperature setting range: 80 to 120 degrees F (27 to 49 degrees C).
d. Flow rate range: 0.25 to 2.25 GPM (1.0 to 8.5 liters per minute).
e. Inlet connections: Two 0.375-inch (DN 10) threaded compression connections, one for hot water and one for cold water.
f. Outlet connections: One 0.375-inch (DN 10) threaded compression connections for tempered water.
g. Basis of design: Powers LFG480.

5. Supply tubing: Provide 0.375-inch (DN 10) chrome-plated copper tubing and fittings between supply stops, thermostatic mixing valve and faucet.
6. P-trap and waste nipple:

a. Chrome-plated, cast brass P-trap with ground joints, 1.25-inch inlet x 1.5-inch IPS outlet, swivel type, with cleanout.
b. Chrome-plated cast brass 1.5-inch IPS waste nipple with cast brass chrome-plated set screw escutcheon.
c. Basis of design: McGuire 8090 P-trap with McGuire waste nipple.

B. F-2 lavatory:

1. Application:

a. Adult general use.

2. Mounting height:

a. 32 inches (813 mm) rim to floor.

3. Faucet and drain:

a. Manual faucet with pop-up drain.

2.3 FAUCETS AND DRAINS

A. Common requirements:

1. Faucets shall be similar in appearance, function, and design to the basis of design model.
2. Faucets shall have a vandal-proof design.
3. Construction: Brass with polished chrome finish.
4. Mounting: Deck-mounted.

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5. Provide faucets with a flow restrictor:

B. Manual faucets:

1. Manual faucet with pop-up drain (8-inch (203-mm) centers):

a. Faucet centers: Mounted in single faucet hole.
b. Actuation: Manual with single water temperature and flow control handle.
c. Spout: 4.1875-inch (106-mm) fixed spout.
d. Water connections: One connection for hot water and one connection for cold water, 0.5-inch (DN 15) threaded connections for 0.375-inch (DN 10) riser.
e. Tailpiece: NPS 1-1/4 (DN 32) with integral pop-up drain.
f. Basis of design: Kohler K-99491-4.

2.4 CARRIERS

A. Plate carrier:

1. Lavatories mounted on shafts or partitions where there is no floor on the opposite side:

a. Single lavatory: The plate carrier shall have a backup plate of 10-gauge steel, at least 6 inches (152 mm) high x 38 inches (965 mm) long.
b. Battery-mounted lavatories: The 10-gauge backup plate shall be continuous for full length of battery of fixtures, with the carrier plates properly spaced and welded to the backup plate.
c. Basis of design: Zurn Z1259 plate carriers.

2. Lavatories mounted on partitions where there is a floor on the opposite side:

a. Plate carrier with legs anchored to floor.
b. Basis of design: Zurn Z1224.

2.5 LAVATORY INSULATION KITS

A. Lavatory insulation kit:

1. Molded interlocking white trap and angle valve insulation assemblies with vinyl jacket.
2. Basis of design: Truebro “Lav-Guard 2” Series 100 E-Z.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide and set lavatories to extent and number indicated on drawings. Lavatories shall be left in first class condition, properly adjusted, cleaned and ready for operation.

B. Provide all parts, fittings, escutcheons, and appurtenances regularly required for each fixture.

C. Provide low-voltage devices and wiring for faucets which require them to operate.

D. Provide rough-in for lavatories. Coordinate elevations with other wall-mounted items.

E. Protect and cover lavatories so they cannot be used until final work acceptance.

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F. Water supply:

1. Faucets with a separate hot water and cold water inlet:

a. Provide supply tubing and fittings between hot water supply stop and thermostatic mixing valve inlet.
b. Provide supply tubing and fittings between cold water supply stop and a 0.375-inch (DN 10) tee fitting. Provide supply tubing and fittings between tee and thermostatic mixing valve inlet and between tee and faucet cold water connection.
c. Provide supply tubing and fittings between thermostatic mixing valve tempered water discharge and faucet hot water connection.
d. Mount thermostatic mixing valve in a location that is accessible and as high as possible.

G. Provide wall-mounted lavatories with carriers.

H. Provide lavatories for the disabled with lavatory insulation kits. Where piping is concealed by a pedestal, the insulation kit may be omitted.

3.2 SETTING OF FIXTURES

A. In locations where fixtures are set against walls, seal crack between wall and fixture with silicon sealant.

B. Securely attach wall hung fixtures to wall using specified supports.

C. After installation, paint undersides of cast-iron lavatories with two coats of white enamel.

END OF SECTION

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SECTION 22 4200.04a - PLUMBING FIXTURES – MOP SINKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mop sinks, faucets, mop hangers, and related components.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.

1.3 SUBMITTALS

A. Product data: For each mop sink specified, including fixture, trim, fittings, accessories, appurtenances, construction details, dimensions of components, and finishes.

B. Certification that products comply with NSF/ANSI 61.

C. Shop drawings: A schedule of proposed fixtures and trim, in the order listed in the specification.

1.4 QUALITY ASSURANCE

A. Lead free requirements:

1. Potable water system components, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

B. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they meet specified requirements and are similar to the basis of design.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following or approved equal.

1. Fixtures:

a. Acorn Engineering Co.
b. Fiat Products
c. Zurn Plumbing Products

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2. Faucets and mop hangers:

    a. Chicago Faucet Co.
    b. Speakman Co.
    c. T & S Brass and Bronze Works, Inc.

2.2 MOP SINKS

A. F-3 mop sink (molded stone):

1. Fixture:

    a. Material: Molded stone, white with black accents.
    b. One-piece floor-mounted mop sink with integral molded shelf 10.5 inches (267 mm) wide.
    c. Dimensions: 24 inches x 24 inches (610 mm x 610 mm), 10 inches (254 mm) deep. Both sides shall be 10 inches (254 mm) high with one inch (25 mm) wide shoulders.
    d. Basis of design: Fiat MSB-2424.

2. Accessories: Drain body, 302 stainless steel, with combination dome strainer and lint basket, designed for an NPS 3 (DN 80) connection.
3. Faucet:

    a. Water connections: 0.5-inch (DN 15) NPT with chrome-plated cast brass escutcheon.
    b. Vacuum breaker spout, 3/4-inch (DN 20) male hose thread outlet, integral stops in shank, quarter turn lever handles, support arms, wall brace with adjustable rod, and pail hook.
    c. Mounting height: 36 inches (914 mm) center line to finished floor.
    d. Basis of design: Chicago 445-897SRXKCCP.

4. Mop hanger:

    a. 24 inches (610 mm) long x 3 inches (76 mm) wide, 18-gauge, 302 stainless-steel mop hanger complete with slotted matching screws for mounting.
    b. Basis of design: Fiat Products, Inc. 889-CC.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide and set mop sinks to extent and number indicated on drawings. Mop sinks shall be left in first class condition, properly adjusted, cleaned and ready for operation.

B. Provide all parts, fittings, escutcheons, and appurtenances regularly required for each fixture.

C. Provide rough-in for mop sinks.

D. Protect and cover mop sinks so they cannot be used until final work acceptance.

E. Install basins for mop sinks as recommended by manufacturer with space between basin and wall completely filled with a waterproof silicon sealant. Provide P trap.

END OF SECTION

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SECTION 22 4200.04c - PLUMBING FIXTURES – EQUIPMENT CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment connections trim, other fittings, and related components.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.

1.3 SUBMITTALS

A. Product data: For each equipment connection specified, including fixture, trim, fittings, accessories, appurtenances, supports, construction details, dimensions of components, and finishes.

B. Certification that products comply with NSF/ANSI 61.

C. Shop drawings: A schedule of proposed fixtures and trim, in the order listed in the specification.

1.4 QUALITY ASSURANCE

A. Lead free requirements:

1. Potable water system components, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

B. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they meet specified requirements and are similar to the basis of design.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following or approved equal.

1. Fixtures:

a. Guy Gray
b. IPS Corporation
c. Oatey
d. Sioux Chief

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2. Supplies, traps, and miscellaneous trim:

    a. Brass-Craft Manufacturing Co.
    b. Chicago Faucet Co.
    c. Elkay Manufacturing Co.
    d. Engineered Brass Co.
    e. McGuire Manufacturing Co.
    f. T & S Brass and Bronze Works, Inc.

2.2 REFRIGERATOR CONNECTION

A. F-5 refrigerator connection:

1. Material: 20-gauge steel with white powder-coated finish.
2. Mounting: Flush mount in partition 42 inches (1066 mm) above floor.
3. Valve:

    a. NPS 0.5 (DN 15) brass quarter turn ball supply valve.
    b. NPS 0.25 (DN 8) brass compression outlet.

4. Integral ASSE 1010 water hammer arrestor.
5. Box inside dimensions: 4.75 inches x 4.125 inches (121 mm x 105 mm).
6. Trim cover dimensions: 7 inches x 7 inches (178 mm x 178 mm).
7. Basis of design: Guy Gray.

B. Backflow preventer:

1. ASSE 1024.
2. Chrome-nickel plated cast copper silicon alloy body.
3. Maximum working pressure: 150 psi (10.3 bar).
4. Temperature range: 33 to 180 degrees F (0.5 to 82 degrees C).
5. Inlet and outlet connection is NPS 0.375 (DN 10).
6. Basis of design: Watts LF7C.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish, provide rough-in for, and set equipment connections to extent and number indicated on drawings. Equipment connections shall be left in first class condition, properly adjusted, cleaned and ready for operation.

B. Provide all parts, fittings, escutcheons, and appurtenances regularly required for each fixture.

C. Protect and cover fixtures so they cannot be used until final work acceptance.

3.2 SUPPLY OR DRAIN BOX INSTALLATION - GENERAL

A. Install boxes in accordance with the manufacturer’s recommendations and coordinated with equipment locations.

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B. Provide a listed installation where boxes are installed in rated walls. Provide supplemental framing, drywall, and sealants as required by the wall's listing.

3.3 INSTALLATION OF REFRIGERATOR CONNECTION

A. Water supply:

1. Provide copper tubing from supply box valve to refrigerator with backflow preventer in line.
2. Provide all required fittings and transitions.
3. Provide transitions and connections to any Owner provided water filters.

END OF SECTION

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SECTION 22 4200.05a - PLUMBING FIXTURES – SINKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sinks and trim, faucets, other fittings, and related components.

1.2 RELATED SECTIONS

A. Piping:

1. Domestic water piping: Section 22 1116.
2. Sanitary waste and vent piping: Section 22 1316.

1.3 SUBMITTALS

A. Product data: For each sink specified, including fixture, trim, fittings, accessories, appurtenances, supports, construction details, dimensions of components, and finishes.

B. Certification that products comply with NSF/ANSI 61.

C. Shop drawings: A schedule of proposed fixtures and trim, in the order listed in the specification.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 22 0500, Common Work Results for Plumbing.

B. Lead free requirements:

1. Potable water system components, including pipe and joining materials, shall comply with NSF/ANSI 61 and with requirements for “lead-free” plumbing as defined by state laws and U.S. Safe Drinking Act.
2. Acceptance product marking: NSF®-61.

C. Fixtures shall be of the best commercial grade of their respective kinds, free from flaws, cracks, craze or other imperfections, complete with fittings and connections. Residential grade fixtures shall not be acceptable. Fixtures manufactured by acceptable manufacturers are acceptable provided they meet specified requirements and are similar to the basis of design.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or scheduled products, or comparable product by one of the following or approved equal.

1. Fixtures:

a. Acorn Engineering Co.
b. American Standard
c. Bradley Corporation

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d. Commercial Enameling Co.
e. Eljer
f. Elkay Manufacturing Co.
g. Just Co.
h. Kohler Co.
i. Zurn Plumbing Products

2. Faucets:

a. Chicago Faucet Co.
b. Speakman Co.
c. T & S Brass and Bronze Works, Inc.
d. Kohler

3. Supplies, traps, and miscellaneous trim:

a. Acorn Engineering Co.
b. Brass-Craft Manufacturing Co.
c. Chicago Faucet Co.
d. Elkay Manufacturing Co.
e. Engineered Brass Co.
f. McGuire Manufacturing Co.
g. T & S Brass and Bronze Works, Inc.

2.2 KITCHENETTE SINKS

A. F-4 sink, kitchen:

1. Fixture:

a. Material: Stainless steel, 18-gauge.
b. Sink type: Single-compartment, undermount
c. Dimensions: 25 inches x 22 inches x 6-5/16 inches (635 mm x 559 mm x 160 mm) (width x depth x height).
d. Mounting: Undermount in countertop specified in Division 12.
e. Basis of design: Kohler K-3894.

2. Faucet:

a. Chrome-plated cast brass, combination hot and cold water faucet, deck-mounted, 8-inch (203-mm) swing spout with non-aerating spray outlet, single-hole faucet centers, single handle for temperature and flow control, integral pull-down sprayhead.
b. Mounting: In countertop specified in Division 12.
c. Water connections: 0.375-inch compression.
d. Water consumption: 1.5 GPM.
e. Basis of design: Kohler “Crue” K-22972 Pull-down kitchen sink faucet with three-function sprayhead.

3. Supply nipples:

a. Two brass nipples, triple-plated polished chrome of length and size as required.
b. Basis of design: Brass-Craft.

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4. Supply stops and risers:

    a. Chrome-plated angle ball valve, 0.5-inch NPT inlet, 0.375-inch OD female compression outlet, loose key handle, and slip wall flange.
    b. Chrome-plated copper 12" bullnose flexible supply riser, loose key handle
    c. Basis of design: Chicago STB-21-11-AB or STB-21-12-AB for length required.

5. Drain:

    a. Crumb cup strainer with 1.5-inch x 4-inch tailpiece.
    b. Basis of design: Elkay LK-35-B.

6. P trap and waste nipple:

    a. Chrome-plated brass body, 1.5-inch x 1.5-inch IPS outlet, swivel type, with cleanout.
    b. Chrome-plated cast brass 1.5-inch IPS waste nipple with cast brass chrome-plated set screw escutcheon.
    c. Basis of design: McGuire 8089 with McGuire waste nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Furnish, provide rough-in for, and set sinks to extent and number indicated on drawings. Sinks shall be left in first class condition, properly adjusted, cleaned and ready for operation.

B. Provide all parts, fittings, escutcheons, and appurtenances regularly required for each fixture.

C. Protect and cover fixtures so they cannot be used until final work acceptance.

END OF SECTION

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SECTION 23 0100 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Start-up and service for refrigeration equipment.

B. Refrigeration equipment warranty.

1.2 RELATED SECTIONS

A. Operating manuals: Division 01 and Section 23 0101.

B. General project warranty: General Conditions.

C. Refrigeration system start-up and service:

1. Ductless split-system units: Section 23 8127.

1.3 SUBMITTALS

A. Shop drawings:

1. Refrigeration system start-up and service organization: Name and address of proposed agency.
2. Proposed service or test agreement of each type included in the project, showing conformance to specifications. Include detailed list of work to be performed at each visit.

B. Certifications:

1. Qualifications of refrigeration installation and service agency.
2. Each installation and service organization: A list of at least ten projects, similar to this project in type, size, and components, which have been operating satisfactorily for at least two heating and cooling seasons.
3. Include evidence of each requirement specified in the article below for qualifications of each service and maintenance agency.
4. Provide a letter from each manufacturer or equipment requiring start-up, service, or warranty, on the manufacturer’s letterhead, indicating that the firm who will perform the work has been trained by the manufacturer and is acceptable to the manufacturer.

C. Field test reports:

1. Start-up reports for each piece of refrigeration equipment.

1.4 QUALITY ASSURANCE

A. Perform work in accordance with the plumbing, electrical, building, fire and safety codes of the state, county or city in which the work is performed.

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1.5 QUALIFICATIONS OF EACH SERVICE AND MAINTENANCE AGENCY

A. Regularly engaged in performing installation, start-up, and service work for equipment and systems of the types included in this project.

B. Located in the Baltimore/Washington, DC, metropolitan area.

C. Staff factory-trained by the manufacturer of the equipment included in this project.

D. Provides emergency service on call 24 hours a day.

E. Maintains an adequate stock of manufacturer's approved parts to service this equipment.

F. Has service contracts available, which can meet requirements specified for the equipment and systems of this project.

1.6 REFRIGERATION EQUIPMENT START-UP, SERVICE, AND WARRANTY

A. Provide start-up, service, and emergency service for each refrigeration system installed as part of the work, by an agency qualified as described above.

B. Start-up:

1. Check all parts of the installation applicable to each refrigeration circuit. Verify that piping, wiring, controls, and appurtenances are in accordance with the recommendations of the equipment manufacturer.
2. Verify there is no physical damage to the equipment.
3. Verify that refrigerant charge is sufficient.
4. Leak test the refrigerant circuit with approved halide or electronic leak detector.
5. Check oil level where applicable and visually check for leaks.
6. Check and adjust operating temperature set points.
7. Check and adjust refrigerant circuit safety devices and set points.
8. Operate for run in period according to the manufacturer's written instructions.
9. Provide a start-up report including the following:

    a. Overall system condition.
    b. Verification that the system has been leak tested.
    c. Verification that the system has been checked for oil leaks.
    d. Record control set points.
    e. Record operating refrigerant pressures and temperatures.
    f. Record expansion valve super heat where applicable.
    g. Record temperatures of fluids entering and leaving evaporator and condenser.
    h. Record proper operation of safety and protection devices.
    i. Record starting and running amperage.
    j. Record power voltage and control voltage.

C. Service:

1. Period of service:

    a. Provide service during the correction period.

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2. Frequency of service:

    a. Provide service near the beginning and the end of each cooling season.

3. Type of service: In addition to the repair service required during the correction period, provide maintenance service including the following for each piece of refrigeration equipment:

    a. All refrigeration equipment:

        (1) Inspect complete refrigerant circuit for refrigerant leaks with approved halide or electronic leak detector. Correct as necessary.
        (2) Replace defective parts and refrigerant at no addition to the contract sum.
        (3) Tighten nuts, screws, and terminal wiring connections as required.
        (4) Clean evaporators and condensers as needed.
        (5) Lubricate moving parts as needed.
        (6) Check for blockage of condensate elimination system and correct as required.
        (7) Check and record unit starting and running amperage.
        (8) Check and record power voltage and control voltage.
        (9) Check and record operating temperatures and pressure. (Pressure not required on hermetic circuits.)
        (10) Check and record thermostatic expansion valve super heat.
        (11) Check temperature and pressure controls and adjust as required.
        (12) Check limit switches and safety controls and adjust as required.
        (13) Provide the Owner with a report describing the work performed and reporting measurements and results of tests.

D. Emergency service: Supply emergency service promptly upon call during correction period with no extra charge to Owner.

E. Warranty:

1. Provide a manufacturer’s warranty to cover replacement of all refrigeration system parts and components for no less than the time of the general project correction period, starting from the date of substantial completion, executed to the Owner.
2. Provide compressors with an additional extended manufacturer’s parts-only warranty for a total of five years, including the general correction period, executed to the Owner, unless a longer duration is specified elsewhere.
3. Provide refrigerant circuits of self-contained units with an additional extended parts-only warranty for a total of five years, including the general correction period.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION

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SECTION 23 0101 - HVAC GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for all HVAC work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 23.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, including all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. HVAC work of this project includes, as a brief general description, the following:

1. HVAC demolition and new work indicated on drawings

F. See Division 01 for requirements related limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, the following options apply to Division 23 specifications.

1. Products specified by reference standards or by description only: Any product meeting those standards or description.
2. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

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a. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
b. Where specification permits “equal” products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

3. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

B. Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in the article “Substitutions,” below for substitutions.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 23 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacture. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

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C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install.

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent before starting any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate HVAC work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all piping, ductwork, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

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E. The Contractors' assistants shall include a competent foreman, who shall be on the premises at all times to check, lay out, coordinate and superintend the installation of work. The foreman shall establish all grades and lines relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of shop drawings and product data for every item of equipment. Shop drawings or product data will not be considered until manufacturers' lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.
4. All exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identification specification paragraph.
5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

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1.10 SPECIALIST

A. The term “Specialist” as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer’s direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

    a. Contract drawings.
    b. Specifications.
    c. Addenda.
    d. Change orders and other modifications to the Contract.
    e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

    a. Manufacturer’s name and product model and number.
    b. Product options, substitutions, or alternates utilized.
    c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

    a. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
    b. Field changes of dimension and detail.
    c. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Lubrication charts: Prepare lubrication charts for each piece of mechanical equipment that requires grease or oil.

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a. Include the following:

1) Types of lubricants required.
2) Locations of lubrication points.
3) Frequency of lubrication.

b. Provide one extra set of lubrication charts mounted in plastic covers, besides those required in Operating and Maintenance Manuals.

3. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
4. Prepare binder covers with printed title “OPERATION AND MAINTENANCE INSTRUCTIONS,” and title of project. Print on spine of binder “O & M INSTRUCTIONS.” If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
5. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
6. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
7. Part 1: Directory, listing names, addresses, and telephone numbers of mechanical engineers; Contractor; mechanical subcontractors; and major mechanical equipment suppliers.
8. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. Significant design criteria, including pump and fan curves and similar performance charts.
b. List of equipment, including operating weight of each piece.
c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
g. Valve charts, including locations of flow fittings.

9. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Air balance reports.
c. Photocopies of certificates.
d. Photocopies of warranties and guarantees.
e. Test reports: Copies of the results of all tests required under all sections of specifications.

10. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
11. Submit final volumes revised, within ten days after final inspection.

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1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The plumbing, mechanical, electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA).
4. International Energy Conservation, Fire, Fuel Gas, Mechanical, and Plumbing Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply. Products shall be certified by manufacturers to meet the requirements of referenced standards.

1. Federal Specifications (FS)
2. Military Specification (MS)
3. Military Standards (Mil. Std.)
4. Air Conditioning, Heating, and Refrigeration Institute (AHRI)
5. Air Movement and Control Association (AMCA)
6. Associated Air Balance Council (AABC)
7. American Association State Highway and Transportation Officials (AASHTO)
8. American National Standards Institute (ANSI)
9. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
10. ASME International (ASME)
11. American Society for Testing and Materials (ASTM)
12. American Society of Sanitary Engineering (ASSE)
13. American Water Works Association (AWWA)
14. International Code Council (ICC)
15. Manufacturer’s Standardization Society of the Valve and Fittings Industry Inc. (MSS)
16. National Electrical Code, NFPA 70 (NEC)
17. National Electrical Manufacturer’s Association (NEMA)
18. National Fire Protection Association (NFPA)
19. National Fuel Gas Code, NFPA 54
20. National Sanitary Foundation (NSF)
21. National Standard Plumbing Code (NSPC)
22. The Occupational Safety and Health Act (OSHA)
23. Piping and Drainage Institute (PDI)
24. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA)
25. Underwriters Laboratory Inc. (UL)

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26. Maryland Occupational Safety and Health Act (MOSHA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Maintain the area and return it to its original condition at project completion.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract Sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer’s recommended temperatures.

E. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

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1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in “Cutting and Patching” below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 WARRANTY

A. All work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties specified in individual sections.
B. During the correction period, the Contractor shall begin correcting any work found to be not in accordance with the requirements of the Contract Documents within 4-hours of receiving written notice from the Owner. Provide detailed schedule for completion of work within 24-hours of receiving written notice from the Owner and revise schedule based on any Owner comments generated. Except as otherwise required in General Conditions and Division 01, the correction period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner

C. When use of the permanent equipment has been permitted for temporary heating or ventilation of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers’ standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

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B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of pipes, ducts and appurtenances. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

END OF SECTION

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SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to more than one section of Division 23.

B. Piping installation materials.

C. Identification devices and materials.

D. Backboards for piping specialties.

E. Treated wood lumber.

F. Equipment installation.

G. Cleaning and painting.

H. Operating instructions.

I. Piping tests.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 23 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 23 0101.

C. Hangers and Supports for HVAC Piping and Equipment: Section 23 0529.

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME Boiler and Pressure Vessel Code (BPVC).
2. ASME A 13.1: Scheme for the Identification of Piping Systems.
3. ASME B1.20.1: Pipe Threads, General Purpose, Inch.
4. ASME B 31.1: Power Piping.
5. ASME B 31.9: Building Services Piping.

B. American Society of Testing and Materials

1. ASTM A 234: Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
2. ASTM B 32: Standard Specification for Solder Metal
3. ASTM B 88: Standard Specification for Seamless Copper Water Tube
4. ASTM B 813: Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
5. ASTM D 635: Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position

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6. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials
7. ASTM E 548: Standard Guide for General Criteria Used for Evaluating Laboratory Competence

C. American Welding Society

1. AWS D1.1: Structural Welding - Steel
2. AWS A5.8: Specification for Filler Metals for Brazing and Braze Welding.
3. AWS D10.9: Specification for Qualification of Welding Procedures and Welders for Piping and Tubing
4. AWS D10.12: Guide for Welding Mild Steel Pipe.
5. AWS QC1: Specification for AWS Certification of Welding Inspectors

D. NFPA 70: National Electric Code

1.4 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

C. DN: Dimension Nominale, nominal pipe size in millimeters, in accordance with the metric system for construction, Systeme Internationale (SI).

D. NPS: Nominal pipe size in inches, in accordance with standard U.S. designations for manufactured pipe. Pipe sizes do not change when projects are designed and built in metric units; each size has a consistent name (nominal dimension) in each system.

1.5 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed based on the use of the particular manufacturer’s products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that render their use impractical, or cause functional fit, access, or connection problems.

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1.6 SUBMITTALS

A. Shop drawings:

1. Schedule of welding and brazing procedures proposed for each piping system in the project.

B. Certifications: Proof of operator and testing agency personnel qualifications as required for welding and brazing in the article "Quality Assurance" below.

C. Test reports: Field test results for each piping system as specified in Part 3 below.

D. Valve charts:

1. Furnish valve charts typed on 8.5 by 11-inch (216 by 279-mm) bond paper, showing locations of all manual and automatic control valves, and flow meters. Include:

a. Number
b. Location
c. Service
d. Function
e. Area served

2. Valve numbering system shall be approved by the Owner prior to final submittal. Place one copy of approved chart in a plastic envelope and mount on wall where directed. Provide another copy for each of the Operating and Maintenance Manuals.

1.7 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the plumbing, mechanical, electrical, building, fire, health and safety, and other applicable codes and regulations of the state, county or city in which the work is performed.

B. Welding procedures and operator qualifications for structural welding: AWS D1.1, Structural Welding Code Steel, electric arc process.

C. Welding, brazing, and soldering procedures and operator qualifications for building systems piping:

1. AWS D10.9, Qualification of Welding Procedures and Welders for Piping and Tubing.
2. ASME B31.9, Building Services Piping.
3. Copper Development Association "Copper Tube Handbook."

D. Qualifications of independent testing laboratory personnel:

1. Welding inspectors: AWS QC1, Certification of Welding Inspectors.

E. UL label:

1. Electrical control panels, equipment, materials and devices provided or installed as work of Division 23 shall be UL listed and shall bear a UL label.
2. Equipment, including custom assemblies, shall be listed and labeled as an assembly.

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3. If a UL label is not available, the item shall be tested and labeled by a qualified nationally recognized testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70 (NEC).
4. Provide testing, if required, without addition to the contract sum.

F. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

G. Products shall contain no urea-formaldehyde content.

PART 2 - PRODUCTS

2.1 GENERAL

A. Piping techniques, testing, identification, painting, and operating instructions specified in this section apply to products specified in other sections of Division 23.

B. Equipment that uses or processes date and time data to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 PIPING INSTALLATION MATERIALS

A. Weldolets and thredolets: Fittings designed for installing branches on piping, with either welded or threaded connection to branch; conforming to ASTM A 234.

B. Soldering materials:

1. Solder: Free of lead, antimony, and zinc and meeting the requirements of ASTM B 32. No solder containing lead is permitted.

a. Tin 95.5 percent, copper 4 percent, and silver 0.5 percent.

(1) Equal to “Silvabrite 100” manufactured by Engelhard Corporation.

b. Tin, copper, bismuth, and silver.

(1) Equal to "Oatey Silver" manufactured by Oatey.

2. Flux:

a. Meeting the requirements of ASTM B 813 and NSF 61 certified.
b. Equal to Oatey H-20^{95}.

C. Brazing filler metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel. Alloy shall have a melting point greater than 1000 degrees F (540 degrees C).

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

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E. Threaded pipe joint materials:

1. Pipe joint compound:

a. Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.

2. Pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, "Teflon."

2.3 IDENTIFICATION DEVICES AND MATERIALS

A. Stenciling materials:

1. Stencils: Manufactured standard stencils prepared for required applications, conforming to ASME A 13.1 for color and size of legend letters, including arrows showing direction of flow.
2. Paint: Exterior type enamel, colors conforming to ASME A 13.1, or black.

B. Equipment identification tags:

1. Laminated plastic with adhesive back, white core and black outer layers, which, when engraved, will produce white letters and numerals on a black background.
2. Tags installed on curved surfaces shall be aluminum or brass.

C. Valve tags: Brass, 1.5 inch (40 mm) in diameter with black-filled numbers not less than 0.25 inch (6 mm) high, complete with brass attachment chains.

D. Ceiling identification tags: Laminated plastic with adhesive back, engraved black letters on white background, minimum 0.5 inch (15 mm) wide and length as required for 0.375 inch (10 mm) high letters for name of concealed device and number.

2.4 BACKBOARDS FOR PIPING SPECIALTIES

A. Backboards: Marine plywood: BS-1080, Veneer Grade A/B, moisture-resistant, spruce-pine-fir multiple ply, 5-ply minimum, pressure-treated construction, 0.563-inch (14-mm) thick minimum

B. Supports: Fiber reinforced plastic (FRP) composite structural shapes: ASTM D 635 and E 84, Pultruded FRP structural shapes, non-corrosive, flame retardant, thermosetting polyester resin, composite factory-fabricated shapes for assorted assemblies and field erection.

1. Ultimate tensile strength: 30,000 psi (207 MPa).
2. Modulus of elasticity: 2.8×10^6 psi (19,300 MPa).
3. Specific gravity: 1.6 to 1.75.
4. Density: 0.062 to 0.070 pounds/cubic inch (1.72 to 1.94 grams/cubic centimeter).
5. Flame spread: ASTM E 84 Class A, 25 maximum.
6. Color: Yellow.
7. Shapes and sizes as required to support the load, and in accordance with minimum sizes indicated on the drawings
8. Acceptable manufacturers:

a. Bedford Reinforce Plastics Company
b. Composites USA, Inc.
c. Liberty Pultrusions, Inc.
d. Strongwell Corporation

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e. Structural Fiberglass, Inc.

C. Fasteners: Corrosion-resistant and suitable for secure anchorage into wall behind backboards.

2.5 TREATED WOOD LUMBER

A. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by ALSC Board of Review.

PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic and do not indicate all fittings or offsets in pipe and ductwork, all access panels, or all specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No pipe or duct shall be run below the head of a window or door.

D. Equipment, ducts, and pipes installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

F. Provide equipment and installations compliant with NFPA 70.

3.2 EQUIPMENT INSTALLATION

A. Prepare for installation:

1. Coordinate work to assure that any required recesses for equipment are correct.
2. Examine areas and conditions where equipment will be installed for rough in locations, compliance with installation requirements and tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.
3. Visually check equipment. Replace any damaged components prior to installation.
4. Remove temporary devices used for equipment transport.
5. Assemble equipment that is not assembled in the factory.

B. Install equipment:

1. Set equipment plumb and level.
2. Install such that labels and safety instructions are clearly visible.

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3. Drawings show the general arrangement of piping, ductwork, conduit and other elements. Coordinate elements to allow access doors to open fully, allow access to removable access panels or casing panels, maintain clearances in front of control panels and electrical components required by the NFPA 70, and maintain the manufacturer's recommended service clearances.
4. Install components inside of equipment enclosures such that they are serviceable when access panels are removed.
5. Extend grease fittings to accessible locations.
6. Install duct and piping hangers and supports so that duct and piping live and dead loads and stresses from movement will not be transmitted to connected equipment. Support equipment independently from piping and ductwork.
7. Provide connection flanges for ductwork to equipment in a manner that maintains the equipment's structural integrity.
8. Support:

    a. Floor-mounted equipment:

        (1) Securely fasten in place with connections to wall and floor.
        (2) Provide supplemental structure as required.
        (3) Provide a concrete equipment foundation where indicated. Comply with requirements of Section 23 0529.

    b. Suspended equipment: Securely hang from structure above. Comply with requirements of Section 23 0529. Provide 0.5 inch (12.5 mm) minimum diameter threaded rods.
    c. Wall-mounted equipment: Securely fasten to wall with metal fasteners, anchors, brackets, sleeves or other devices recommended by the equipment manufacturer. Provide blocking where required.
    d. Structural frame-mounted equipment: Securely fasten to structural frame.
    e. Equipment mounted at grade: Securely fasten to structural foundation. See drawings for details of construction of structural foundation.
    f. Coordinate supports so they do not interfere with access to other equipment that requires service.
    g. Provide vibration isolation where required.

9. Snugly fit equipment to architectural finishes in finished spaces unless otherwise indicated.
10. Ensure that equipment, coils, and drain pans properly drain. Test drain pans.
11. Connect associated ducts, piping, power, controls, and other associated systems.
12. Conceal associated ducts, piping and electrical connections in finished spaces unless otherwise indicated.
13. In rooms without ceilings or other finishes to conceal ducts, piping, and electrical connections, arrange these elements to provide a neat and finished appearance.
14. Install dielectric pipe fittings at water coil connections where dissimilar metals are joined.
15. Coordinate with installation of building automation system controls.
16. Install equipment with a safety listing or certification as required to comply with their listing or certification requirements.

C. Install and wire items furnished with equipment:

1. Install control devices, accessories, and appurtenances furnished loose with equipment.
2. Wire devices furnished with equipment that are not factory-wired.

    a. Perform the work as required in Section 23 0901.
    b. Comply with requirements in Section 23 0902.

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c. Comply with requirements in Division 26.
d. Comply with requirements in NFPA 70.
e. Comply with the manufacturer's installation requirements.

D. Prepare equipment for use:

1. Clean equipment and repair any damaged finishes. Remove paint splatters, dirt, and debris. Repair damaged finish to match original finish.
2. Adjust tension on belts.
3. Adjust discharge air devices.
4. Lubricate equipment.
5. Adjust equipment packaged controls to put the system into operation as intended.
6. Start up and operate equipment in accordance with manufacturer's instructions.
7. Verify smooth rotation and proper direction of rotation of motors.
8. Test controls, unit operation, and safety devices. Replace any failed components and retest.
9. Provide equipment identification.

3.3 PIPE INSTALLATION

A. Install piping in concealed locations, unless otherwise indicated or unless the piping is located in equipment rooms and service areas.

B. Install pipe exposed to view parallel to building lines and as close to walls, columns, and ceilings as may be practical, maintaining proper clearances for access at all parts requiring servicing. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install pipe a sufficient distance from other work to permit a clearance of not less than 0.5 inch (15 mm) between its finished covering and adjacent work.

D. Install piping free of sags and bends.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping and valves in locations to permit valve servicing.

G. Remove burrs resulting from cutting pipe or from any other operation.

H. Thoroughly clean pipe and fittings before they are installed, and keep them clean until the acceptance of the completed work. Cap or plug the ends of the lines so as to prevent earth and other debris from entering during construction.

I. Provide for expansion and contraction of piping and connections so that no breakage or excessive strain will occur. Provide anchors and guides of approved design where shown on drawings and where necessary to allow for proper expansion and contraction. At the time of installation, expansion loops shall be cold sprung to one-half of the calculated expansion.

J. Pipe connection flexibility:

1. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
2. Connect risers and branch connections to equipment with at least four pipe fittings, including tee in riser.

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3. Connect mains and branch connections to equipment with at least four pipe fittings, including tee in main.
4. Connections shall be arranged so that movement in piping due to expansion and contraction will not transmit excessive force to equipment.

K. Install unions or flanges in the piping at each item of equipment, control valve, and appliance, so as to provide easy removal of the equipment, valve, or appliance, and to provide for easy removal of coils.

L. Pitch hydronic piping so that air in the system can be properly vented. Provide shutoff valves where necessary to isolate parts of system for repairs without draining the entire system.

M. Interface with other products:

1. Where pipe is provided through walls, provide finished, permanent, waterproof installation complete with inserts, sleeves, supports or hangers, seals, and other appurtenances as required. Do not pierce, cut, or notch any footing or other structural member.
2. Waterproofing and dampproofing of the building shall be unharmed by the installation of the work. Where pipe has to pierce waterproofing or dampproofing, including outside walls, the penetration shall be made watertight. Waterproofing damaged or destroyed shall be repaired or replaced with new waterproofing.

N. Flanges shall be welded neck or slip-on pattern of class to suit the valves or equipment connections. Flanges shall have machine bolts with hex nuts and washers.

O. Threaded connections:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
2. Cut threads full and clean.
3. Apply specified pipe joint compound or tape on male threads only.
4. Where piping is installed in crawl spaces and tunnels, cover exposed threads with rust-inhibitive paint. Apply after joints have been assembled and tested.

P. Welded Joints:

1. Construct joints according to AWS D10.12, using qualified processes and welding operators.
2. Bevel plain ends of steel pipe.

Q. Copper tubing installation:

1. Cut pipe with a tubing cutter or fine-tooth saw. Cuts made with a saw shall be true and square, and the end shall be filed smooth with a fine-tooth file. Remove all marks and burrs with sandpaper.
2. Solder joints for copper tubing: Clean ends of tubing and inside of fitting ends thoroughly with emery cloth before applying flux.
3. Provide dielectric fittings between copper and steel piping to prevent electrolysis.
4. Follow the techniques for soldering and brazing pipe, fittings, and valves as recommended by the manufacturer.
5. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

3.4 IDENTIFICATION

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A. General: Do not apply identification until insulation and finish painting work is complete.

B. Equipment:

1. Stencil equipment with minimum two-inch (50-mm) -high letters or provide identification tags. Clearly indicate equipment designation and area served.
2. Firmly fasten each identification tag to its appropriate piece of equipment with drive screws, sheet metal screws, or rivets. Do not interfere with operation of, or damage the item being marked.

C. Piping:

1. Mark by stenciling.
2. Mark to identify service with arrows showing direction of flow. Apply markings near building walls where pipes enter or leave an accessible space and in intermediate locations so that markings are no more than 30 feet (9 m) apart. They shall be readily visible to a person standing on the floor.
3. Fully identify all piping installed as work of the project.
4. Mark pipe with letters of height and with colors as required by OSHA and conforming to ASME A 13.1.
5. Identify every thermometer, gauge, and control device.

D. Valves:

1. Provide valve tags for all valves except shutoff valves on individual pieces of equipment where the equipment is immediately adjacent and their function is obvious. Numbers shall correspond to those shown on the Valve Chart. Attach tags to valve shaft.
2. Provide ceiling identification tags where valves are above a ceiling. Number shall correspond to tag number.

E. Ductwork: Stencil ductwork after insulation is applied, if required, with minimum two-inch (50-mm)-high letters, clearly identifying service (supply, return, exhaust) and showing direction of flow with arrows. Mark ducts near building walls where they enter or leave a space, and at intervals of not more than 30 feet (9 m). Identification shall be visible to a person standing on the floor.

F. Ceiling identification tags: Provide on access doors or, in suspended ceilings, on the ceiling support grid near the item identified.

1. Valves: Identify with the same number shown on the valve tag.
2. Terminal units above ceilings: Identify with unit description and number.

3.5 CLEANING AND PAINTING

A. Cleaning: Clean all piping and equipment. Where items are to be painted, clean ready for painting.

B. Painting: Coordinate painting with requirements of Division 09. Paint the items identified below to be painted. Use paint materials and systems specified in Division 09.

C. Items to be painted:

1. Items furnished with manufacturer’s prime coat.
2. Mechanical rooms (including but not limited to boiler, chiller, and air-handling unit rooms):

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a. Insulation and uninsulated steel: Piping, pumps, tanks, and vessels.
b. Hangers and supports.

3. Piping and ductwork exposed in finished spaces, insulated and uninsulated.
4. Inside ducts behind registers, grilles, and diffusers.

D. Items not to be painted: Copper, stainless steel, and equipment furnished with manufacturer's finish.

E. Paint systems in mechanical rooms: Paint piping with conforming to ASME A 13.1.

1. Galvanized steel: One coat of primer recommended for galvanized surfaces and one coat of glossy alkyd enamel.
2. Ferrous metal: One coat of primer recommended for ferrous metal and one coat of glossy alkyd enamel.
3. Items protected with rust-inhibitive primer: Finish coat of compatible glossy enamel.

F. Paint systems for exposed piping and ductwork: Primer compatible with the substrate, whether steel, galvanized steel, insulation jacket, or other material; one coat or two, if required to cover, of paint to match adjacent surfaces in color and texture.

G. Painting inside ducts behind registers, grilles, and diffusers: Matte black, compatible with substrate and suitable for the temperatures at which the duct will operate, extending from the duct opening to a depth such that no unpainted surface will be visible to a person standing on the floor or adjacent balconies.

3.6 BACKBOARDS FOR PIPING SPECIALTIES

A. Provide wall-mounted backboards, sizes and locations as indicated on the drawings, for mounting piping specialties. Assembly shall consist of plywood board, FRP supports, and fasteners.

3.7 TREATED WOOD LUMBER

A. Provide wood-preservative-treated lumber where wood members are required as detailed on the drawings and in the following applications:

1. Cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
2. Sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
3. Framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.

3.8 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish factory-trained/equipment vendor-employed or factory-trained/factory-employed service technicians with the skills and labor to start-up and operate all mechanical systems and equipment. Provide the following services.

1. Start up and operate all systems and equipment for one 8-hour day.
2. Training:

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a. Provide at least 8 hours of training time, consisting of two periods of four consecutive hours, during a period of not less than 90 days.
b. Maintenance training:

(1) Train the Owner's designated personnel in the manufacturer's recommended preventive maintenance procedures for each unique type of equipment that requires periodic maintenance.
(2) Training shall include, but not be limited to filter changes, belt changes, lubrication, and adjustment.
(3) Engage the Owner's designated personnel in hands-on training activities that demonstrate required maintenance and service.

c. Operation training:

(1) Train the Owner's personnel in the operation of equipment and systems.
(2) Training shall include, but not be limited to demonstration of packaged controls, modes of operation, and observation of equipment operating parameters and self-diagnostic capabilities.
(3) Provide troubleshooting opportunities during each training session.

d. Make the Operating and Maintenance Manual available at the time of the instructions, for use by instructors and Owner personnel.
e. Record training:

(1) Furnish a qualified videographer to record training and demonstration activities.
(2) Record each training and demonstration activity separately.
(3) Record instruction, demonstrations, diagrams, and visual aids as necessary.
(4) Record each session in 720p DVD video and audio format at a minimum.
(5) Provide audio pickup sufficient for future use as a teaching and demonstration tool. Use microphones where necessary. Repeat all training where audio is unintelligible.
(6) Audibly describe training and demonstration activities during recordings. Indicate floor, room number, and vantage point as part of the narration.
(7) Provide two sets of DVDs within seven days of each training activity.

3. Schedule start-up and operation as well as training at times agreed upon by the Owner and the Architect.

a. Submit training itinerary to the Owner a minimum of two-weeks prior to the anticipated date of performing the first scheduled activity.
b. Provide a proposed schedule similar in format to the sample included below to coordinate the training effort.
c. Revise the schedule based on comments received from the Owner and resubmit a final copy for record.

Item	Demonstrating Organization	Date	Start Time	End Time
Start-up and Operation Day				
Equipment Type #1 Training				
Equipment Type #2 Training				
Equipment Type #3 Training				
Etc.				

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3.9 PIPING TESTS

A. Refrigerant pipe testing: Test as specified in Section 23 2300.

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SECTION 23 0502 - SLEEVES AND PLATES FOR HVAC PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sleeves.

B. Sealing materials.

C. Escutcheon plates.

D. Mechanical penetration seals.

1.2 SUBMITTALS

A. Product data:

1. Sleeves.
2. Sealing materials.
3. Escutcheon plates.
4. Mechanical penetration seals.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Sleeves without water stops:

1. Steel sleeves: Schedule 40 black steel pipe, ASTM A 53.
2. Copper sleeves: Type L, ASTM B 88 hard drawn.

B. Sleeves with water stops:

1. Cast-iron sleeves with water stops: Extra heavy, equal to product of U.S. Pipe Co. with water stop and ends as shown on the drawings.

2.2 SEALING MATERIALS

A. Waterproof sealant:

1. Bare and insulated pipes carrying fluids 150 degrees F (65 degrees C) and below:

a. High-performance, moisture cured, 1-component, polyurethane-based, non-sag, elastomeric sealant. Use a primer for applications required by the manufacturer.
b. Basis of design: Sika Corporation “Sikaflex - Ia.”

2. Bare and insulated piping carrying fluids 151 degrees F (66 degrees C) and above:

a. One-part RTV silicone, neutral-cured, architectural grade sealant. Use a primer for applications required by the manufacturer.
b. Basis of design: Dow Corning Corporation “790 Silicone.”

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B. Grout: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout, 5000 psi (34.5 MPa), 28-day compressive strength.

2.3 ESCUTCHEON PLATES

A. Floor, wall, and ceiling escutcheon plates for existing piping:

1. Stamped or cast brass with set screw, split and tabbed.
2. Finish: Chrome.

B. Floor, wall, and ceiling escutcheon plates for new piping:

1. Stamped or cast brass with set screw.
2. Finish: Chrome.

2.4 MECHANICAL PENETRATION SEALS

A. Mechanical penetration seals:

1. Seals shall be modular mechanical type, consisting of interlocking synthetic links shaped to continuously fill the annular space between the pipe and wall opening. Bolt and nut fasteners for the seals shall be stainless steel for units used in penetrations below grade.
2. Basis of design: PSI “Link-Seal Modular Seals” or Calpico Sealing Link “LINX”.

PART 3 - EXECUTION

3.1 INSTALLING SLEEVES

A. Provide sleeves for bare piping, or piping with insulation continuous through sleeve, passing through walls, partitions, beams, or slabs. Sleeves for insulated piping shall be large enough to pass piping and insulation.

B. Sleeve materials:

1. Penetrations in non-fire-rated interior construction:

a. Provide steel sleeves for penetrations of steel, cast iron, and insulated piping.
b. Provide copper sleeves for penetrations of uninsulated copper tubing and piping.

2. Penetrations in fire-rated construction:

a. Provide sleeves that are acceptable components of through-penetration firestop assemblies specified in Division 07.
b. Where acceptable for floor penetration listing, provide sleeve projections above floor slabs in compliance with requirements of this section.
c. Where pre-manufactured cast in place or drop in fire rated sleeves are used in floors, provide the manufacturer’s water dam accessories to achieve compliance.

3. Penetrations in exterior walls and foundations, masonry or concrete:

a. Provide cast iron sleeves with water stops in new cast concrete walls.
b. A core drill may be provided in cast concrete walls in lieu of a sleeve.

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c. Provide steel sleeves in masonry walls.

C. Sleeve projection:

1. Sleeves through walls and partitions: Flush with finished surfaces.
2. Sleeves through floors:

a. Typical floors: Extend 0.375 inch (10 mm) above finished floor.
b. Mechanical or equipment room floors: Extend one inch (25 mm) above finished floor.
c. Finish neat and level.
d. Provide anchor clips to prevent sleeves from being loosened and knocked down.

3.2 INSTALLING SEALING MATERIALS

A. Penetrations in non-fire-rated interior construction:

1. Seal exterior of sleeve to wall or floor being penetrated:

a. Provide grout where sleeves penetrate concrete or masonry.
b. Provide waterproof sealant or wall construction materials where sleeves penetrate gypsum board walls.

2. Sealant between sleeve interior and pipe or pipe insulation:

a. Typical applications: Seal spaces between sleeves and pipe, or between sleeves and pipe insulation, with mineral wool.
b. Kitchens and food service areas: Seal space between sleeves and pipe, or between sleeves and pipe insulation, with waterproof sealant and finish even with sleeve.

B. Penetrations in fire-rated construction: Seal as required by the through-penetration firestop assembly specified in Division 07.

3.3 INSTALLING ESCUTCHEON PLATES

A. Provide plates of size and depth required to conceal sleeves where exposed piping passes through interior walls, partitions, floors, and ceilings. Secure plates in place with set screws.

3.4 INSTALLING MECHANICAL PENETRATION SEALS

A. Penetrations in exterior masonry or concrete walls and foundations:

1. Above grade: Mechanical penetration seal, at outside face of wall.

END OF SECTION

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SECTION 23 0504 - HVAC DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Demolition.

B. Disposal.

C. Protection

1.2 RELATED SECTIONS

A. Demolition: Division 02.

1.3 REFERENCES

A. ANSI/ASHRAE Standard 147: Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. Systems with refrigerants:

1. Before beginning to remove equipment containing refrigerants, recover the refrigerants.
2. Following the recommendations of ANSI/ASHRAE Standard 147 and requirements of local authorities having jurisdiction, and use approved equipment.
3. Store each refrigerant in a separate container meeting refillability requirements.
4. Deal with the refrigerant as described below:

    a. Remove refrigerants.

3.2 DEMOLITION

A. Extent and location of demolition is indicated on the drawings.

B. Comply with demolition and disposal requirements of Division 02.

C. Perform demolition operations expeditiously and in accordance with accepted practice and applicable building code provisions. Perform demolition operations neatly and with the least possible disturbance to the building.

D. If, in the course of the work, workers encounter a material they suspect to be hazardous:

1. Promptly notify the Architect in writing.

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2. Do not perform any work which would disturb the suspected material until written instructions have been received.

E. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during demolition operations.

F. Demolish, remove, demount, and disconnect inactive and obsolete piping, fittings, specialties, equipment, ductwork, controls, fixtures, insulation, and associated appurtenances.

1. Piping and ducts embedded in floors, walls, and ceilings may be abandoned in place if they do not interfere with new installations. Cut back to at least one inch (25 mm) below the finished surface.
2. Remove materials above accessible ceilings.
3. Drain and cap items to remain behind finished surfaces.
4. Patch and repair surface materials as required in Division 01 and Section 23 0101.

G. Remove supports, hangers, anchors, and fasteners associated with piping and equipment being removed.

3.3 DISPOSAL

A. Dispose of equipment and materials removed, and other waste material, as work progresses.

B. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily as a minimum.

3.4 PROTECTION

A. Protect existing materials that will remain. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Provide and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Keep standby patching materials on hand to patch and maintain protection as required. Remove protection and barriers after demolition operations are complete.

C. Ensure weathertightness at all times. Prevent the entry of dust or water.

END OF SECTION

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SECTION 23 0513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Unless otherwise specified in a particular section or required for a particular application, motors shall conform to the following requirements, whether factory-installed or field-installed.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Motor capacitors: Division 26.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Fans:

1. HVAC fans: Section 23 3400.

B. Ductless split-system units: Section 23 8127.

C. Terminal units:

1. Electric resistance terminal units: Section 23 8238.

1.4 REFERENCES

A. NEMA MG 1: Motors and Generators.

B. NEMA MG 11: Energy Management Guide for Selection and Use of Single-Phase Motors.

C. UL 508: Industrial Control Equipment.

1.5 DEFINITIONS

A. Energy efficient motor: Motor meeting the nominal and minimum efficiency levels listed for its horsepower and speed in Table 12-10 of NEMA MG 1.

B. Nominal efficiency: Efficiency as defined in Table 12-8, Efficiency Levels, in NEMA MG 1, and identified on the motor nameplate.

1.6 SUBMITTALS

A. Product data:

1. Motors and drives not provided with equipment:

a. Include nameplate data and ratings; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lugs, and coatings.
b. Electrical characteristics.
c. Include verification of compliance with ASHRAE 90.1.

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2. Motor capacitors.
3. Wiring diagrams required for the proper installation of mechanical equipment.

B. Certifications:

1. Actual motor power factor for each motor, certified test results for each motor proposed for use on this project.
2. Field test showing corrected power factor, if required.

1.7 QUALITY ASSURANCE

A. UL label: As specified in Section 23 0500, Common Work Results for HVAC.

B. Actual motor power factor shall be tested and certified by an independent testing laboratory.

C. HVAC equipment shall meet the energy performance requirements of ASHRAE 90.1.

1.8 REGULATORY REQUIREMENTS

A. Motors shall conform to the requirements of NEMA MG1 and applicable portions of the National Electric Code (NEC, NFPA 70).

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS OR APPROVED EQUAL

A. Motors:

1. A.O. Smith
2. Baldor Electric Co.
3. Marathon
4. Rockwell
5. Siemens
6. Toshiba International

B. Motor capacitors:

1. ABB Power Distribution
2. Commonwealth Sprague
3. General Electric

2.2 BASIC MOTOR REQUIREMENTS

A. Capacity: Each motor shall have sufficient capacity and torque to start, accelerate, and operate the machine it drives without exceeding the motor nameplate rating at the speed specified, or at any speed and load which may be obtained by the drive actually furnished.

B. Starting: Each automatically controlled motor shall be capable of starting as frequently as the control sequence may demand. Motors not automatically controlled shall be capable of making no fewer than 4 starts per hour.

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C. Loads: Belt-connected motors shall be equipped with shafts and bearings designed to withstand both the normal connected loads of the drive furnished, and momentary loads imposed during acceleration.

D. Ratings: Motors shall be rated for continuous duty at 100 percent of rated capacity, and temperature rise shall be based on ambient temperature of 40 degrees C.

E. Phase: Unless otherwise indicated, motors one-half horsepower and larger shall be polyphase and motors smaller than one-half horsepower shall be single-phase motors.

F. Motor construction:

1. ODP (open drip-proof) NEMA design B construction:

a. Motors for fans, air-handling units, and pumps, unless specified otherwise.
b. Motors outdoors but inside of a weather-tight enclosure, unless specified otherwise.

G. Efficiency: The term “energy efficient” is defined in the article “Definitions” in Part 1 above.

1. Single-phase motors, alternating-current fractional horsepower, rated 1/20 to 1 horsepower, 250 volts or less: NEMA MG 11, types and efficiencies selected for their applications.
2. Motors for packaged hermetic and semi-hermetic refrigeration compressors need not comply with these efficiency requirements but they shall comply with the requirements indicated for power consumption.

2.3 SINGLE-PHASE MOTORS

A. Permanent split-capacitor or split-phase type.

B. Bearings: Sealed, permanently-lubricated ball bearings.

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.

2.4 ELECTRONICALLY COMMUTATED MOTOR (ECM)

A. Brushless direct current (DC) variable speed motor supplied with alternating current, with a permanent magnet with near zero rotor losses, electronic commutation, designed for synchronous rotation, and at least 70 percent efficient at all operating speeds.

B. Bearings: Sealed, permanently-lubricated ball bearings.

C. Thermal protection: Internal thermal overload protection.

D. As a minimum, the motor shall include the following features:

1. Integrated controller / invertor that operates the wound stator and senses rotor position to electronically commutate the stator.
2. Built-in soft start and soft speed change ramps.
3. Inductors to minimize harmonic distortion and line noise.
4. Designed to overcome reverse rotation without affecting life expectancy.

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5. Motor speed shall be controllable down to 20 percent of full speed. Speed shall be controlled by either a potentiometer with manual adjustment on the motor or by a 0-10Vdc analog signal from a remote source, as required by other sections of Division 23 specifications.
6. Software for motor control shall be as indicated or described in other Division 23 specifications.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount direct-connected motors securely and in accurate alignment. The drive shall be free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.2 ADJUSTING

A. Provide additional drive and belt changes where required to meet requirements of testing and balancing specified in Section 23 0593, Testing, Adjusting and Balancing.

3.3 OPERATING INSTRUCTIONS

A. As specified in Section 23 0500, provide operating instructions.

END OF SECTION

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SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Pipe hangers and supports.

B. Trapeze pipe hangers.

C. Metal framing systems.

D. Insulation protection.

E. Fasteners.

F. Equipment foundations and supports.

1.2 RELATED SECTIONS

A. Vibration control supports: Section 23 0548.

B. HVAC Piping Insulation: Section 23 0719

1.3 REFERENCES

A. American Society of Mechanical Engineers

1. ASME B31.1: Power Piping.
2. ASME B31.9: Building Services Piping.

B. ASTM International

1. ASTM A 36: Standard Specification for Carbon Structural Steel
2. ASTM A 53: Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
3. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
4. ASTM A 563: Standard Specification for Carbon and Alloy Steel Nuts ASTM A 1064: Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
5. ASTM C 533: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
6. ASTM C 552: Standard Specification for Cellular Glass Thermal Insulation
7. ASTM F 594: Standard Specification for Stainless Steel Nuts
8. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

C. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

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D. Metal Framing Manufacturer's Association

1. MFMA-4: Metal Framing Standards Publication
2. MFMA-103: Guidelines for the Use of Metal Framing

E. Manufacturer's Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

1.4 DEFINITIONS

A. High Temperature Hot Systems: Operating temperatures 200 degrees F (93 degrees C) and above.

B. Hot Systems: Operating temperatures 120 degrees F (49 degrees C) to 200 degrees F (93 degrees C).

C. Ambient Systems: Operating temperatures 60 to 119 degrees F (16 to 48 degrees C).

D. Cold Systems: Minimum operating temperatures 59 degrees F (15 degrees C) and below.

1.5 SUBMITTALS

A. Product data:

1. Provide manufacturer's literature showing compliance with specifications for each type of hanger, framing system, support, fastener, and accessory materials.
2. Provide a schedule of piping types and sizes and associated pipe hanger types.
3. Provide a schedule of building attachment types and associated attachment hardware.
4. Provide a schedule of pipe types and sizes and proposed hanger spacing and support rod diameters.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Qualifications of welders: As specified in Section 23 0500, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Pipe hangers:

1. Anvil International
2. Carpenter and Paterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. PHP Systems/Design

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B. Metal framing systems:

1. Anvil International
2. Cooper Industries
3. Hydra-Zorb
4. PHD Manufacturing, Inc.
5. PHP Systems/Design
6. Unistrut

C. Pipe covering protection shields:

1. Anvil International
2. Carpenter and Patterson, Inc.
3. Cooper Industries
4. National Pipe Hanger Corporation
5. PHD Manufacturing, Inc.
6. Pipe Shields, Inc.
7. Rilco Manufacturing Co., Inc.

2.2 PIPE HANGERS AND SUPPORTS

A. General: Comply with requirements of MSS SP-58.

B. Hangers and clamps:

1. Typical interior applications: Galvanized steel or factory painted.
2. Exterior and corrosive applications: Stainless steel.
3. For use with uninsulated copper pipe: Copper plated.

C. Trapeze pipe hanger: MSS SP-58, Type 59, shop-fabricated or field-fabricated pipe support assembly made from structural carbon-steel shapes with pipe saddles and U-bolts to secure piping on top of hanger.

D. Supplemental materials:

1. Threaded rod: Continuously threaded.

a. Zinc-plated or galvanized carbon steel for indoor applications.
b. Stainless steel for outdoor and corrosive applications.

2. Nuts and washers: Provide the same material used for threaded rods (ASTM A 563 for steel, ASTM F 594 for stainless steel).
3. Structural carbon-steel shapes: ASTM A 36.
4. Steel pipe: ASTM A 53, Grade B, Type E (electric resistance welded), Schedule 40, black and galvanized steel.

E. Metal framing systems:

1. Description: Shop- or field-fabricated, pipe-support assembly made of channels, nuts, bolts, structural connections, accessories, fittings, and other manufactured components, including brackets and braces required to resist lateral loads.
2. Standard: Comply with MFMA-4 for factory-fabricated components for field assembly.

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3. Channels: Continuous slotted galvanized steel channel with inturned lips, width selected for applicable load criteria.
4. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Zinc-plated or galvanized carbon steel for indoor applications.
6. Stainless steel for outdoor and corrosive applications.
7. Metal framing system pipe clamps:

    a. Galvanized steel clamp pipe support with elastic stop nut, and hex head machine screw, and manufactured to connect to metal framing system channels.
    b. For insulated piping: Clamp shall have friction tape on inside of clamp surface, manufactured to connect to pipe clamp insulating insert over pipe.
    c. For uninsulated piping: Clamp shall have an integral molded thermoplastic elastomer clamping insert on inside of clamp surface, manufactured to connect to uninsulated pipe.

F. Insulation protection:

1. Pipe clamp insulating insert:

    a. Insulating insert material: Closed-cell, sponge or expanded rubber, ASTM C 534, Type I for tubing material, with integral supports constructed from non-compressive closed cell material, single piece construction with self-adhesive closure strips. Insert thickness shall match adjacent piping insulation thickness. If insulation thickness is not available, provide maximum available thickness and seal insulation vapor barrier at thickness transition.
    b. Insulation protection jacket: Aluminum or stainless steel, bonded to insulation insert.
    c. Insulating insert and jacket shall cover entire circumference of pipe.
    d. Equal to Armacell “Armafix” insulating inserts.

2.3 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer’s stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors “Red Head.”

B. Fasteners to drywall or cavity wall construction:

1. Toggle bolts with hollow wall drive anchors or nylon anchors as required.
2. Basis of design: ITT Phillips Anchors “Red Head” toggle bolts.

C. Fasteners to wood construction: Lag bolts.

D. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

2.4 CONCRETE AND GROUT

A. Concrete:

1. Concrete shall be no less than 3000-psi (25,000 kPa) strength.

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2. Reinforcement: 6 by 6 inch (150 by 150 mm) welded steel wire fabric, ASTM A 1064.

B. Grout:

1. Premixed, non-shrink grout consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi (48,000 kPa) in 28 days.
2. Provide grout by one of the following manufacturers:

a. Sonneborn-Rexnord “Sonogrout”
b. L&M Construction Chemical Company “Crystex”
c. US Grout Corporation “Five-Star Grout”

PART 3 - EXECUTION

3.1 GENERAL

A. Provide hangers and supports in accordance with schedules at the end of this section, as modified by specifications for each location and type.

B. Comply with MSS SP-58. Provide hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

C. Provide hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a hanger location to multiple locations in the structure to get support from an appropriate location or to increase the strength of the connection to the structure.

E. Support horizontal piping from above with hangers and threaded rod where possible, unless otherwise indicated.

F. Riser support:

1. Support pipe risers through floor slabs with riser clamps.
2. Where pipe sleeves or associated water dams are not capable of accepting the weight of the piping, provide supplemental supports to transfer the weight of the piping to the structure.
3. Provide additional supports as needed not to exceed scheduled maximum vertical support spacing.

G. Provide hanger sizes to allow for continuous insulation for insulated piping systems.

H. Fabricate wall-mounted and floor-mounted supports using metal framing systems or structural steel where required.

I. Support groups of small piping along a structural wall using a metal framing system secured to the wall.

J. Trim threaded rods with a maximum excess length of 1 inch (25 mm). Provide protective rubber red end caps on the ends of threaded rods exposed and within 8 feet (2.4 meters) of the floor, roof, or grade below.

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K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Coordinate with requirements for hangers that require vibration control. See Section 23 0548.

P. Trapeze pipe hangers: Provide where required for grouping of parallel runs of horizontal piping.

1. Weld steel according to AWS D-1.1.
2. Hang with threaded rods. Size threaded rods in accordance with MSS SP-58
3. Design trapeze pipe hangers and supports based on supported load plus a 50 percent minimum safety factor.
4. Hanger spacing shall not exceed the requirements for the smallest pipe in the rack.
5. Hanger spacing shall not exceed 6 feet (1.8 m) where hung from wood.

Q. Metal framing systems: Provide where required for grouping of parallel runs of piping, and support together on field-assembled strut systems. Comply with MFMA-103 for metal framing system selections and applications.

R. Where piping penetrates metal studs within metal stud partitions, provide polymer inserts manufactured for the purpose to isolate piping and insulation from the metal stud material.

3.2 BUILDING ATTACHMENTS

A. Attaching to concrete slabs and composite slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting pipe from concrete slabs or composite slabs. Where approved, provide mechanical expansion anchors and steel bolts or rods.

B. Attaching to wood construction:

1. Trusses: Follow roof truss manufacturers' recommendations for attachment locations, loads, spacing, and methods of attachment.
2. Joists: Provide MSS SP-58 Type 34 side beam connectors.

3.3 INSTALLING EQUIPMENT FOUNDATIONS AND SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor. Provide lateral bracing, to prevent swaying.

B. Provide minimum four-inch (100-mm) -high concrete foundations (housekeeping pads) or as indicated on drawings, reinforced with welded-wire fabric, for floor-mounted equipment and where indicated. Anchor concrete foundations by dowels inserted into the floor slab.

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C. Unless otherwise specified, provide concrete foundations, bolts, sleeves, and appurtenances as work of the section where the supported equipment is specified and in accordance with the requirements of Division 03.

D. Equipment shall be properly aligned and leveled and grouted where necessary. Support piping independently of equipment and so as not to cause a strain or thrust.

E. Coordinate exact size, configuration and location of equipment, foundations, and supports using approved shop drawings of equipment.

3.4 PIPING HANGER AND SUPPORT SCHEDULES

A. Refrigerant piping applications:

HANGERS & SUPPORTS FOR REFRIGERANT PIPING APPLICATIONS		
MSS SP-58 Classification	Description	Piping applications
Hung from Above		
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	All sizes.
Supported from Below		
N/A	Metal framing system with metal framing system pipe clamps and pipe clamp insulating inserts.	All sizes.
Risers		
Type 8	Riser clamp.	All sizes

B. Minimum threaded rod sizes: Provide at least the following minimum rod diameters for single rods supporting a single pipe hanger.

PIPE SIZE	MINIMUM ROD DIAMETER
NPS 2 (DN 50) and below	0.375 inches (10 mm)

C. Maximum hanger and support spacing:

1. Provide additional hangers or supports for concentrated loads such as flanges, valves, expansion compensators, fittings, and other specialties.
2. Spacing schedule for metallic piping:

PIPE SIZE	COPPER PIPING
NPS 0.75 (DN 20) and below	5 feet (1.5 m)
NPS 1 (DN 25)	6 feet (1.8 m)
NPS 1.25 (DN 32)	7 feet (2.1 m)

END OF SECTION

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SECTION 23 0548 - VIBRATION CONTROL SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Vibration control supports for HVAC equipment.

1.2 RELATED SECTIONS

A. Hangers and supports: Section 23 0529.

B. Flexible duct connections: Section 23 3300.

1.3 SUBMITTALS

A. Product data: For each type of vibration control support included in the work.

1. For Specification D hanger, include scaled drawing showing degrees of hanger rod swing.

B. Shop drawings: Custom-fabricated supports.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Mason Industries product, or comparable product by one of the following or approved equal:

1. Amber/Booth Company, Inc.
2. Kinetics Noise Control
3. Mason Industries
4. Vibro-Acoustics
5. Vibration Eliminator Company, Inc.
6. Vibration Mountings and Controls, Inc.

2.2 VIBRATION CONTROL SUPPORTS

A. Provide engineered supports for equipment and locations shown on drawings and specified in Part 3 below. The units shall prevent the transmission of vibration and mechanically transmitted sound to the building structure.

1. Select units in accordance with the weight distribution of the equipment, so as to produce reasonably uniform deflection. Deflections shall be as specified.
2. Units installed on exterior shall be galvanized.

B. Specification A:

1. Double-deflection neoprene type. All metal surfaces shall be covered with neoprene and have friction pads both top and bottom. Provide bolt holes for mounting. Provide steel rails where necessary to compensate for equipment overhang.
2. Basis of design: Mason Industries ND.

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C. Specification D: Hangers, combination spring and minimum 0.3-inch (8-mm) deflection neoprene in series.

1. Neoprene element: Molded with a rod isolation bushing that passes through the hanger box.
2. Spring diameters and hanger box lower hole sizes: Large enough to permit the hanger rod to swing through a 30-degree arc before contacting the edges of the hole.
3. Springs shall have a minimum additional travel to solid equal to 50 percent of rated deflection.
4. Basis of design: Mason Industries Type 30N.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Adjust vibration control supports as recommended by manufacturer to eliminate transmission of vibration to building structure or other systems.

B. Replace springs that become permanently deformed with new springs.

C. Provide 0.25-inch (6-mm) structural plate sized as required between isolator and equipment.

3.2 FAN VIBRATION CONTROL

A. Suspended from structure: Provide Specification D hanger, selected for weight, with minimum 1.0 inch static deflection.

3.3 REFRIGERATION COMPRESSOR VIBRATION CONTROL

A. Refrigeration compressors and equipment with self-contained refrigeration compressors:

1. Refrigeration compressors, condensing units, and other rotating equipment mounted on floor slab on earth: Specification A mountings having at least 0.35 inch (89 mm) static deflection.

END OF SECTION

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SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall engage and the Architect shall approve an independent balancing and testing subcontractor.

B. This section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:

1. Balancing airflow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
2. Adjusting total HVAC systems to provide indicated quantities.
3. Measuring electrical performance of HVAC equipment.
4. Setting quantitative performance of HVAC equipment.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of the activities and procedures specified in this section.

1.2 RELATED SECTIONS

A. Testing and adjusting requirements unique to particular systems and equipment are included in the sections that specify those systems and equipment.

B. Field quality-control testing to verify that workmanship quality for system and equipment installation is specified in system and equipment sections.

1.3 PERFORMANCE REQUIREMENTS

A. Select and obtain approval of the testing and balancing subcontractor at the earliest possible time and before beginning ductwork installation.

B. The testing and balancing subcontractor shall visit the job site periodically, beginning with the initial stages of construction of the mechanical systems, and shall ensure that the necessary devices are properly installed so that specified testing and balancing can be performed.

1.4 SUBMITTALS

A. Submit qualifications of testing and balancing subcontractor, as required in article “Quality Assurance” below.

B. Submit certified balance report. In addition to general requirements for submittals, submit three copies of final reports and certificates, bound into a booklet.

1.5 QUALITY ASSURANCE

A. Testing and balancing subcontractor qualifications:

1. Current certified member of the Associated Air Balance Council, or certified by National Environmental Balancing Bureau for air and hydronic systems testing and balancing.
2. Has successfully completed at least five projects of similar size and scope.

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3. Not affiliated with any other subcontractor participating in this project. Work performed by the subcontractor shall be limited to testing, adjusting, and balancing HVAC systems.

B. Testing and balancing work shall comply with one of the following standards:

1. National Standards for Testing and Balancing Heating, Ventilating and Air Conditioning Systems, published by the Associated Air Balance Council.
2. Procedural Standards for Testing Adjusting Balancing of Environmental Systems, published by the National Environmental Balancing Bureau.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. Instruments: Approved and properly calibrated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Witness air duct leakage tests required in Section 23 3113, Metal Ducts, and advise and approve the methods and instruments used.

B. Using bench-calibrated instruments, field-calibrate pressure gages and dial-type duct thermometers.

3.2 BALANCING OF SYSTEMS, GENERAL

A. Tabulate settings of temperature control devices and ascertain that thermostats, controllers, and valves are set at specified or approved positions. Verify and certify that the sequence of operation for each system is as shown on drawings, specified, or approved.

B. Provide all labor and devices necessary for the testing and balancing work.

3.3 AIR SYSTEMS BALANCING

A. Balance all air distribution, supply, return, exhaust, and outdoor air systems and equipment.

B. Test and adjust fans to deliver design airflow at lowest possible speed. Adjust air-handling equipment to deliver the required air volumes. Note that air quantities scheduled on drawings do not include allowances for duct leakage. Preliminary adjustments of fan speed should be slightly in excess of scheduled airflow delivery. Make adjustments by adjusting adjustable sheaves, changing sheaves and associated belts, changing wiring connections of motors, or adjusting speed controller.

C. Test and adjust system to design airflow requirements to the greatest extent possible. Manual volume dampers in ducts shall be adjusted to obtain required airflow rates at grilles, registers, and diffusers. Dampers integral to airflow devices should be fully open or minimally closed for airflow fine adjustments.

D. Make pitot tube traverse of main supply, return, and outdoor air ducts to obtain total airflow for fan or air-handling unit.

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E. Adjust rooms or zones to design airflow (supply, return, and exhaust).

F. Adjust general HVAC systems to design airflow within the following tolerances:

1. Total system exhaust: (design to plus 10 percent).
2. Total exhaust for a room or space: (minus 5 percent to plus 5 percent).
3. Grilles, registers, and diffusers:

    a. One per room or space: (minus 5 percent to plus 5 percent).

G. Grilles, registers, and diffusers:

1. Identify each grille, register, and diffuser as to location and area. List manufacturer, type, and size.
2. Identify type of testing equipment used.
3. Test and adjust each grille, register, and diffuser to design airflow. List (design-actual) cfm (cubic meters per minute) and (design-actual) velocity in fpm (meters per second) when applicable.

H. Test and record the following data, as applicable, for exhaust fan:

1. Manufacturer and model number.
2. Total airflow (design-actual).
3. Total and external static pressure (design-actual). Include static pressure at suction, and discharge.
4. Motor horsepower (rated-actual).
5. Voltage and phase (rated-actual).
6. Fan speed, rpm (rated-actual).
7. Amperage (rated-actual).

3.4 MARKING OF SETTINGS

A. Following final balance procedures, permanently mark the settings of dampers, and other adjustment devices, so that adjustment can be restored if disturbed at any time. Return and make required adjustments after submittal and approval of the Certified Balance Report.

END OF SECTION

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SECTION 23 0700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Definitions and general requirements applicable to the insulation systems specified in “Related Sections.”

1.2 RELATED SECTIONS

A. HVAC piping insulation: Section 23 0719.

B. Duct insulation: Section 23 0713.

1.3 REFERENCES

A. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

B. NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials

C. UL 723: Standard for Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Ceiling space: The space between the ceiling and the floor of an air-conditioned space above.

B. Roof space: The space between the ceiling and the roof, where building insulation is located at the roof level or the space between the ceiling and the floor of a non-air conditioned space above.

C. Attic space: The space between the ceiling and the roof, where building insulation is located at the ceiling level.

D. Air-conditioned areas or spaces: Areas or spaces where the occupied room temperature is maintained between 65 and 80 degrees F (18.3 and 26.7 degrees C).

E. Concealed insulation shall include work:

1. Above ceilings.
2. Where furred in and in pipe chases.

F. Exposed insulation shall include work:

1. In all rooms and areas.
2. In mechanical equipment rooms, penthouses, or other similar utility spaces.
3. In storage rooms.

G. Unconditioned areas: Areas outside of the insulated envelope.

H. Finished spaces: Areas of the building accessible to the public and to building occupants other than service personnel.

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1.5 QUALITY ASSURANCE

A. Perform work in strict accordance with the building, fire and safety codes of the state, county or city in which the work is performed.

B. Insulation, including fittings and butt strips, jackets, facings, and accessories such as adhesives, mastics, cements, tapes and cloth, shall have a fire and smoke hazard rating and label as tested by ASTM E84, NFPA 255, and UL 723, not exceeding Flame Spread 25, Fuel Contributed 50, Smoke Developed 50.

C. All insulation and accessories shall be free of asbestos.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver insulation and accessory products in manufacturers' wrapping or cartons, identified on the exterior and bearing labels showing conformance to flame and smoke rating requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Refer to sections listed in "Related Sections."

PART 3 - EXECUTION

Not Used.

END OF SECTION

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SECTION 23 0713 - DUCT INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct insulation with the thickness and R-value indicated in the schedule at the end of this section.

1.2 RELATED SECTIONS

A. Definitions and general insulation requirements: Section 23 0700.

1.3 REFERENCES

A. American Society of Testing and Materials

1. ASTM C 553: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
2. ASTM C 612: Standard Specification for Mineral Fiber Block and Board Thermal Insulation
3. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer's name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer's instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installer qualifications: Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store rigid insulation products so as to protect them from breakage.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article “Product Options” in Section 23 0101 or approved equal.

B. Mineral fiber insulation:

1. CertainTeed Corporation.
2. Johns Manville.
3. Knauf Insulation
4. Manson Insulation
5. Owens-Corning.

C. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac

2.2 MINERAL FIBER INSULATION MATERIALS

A. Flexible mineral fiber insulation: ASTM C 553, Type I, nominal density at least 1 pound per cubic foot (16 kg per cubic meter), k-factor of 0.27 at 75 degrees F (k(SI) of 0.037 at 24 degrees C) mean temperature, of thickness as specified in Part 3 below, with foil-scrim-kraft vapor-barrier jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Minimum 1.5 inches (38 mm) of thickness with R-value of R-4.5 (RSI-0.79) in the installed condition with 25% compression.

B. Rigid mineral fiber insulation: ASTM C 612, Types IA-IB, nominal density at least 6 pounds per cubic foot (96 kg per cubic meter), with k-factor of 0.22 at 75 degrees F (k(SI) of 0.032 at 24 degrees C) mean temperature, of thickness as specified in Part 3 below, with factory-applied jacket composed of a reinforced white kraft and aluminum-foil laminate with the white kraft facing out. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

1. Minimum R-value of R-6.8 (RSI-0.79) with 1.5 inches (38 mm) of thickness.

C. Mineral fiber insulation accessories

1. Mechanical fasteners: Adhesively attached, minimum 12-gauge zinc-plated steel pin welded to a 2 inch by 2-inch, 22-gauge minimum galvanized steel perforated baseplate and self-locking retaining washer. Pin length as required. Comply SMACNA HVAC Duct Construction for Mechanical Fasteners. Provide adhesive recommended by fastener manufacturer. Peel and press (self-sticking) type fasteners are not acceptable.

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2. Tape for flexible mineral fiber insulation: Self-adhesive foil-scrim-kraft vapor-barrier tape with removable backing and pressure-sensitive acrylic adhesive, 3” (75 mm) wide minimum. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
3. Tape for rigid mineral fiber insulation: Self-adhesive foil faced vapor-barrier tape with removable backing and pressure-sensitive acrylic adhesive, 2” (50 mm) wide minimum. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
4. Mineral fiber insulation vapor barrier mastic:

    a. Vapor barrier coating for use over ASJ jackets to give a vapor barrier seal at joints, laps and punctures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
    b. Basis of design: Foster 30-65 “Vapor-Fas”.

5. Corner Angles: Aluminum, 0.040 inch (1.0 mm) thick, minimum 1 by 1 inch (25 by 25 mm).
6. Trapeze hanger support inserts: Calcium silicate insulation, ASTM C 533, Type I.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

B. Tape and seal terminations of insulation with vapor barrier mastic.

C. Provide continuous insulation and jacket through trapeze hanger supports. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

D. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

E. 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.

F. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

G. Install insulation with longitudinal seams at top and bottom of horizontal runs.

H. Install multiple layers of insulation with longitudinal and end seams staggered.

I. Install insulation with least number of joints practical.

J. Stagger joints.

K. Install insulation continuously around hangers.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

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3.2 INSTALLATION INSIDE BUILDINGS

A. Install in accordance with the Minimum Insulation Thickness and R-Value Schedule at the end of this section.

B. Concealed ducts: Provide flexible mineral fiber insulation.

1. Mechanical fasteners: On ducts more than 24 inches (610 mm) wide, secure insulation on the underside with mechanical fasteners as required to prevent sagging, 16” (406 mm) maximum on center and 3” (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with tape.
2. Transverse joints and longitudinal seams: Butt insulation with facing overlapping at least 2 inches (50 mm). Staple and seal with tape.
3. Seal breaks and punctures with tape.

C. Exposed ducts: Provide rigid mineral fiber insulation.

1. Mechanical fasteners: Fastened with mechanical fasteners. Fasteners shall be spaced 16” (406 mm) on center with a minimum of two rows per side of duct and 3” (75 mm) maximum from joints. Secure insulation in place with washers firmly embedded in insulation. Cut excess portion of pins extending beyond washers. Cover exposed pins and washers with tape.
2. Transverse joints and longitudinal seams: Provide a continuous unbroken vapor barrier. Create a facing lap by removing 2 inches (50 mm) from one edge and one end of insulation segments. Secure laps to adjacent insulation section with staples, 6 inches (150 mm) on center maximum. Seal seams and joints with tape.
3. Seal breaks and punctures with tape.
4. Apply corner angles to all outside corners and straight edges.
5. For curved surfaces, such as exposed elbows, score or cut insulating board in narrow strips as necessary for snug and neat fit.

D. Where necessary to conceal the standing seams and reinforcing angles on exposed ducts, increase insulation thickness to 2 inches (50 mm).

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3.3 SCHEDULES

Minimum Insulation Thickness and R-Value for Duct Insulation Inside Buildings[1]			
	Default Unless Otherwise Noted	Exposed in Area Served	Ceiling, Chase, or Shaft Space in Air-Conditioned Area
Outside Air and Exhaust Air			
Exhaust air between exterior connection and backdraft damper, but not less than 10 feet (3 meters)	1.5 inch (38 mm)	1.5 inch (38 mm)	1.5 inch (38 mm)

Notes:
1: Insulation thickness shall be increased to 2 inches (50 mm) where necessary to conceal standing seams and reinforcing angles on exposed ducts.

END OF SECTION

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SECTION 23 0719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC piping insulation for the interior piping systems listed in the minimum insulation thickness schedule at the end of this section.

B. HVAC piping insulation for exterior piping systems.

1.2 RELATED SECTIONS

A. Firestopping: Division 07.

B. Definitions and general insulation requirements: Section 23 0700.

C. Pipe hangers and protection shields: Section 23 0529.

D. Pre-insulated refrigerant tubing system: Section 23 2300.

1.3 REFERENCES

A. American Society of Testing and Materials

1. Standards for mineral fiber insulation materials

a. ASTM C 449: Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
b. ASTM C 547: Mineral Fiber Pipe Insulation.
c. ASTM C 553: Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
d. ASTM C 1136: Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

2. Standards for all insulation materials

a. ASTM C 450: Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
b. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Building Materials

1.4 SUBMITTALS

A. Material list: Each type of insulation and accessory, with manufacturer’s name and material name and number. Identify locations for use, thickness of material, type of jacket, vapor barrier, and method of application.

B. Product data: Sufficient to show that the product meets the specified requirements for materials, composition, and performance.

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C. Submit a single manufacturer for each product. Submittals that include multiple manufacturers for a single product are not acceptable.

D. Installer qualifications.

1.5 QUALITY CONTROL SUBMITTALS

A. Manufacturer's instructions: Recommended accessory materials and products; installation instructions.

1.6 QUALITY ASSURANCE

A. Installers shall be mechanics skilled in this trade, employed with a firm that has a minimum of five years of experience installing mechanical insulation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The listed manufacturers and particular products are intended to set a standard for materials, composition, and performance. Products of other manufacturers may be proposed as permitted by the provisions of Division 01 and the article "Product Options" in Section 23 0101 or approved equal.

B. Flexible elastomeric insulation:

1. Aeroflex USA*
2. Armacell LLC*
3. K-Flex USA
4. Rubatex

C. Coatings, adhesives, and fabrics:

1. Childers
2. Foster
3. Manville Building Materials Group
4. Rock Wool Manufacturing Company
5. Trimac

2.2 FLEXIBLE ELASTOMERIC INSULATION MATERIALS

A. Flexible elastomeric preformed pipe insulation: Closed-cell, sponge- or expanded-rubber, ASTM C 534, Type I for tubular materials. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

B. Flexible elastomeric preformed fitting and valve covers: Closed-cell, sponge- or expanded-rubber, made from the same material and density as adjacent pipe insulation, meeting ASTM C 450 requirements for dimensions used in forming insulation to cover valves, elbows, tees, flanges, strainers, and unions. Provide with preformed PVC field-applied jacket. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

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1. Where flexible elastomeric insulation is used on hot gas piping in VRF applications, insulation shall be tested in accordance with ASTM C411 at 250 degrees F (121 degrees C) for a 96 hour time period and shall meet an ASTM E 84 surface burning characteristic (flame spread/smoke developed) rating less than 25/50 at 2 inches (50 mm) of thickness.

C. Flexible elastomeric insulation adhesive:

1. Water resistant contact cement designed especially suited for bonding two impermeable surfaces and recommended for rubber foam, steel, or aluminum surfaces, and compatible with service temperatures. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Foster 85-75 “Drion”.

D. Flexible Elastomeric Tape: Black, closed cell, self-adhering, elastomeric thermal insulation tape for insulating pipes and fittings, 0.125 inch (3 mm) thick, 2 inches (50 mm) wide, ASTM C 534, Type I — Grade 1. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.

E. Flexible elastomeric insulation vapor barrier coating:

1. Water-based latex enamel coating for use over flexible elastomeric insulation, providing a moisture-resistant protective finish suitable for both indoor and outdoor applications. ASTM E 84 surface burning characteristics (flame spread/smoke developed) rating less than 25/50.
2. Basis of design: Armacell “WB Armaflex” latex enamel.

F. Exterior flexible elastomeric insulation:

1. Flexible elastomeric foam insulation complete with flexible co-extruded UV resistant jacketing.
2. Basis of design: K-Flex “Titan”.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide interior piping insulation in accordance with the Minimum Insulation Thickness Schedule for Interior Applications at the end of this section, as modified by specifications for each location and type.

B. Provide flexible elastomeric insulation for refrigerant piping.

C. Apply insulation in a neat and workmanlike manner and in accordance with manufacturer’s printed instructions.

D. Maintain a continuous vapor barrier on systems that convey fluid at below-ambient temperatures, including the following applications:

1. Refrigerant piping

E. Where a continuous vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

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F. Installation at pipe hangers:

1. Insulation shall be continuous through hangers for all piping systems.
2. Install pipe covering protection shields with thickness of structural insulation inserts equal, under load, to that of adjoining insulation.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
5. Shields and structural insulation inserts are specified in Section 23 0529, Hangers and Supports for HVAC Piping and Equipment.

G. Where insulated piping systems pass through sleeves or openings in partitions and floors, the insulation shall be continuous through the sleeves and openings. See Firestopping specifications for coordinating insulation and firestopping.

H. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

I. 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.

J. Install insulation with longitudinal seams at top and bottom of horizontal runs.

K. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

L. Install insulation with least number of joints practical.

M. Finish installation with systems at operating conditions. Repair separations and cracking caused by thermal movement.

N. Return piping systems shall be insulated to meet the temperature demands of supply piping systems. There shall be no reduction of insulation thickness for anticipated temperature change between supply and return.

3.2 INSTALLING FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and circumferential joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Installation on fittings and flanges:

1. Install insulation over fittings and flanges with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate using flexible elastomeric preformed fitting covers whenever possible. Install preformed fittings with adhesive. Tape and seal with vapor barrier coating.

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3. Where flexible elastomeric preformed fitting covers are not available, insulate using mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining pieces and bonded with adhesive. Tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.
4. Install fitted PVC cover. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
5. Flanges: Install pre-formed pipe insulation to outer diameter of pipe flange. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation. 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. Secure insulation to flanges and tape and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated. Seal with vapor barrier coating.

3.3 INSTALLING EXTERIOR PIPING INSULATION

A. Locations: Provide insulation for piping systems exterior of building heated space, including but not limited to attics and unheated parking garages.

B. Provide flexible elastomeric insulation with flexible co-extruded UV resistant jacketing for refrigerant piping

C. Insulation: Minimum 2 inches (50 mm) thick, or 0.5 inches (13 mm) thicker than scheduled for interior insulation on similar system, whichever is greater.

D. Start insulation 30 inches (760 mm) below grade, 30 inches (760 mm) below roof or 30 inches (760 mm) inside exterior wall. Secure insulation with aluminum bands on 12-inch (305-mm) centers.

3.4 SCHEDULES

A. Minimum insulation thickness schedule for interior heat pump refrigeration applications:

MINIMUM INSULATION THICKNESS SCHEDULE FOR INTERIOR HEAT PUMP REFRIGERATION APPLICATIONS (1)			
Application	Fluid Temperature Range	NPS 1.25 (DN 32) & Smaller	NPS 1.5 (DN 40) & Greater
Refrigerant Liquid	61F to 140F (16.1C to 60C)	1-inch (25 mm)	1.5-inch (38 mm)
Refrigerant Suction/Hot Gas (2)	61F to 140F (16.1C to 60C)	1-inch (25 mm)	1.5-inch (38 mm)
Refrigerant Hot Gas (3)	105F to 140F (40.6C to 60C)	1-inch (25 mm)	1.5-inch (38 mm)
(1) – See additional thickness requirements for exterior applications. (2) – For heat pump applications where piping may be either hot gas or refrigerant suction depending on the mode of operation, insulate the piping to meet the more demanding requirements of refrigerant hot gas. (3) – Hot gas may be required for split system hot gas reheat applications.			

END OF SECTION

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SECTION 23 0902 - CONTROL SYSTEMS WIRING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wiring.

B. Conduit and fittings.

1.2 RELATED SECTIONS

A. Disconnect switches: Division 26.

1.3 SUBMITTALS

A. Product data: For each type of product, include a description, characteristics, materials, composition, finishes, and performance. Include the following:

1. Wiring.
2. Conduit and fittings.
3. Control power transformers.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 23 0500, Common Work Results for HVAC.

B. Control system power circuits shall not supply power to other building components such as lights or receptacles.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Electrical materials and devices shall be UL listed and shall meet the requirements of NEC (NFPA 70) and Division 26, Electrical.

2.2 WIRING

A. Wiring 50 V and below: Fully color coded, copper 600 V type THW or THHN, minimum No. 22 or as specified in Division 26, Electrical.

B. Wiring above 50 V: As specified in Division 26.

2.3 CONDUIT AND FITTINGS

A. Galvanized steel conduit: Minimum size 0.5 inches (16 mm), hot-dip galvanized with threads galvanized after cutting, one of the following:

1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.01.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.03.

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B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

   1. Insulating bushings.

      a. Basis of design: Thomas & Betts Series 22.

   2. Hub fittings with recessed sealing ring and nylon insulated throat.

      a. Basis of design: Thomas & Betts Series 370.

   3. Fittings for exposed locations: Conduit outlet bodies, zinc- or cadmium-plated.

C. Electrical metallic tubing (EMT):

   1. Minimum size 0.5 inch (16 mm), maximum 1.5 inch (41 mm), hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C 80.03.
   2. Connectors and couplings for EMT: Concrete- or rain-tight, compression or set screw type, made of cadmium-plated steel with nylon insulating throat.

      a. Basis of design: Thomas & Betts Series 5031, 5123 and 5120.

D. Flexible metal conduit:

   1. Minimum size 0.5 inch (16 mm), made of sheet metal strip, interlocked construction, conforming to UL 1.
   2. Connectors for flexible metal conduit: Angle wedge type with nylon insulated throat.

      a. Basis of design: Thomas & Betts Series 3110 and 3130, “Tite-Bite.”

E. Liquidtight flexible metal conduit:

   1. Conform to UL 360.
   2. Liquidtight connectors: UL 14814A, with fittings and nylon-insulated throat.

      a. Basis of design: Thomas & Betts Series 5331.

F. Surface metal raceway: Raceway dimensions 0.65 by 0.75 inches minimum size, complete with fittings, connectors, and accessories.

   1. Basis of design: Wiremold No. 700.

G. Plastic conduit:

   1. Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2 and UL 651.
   2. Plastic conduit fittings and cement:

      a. Fittings: Complying with NEMA TC 3 and UL 514.
      b. Cement: Solvent cement made by the manufacturer of the conduit and fittings.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Electrical equipment is specified in Division 26. Provide circuit breakers, disconnect switches, power wiring, control power transformers, control wiring, and other equipment, meeting requirements of Division 26, so the automatic temperature control system will function as specified and indicated on the drawings.

B. Conduit:

1. Install conduit and wiring as specified in Division 26.

C. Make each run of cable or conductor connecting two points with a single continuous piece of cable or conductor. Do not splice. Cable or conductor may be extended by use of suitable connectors if approved by the Architect.

D. Shielding:

1. All input, output, and communications wire is to be shielded except when specifically disallowed by the controller or end device manufacturer.
2. All shields on controller input and output wiring shall be terminated except when specifically disallowed by the controller or end device manufacturer. The shield must be terminated at the controller end only.
3. RS-485 communication shield wiring shall be continuous from one end of the trunk to the other and must only be terminated at the ‘originating’ router.
4. The shields (foil and drain wire) from individual wire segments at a controller must be twisted, and the free end of the shield taped back (using electrical tape) to one of the communication wires. A portion of the shield must be exposed to allow a technician to verify the continuity of the shield.

E. When connecting to electrical wiring of equipment provided with pilot lights, connect to circuit so that pilot light is energized only when equipment is energized.

F. When connecting to electric wiring of fans with Hand/Off/Automatic (HOA) switches and isolation dampers, connect to circuit so that isolation dampers open in both Hand and Automatic positions.

3.2 RENOVATION PROCEDURES

A. Wherever possible, provide concealed wiring within wall cavities to wall-mounted devices.

B. Wherever wall cavities are not available for wiring, provide wiring from ceiling cavities to wall-mounted devices by channeling a pathway within the existing wall, providing wiring within conduit within existing wall, and patching the existing wall to match adjacent surfaces.

C. Wherever possible, provide concealed wiring above existing ceilings.

D. Create hand holes in existing surfaces where required to provide concealed wiring. Patch existing surfaces to match adjacent surfaces.

E. Patch existing surfaces in accordance with requirements of Division 01.

END OF SECTION

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SECTION 23 2300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Refrigerant piping.

B. Refrigerant piping accessories.

1.2 RELATED SECTIONS

A. Piping materials and methods: Section 23 0500.

B. Piping hangers and supports: Section 23 0529.

C. Piping insulation: Section 23 0719

D. Equipment:

1. Ductless split-system units: Section 23 8127.

1.3 REFERENCES

A. Air Conditioning, Heating, and Refrigeration Institute

1. AHRI 495: Performance Rating of Refrigerant Liquid Receivers
2. AHRI 730: Flow Capacity Rating of Suction Line Filters and Suction Line Filter Driers
3. AHRI 750: Thermostatic Refrigerant Expansion Valves
4. AHRI 760: Performance Rating of Solenoid Valves for Use with Volatile Refrigerants

B. American Society of Testing and Materials

1. ASTM B 280: Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
2. ASTM C 1427-07: Standard Specification for Extruded Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form

C. American Society of Mechanical Engineers/American National Standards Institute

1. ASME/ANSI B16.22: Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

D. American Society of Refrigerating and Air-Conditioning Engineers

1. ASHRAE 15: Safety Standard for Refrigeration Systems.
2. ASHRAE Standard 34: Designation and Classification of Refrigerants
3. ASHRAE Standard 147: Reducing the Release of Halogenated Refrigerants from Refrigerating and Air-Conditioning Equipment and Systems

E. American Welding Society

1. AWS A5.8/A5.8M: Specification for Filler Metals for Brazing and Braze Welding

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F. Society of Automotive Engineers

1. SAE J533: Flares for Tubing

G. UL

1. UL 429: Standard for Safety Electrically Operated Valves

1.4 DESIGN REQUIREMENTS

A. Refrigerant piping shall be sized by the manufacturer of the refrigeration compressor, as specified in sections describing refrigeration equipment.

B. Design pressures: Calculated in accordance with "System Design Pressure" in ASHRAE 15.

1.5 SUBMITTALS

A. Product data:

1. Piping, fittings, brazing filler metal, brazing flux, and pipe joint compound.
2. Each type of valve, including materials, classifications, arrangement, dimensions and required clearances, and installation instructions.
3. Each type of device and accessory.

B. Shop drawings:

1. Pre-insulated tubing, including sizes and approximate lengths of lines.
2. Built-up system piping diagram, including sizes, details, and accessories.
3. Submit system design pressures for use in testing system. In accordance with the International Mechanical Code, "Field Test" for refrigeration systems, including the pressures listed on the condensing unit, compressor, or compressor unit nameplate, and the settings of pressure relief devices.
4. Coordinate drawings with other trades.

C. Operation and maintenance data: Include operating and maintenance data for each refrigerant piping accessory in the project Operation and Maintenance Manual as specified in Division 01 with supplemental requirements as specified in Section 23 0101.

1.6 QUALITY ASSURANCE

A. Comply with ASHRAE 15 for leak testing, and installation.

B. Pipe shall be certified by the manufacturer to meet referenced standards and shall bear a label, directly on the pipe, indicating compliance.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Refrigerant: R-410A.

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2.2 PIPING (PRE-INSULATED TUBING)

A. Refrigerant pipe:

1. Pre-insulated Type L soft drawn seamless copper tubing, ASTM B 280. Provide complete with factory-applied, closed-cell insulation and jacketing in accordance with ASTM C 1427-07, Type I, Grade I, suitable for a maximum operating temperature of 250 degrees F, and meeting the minimum insulation thickness requirements of Section 23 0719.
2. Basis of design: H Max pre-insulated copper line sets.

2.3 PIPE AND FITTINGS (BUILT-UP SYSTEMS)

A. Refrigerant pipe: ASTM B 280 Type ACR hard-drawn seamless copper tubing.

B. Fittings: Wrought copper, solder-joint type, ANSI B16.22.

C. Brazing Filler Metals: AWS A5.8/A5.8M.

1. Type BCuP (copper-phosphorus) alloy for joining copper socket fittings with copper pipe.
2. Type BAg (cadmium-free silver) alloy for joining copper with bronze or steel.

D. Brazing Flux: Non-corrosive.

E. Threaded pipe joint compound: Pipe joint compound recommended by the manufacturer for use at the temperature and pressure of the system.

F. Threaded pipe joint tape: Polytetrafluoroethylene (PTFE) pipe thread tape, "Teflon."

2.4 ACCESSORIES (BUILT-UP SYSTEMS)

A. System: Provide the listed accessories as a minimum on each built-up system, in accordance with approved shop drawings and as recommended by the refrigeration equipment manufacturer. Accessories provided by the equipment manufacturer with the equipment are acceptable.

B. Isolation valves:

1. Forged brass body ball valve.
2. Full port.
3. Extended copper connections suitable for brazing.
4. Brass ball.
5. Polytetrafluoroethylene PTFE seals, “Teflon”.
6. Vented ball cavity.
7. Blow out proof stem.
8. Double O-ring stem seals.
9. Positive shut-off in both directions.
10. Factory tested.
11. UL listed.
12. Working Pressure Rating: 500 psig (3450 kPa).
13. Maximum Operating Temperature: 275 degrees F (135 degrees C).

C. Check valves:

1. Body: Forged brass, or cast bronze; globe pattern.

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2. Bonnet: Bolted forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. End Connections: socket or threaded.
6. Maximum Opening Pressure: 0.50 psig (3.4 kPa).
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 deg F (135 deg C).

D. Service valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig (3450 kPa).

E. Solenoid Valves:

1. Comply with AHRI 760 and UL 429; listed and labeled by a National Recognized Testing Laboratory.
2. Body and Bonnet: Plated steel.
3. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch (16-GRC) conduit adapter, and a coil compatible with the control signal and available power.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 240 degrees F (116 degrees C).

F. Safety Relief Valves:

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by a National Recognized Testing Laboratory.
2. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
3. Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Seat: Polytetrafluoroethylene.
5. End Connections: Threaded.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 degrees F (116 degrees C).

G. Thermostatic Expansion Valves:

1. Comply with AHRI 750.
2. Body, Bonnet, and Seal Cap: Forged brass or steel.
3. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
4. Packing and Gaskets: Non-asbestos.
5. Capillary and Bulb: Copper tubing filled with refrigerant charge.
6. Suction Temperature: 40 degrees F (4.4 degrees C).
7. Superheat: Adjustable.
8. Provide reverse-flow option for heat-pump applications.
9. End Connections: Socket, flare, or threaded.
10. Working Pressure Rating: 500 psig (3450 kPa).

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H. Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig (3450 kPa).
6. Maximum Operating Temperature: 275 degrees F (135 degrees C).

I. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in parts per million (ppm).
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig (3450 kPa).
7. Maximum Operating Temperature: 240 degrees F (116 degrees C).

J. Filter Dryers:

1. Comply with AHRI 730.
2. Replaceable-core.
3. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
4. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
5. Desiccant Media: Activated alumina and activated charcoal.
6. Provide units designed for reverse flow for heat-pump applications.
7. End Connections: Socket.
8. Access Ports: NPS 1/4 (DN 8) connections at entering and leaving sides for pressure differential measurement.
9. Maximum Pressure Loss: 2 psig (14 kPa).
10. Working Pressure Rating: 500 psig (3450 kPa).
11. Maximum Operating Temperature: 240 degrees F (116 degrees C).

K. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch-(180-mm-) long assembly.
4. Working Pressure Rating: Factory test at minimum 500 psig (3450 kPa).
5. Maximum Operating Temperature: 250 degrees F (121 degrees C).

L. Mufflers:

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or flare.
3. Working Pressure Rating: 500 psig (3450 kPa).
4. Maximum Operating Temperature: 275 degrees F (135 degrees C).

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M. Receivers:

1. Comply with AHRI 495.
2. Comply with 2010 ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
3. Comply with UL 207; listed and labeled by an NRTL.
4. Body: Welded steel with corrosion-resistant coating.
5. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
6. End Connections: Socket or threaded.
7. Working Pressure Rating: 500 psig (3450 kPa).
8. Maximum Operating Temperature: 275 degrees F (135 degrees C).

N. Liquid Accumulators:

1. Comply with AHRI 495.
2. Body: Welded steel with corrosion-resistant coating.
3. End Connections: Socket or threaded.
4. Working Pressure Rating: 500 psig (3450 kPa).
5. Maximum Operating Temperature: 275 degrees F (135 degrees C).

PART 3 - EXECUTION

3.1 INSTALLATION (GENERAL)

A. Install piping as indicated on the drawings and in accordance with provisions of Section 23 0500 and the piping system application article at the end of Part 3.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Actual size and configuration of refrigerant piping shall be in conformance with the recommendations of the refrigeration equipment manufacturer.

C. Install refrigerant piping according to ASHRAE 15 and the International Mechanical Code, including the following:

1. Limitations on exposed piping within exits.
2. Requirements for refrigerant piping shafts.
3. Protection of concealed A2L refrigerants piping.
4. Shaft ventilation requirements for A2L refrigerant piping.

D. Hang horizontal piping NPS 2 (DN 50) and smaller using a metal framing system, clamps, and insulation inserts in accordance with Section 23 0529. For pre-insulated tubing systems, remove section of factory-applied insulation at metal framing system and provide specified clamps and insulation inserts. Seal ends of piping insulation and inserts in accordance with manufacturer's instructions.

E. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

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H. Install piping adjacent to machines to allow service and maintenance.

I. Install piping free of sags and bends.

J. Select components with pressure rating equal to or greater than system operating pressure.

K. Install piping as direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment.

M. Install valves and specialties in accessible locations to allow for service and inspection.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

3.2 INSTALLATION (PRE-INSULATED TUBING)

A. Install piping and seal ends of piping insulation as shown on drawings and in accordance with manufacturer's instructions and approved shop drawings.

3.3 INSTALLATION (BUILT-UP SYSTEM)

A. Install piping as shown on drawings and in accordance with manufacturer's instructions and approved shop drawings.

B. Brazed joints:

1. Install piping with brazed joints where possible.
2. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation. To permit flow and to avoid pressure build-up, make sure one end of the pipe is open.

C. Flared fittings:

1. Install piping with flared joints where required for connections.
2. Flare joints shall conform to SAE J533.

D. Threaded joints:

1. Install piping with threaded joints where required for connections.
2. Make threaded connections with pipe joint compound approved for the service, or "PTFE" tape.

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E. Isolation valves:

1. Provide isolation valves in suction and discharge lines of compressors.
2. Provide isolation valves at the inlet and outlet of liquid receivers.
3. Provide isolation valves on inlet and outlet side of filter dryers. Provide an additional isolation valve and pipe and fittings to bypass the filter dryer.

F. Check valves: Install a check valve at the compressor discharge.

G. Service valves:

1. Provide service valves to enable pressure testing, refrigerant charging, and system evacuation.
2. Provide service valves between isolation valves and compressor suction connections if they not an integral part of the isolation valves or compressor equipment.
3. Provide service valves for gage taps at inlet and outlet of strainers if they are not an integral part of valves and strainers.

H. Solenoid valves:

1. Provide solenoid valves upstream from each expansion valve.
2. Provide solenoid valves in horizontal lines with coil at top.

I. Safety relief valves:

1. Install safety relief valves where required by the ASME Boiler and Pressure Vessel Code.
2. Vent safety relief valves to the atmosphere in accordance with ASHRAE 15 and ASHRAE 34.

J. Thermostatic expansion valves:

1. Provide thermostatic expansion valves as close as possible to distributors on evaporators.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
4. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

K. Strainers: Provide strainers upstream from and adjacent to solenoid valves and thermostatic expansion valves, unless they are furnished as an integral assembly for the device being protected.

L. Moisture/Liquid Indicators: Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

M. Filter driers: Provide filter dryers in liquid line between compressor and thermostatic expansion valve.

N. Flexible connectors: Provide flexible connectors at compressor connections.

O. Muffler: Provide muffler on the discharge side of the compressor, between the flexible connector and the condenser.

P. Receivers: Provide receivers sized to accommodate pump-down charge.

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Q. Liquid accumulators: Provide liquid accumulator at compressor suction.

3.4 LEAK TEST

A. After the refrigeration systems have been installed, and prior to insulation of field joints, perform a leak test before evacuating the systems.

1. The cylinder of oil-pumped nitrogen shall be equipped with a shutoff valve, pressure reducing valve, cylinder pressure gauge, line pressure gauge, and bleed valve.

B. Remove controls or relief valves which could be damaged by test pressures.

C. Separate the high side from the low side and bleed in enough refrigerant to raise the system pressure to 12 to 15 psig (83 to 103 kPa). Then, using oil-pumped dry nitrogen, raise the pressures to the test pressures established as required in "Submittals" in Part 1 above.

D. Test the entire system for leaks:

1. Meet or exceed the requirements of the International Mechanical Code.
2. Pressure test for not less than 60 minutes.
3. Test at the design pressure listed on the system condensing unit.

E. Bleed off the pressure into cylinders, in accordance with ASHRAE Standard 147, and repair leaks. Do not attempt to repair a leak while the system is under pressure. Do not repair bad joints by remelting and adding more brazing material. Take joint apart, thoroughly clean, and remake as a new joint.

F. Retest the system if a leak is found.

G. When tests and repairs are complete, replace valves or controls removed for protection.

H. Submit test certificate required in "Submittals" in Part 1 above.

3.5 EVACUATION

A. To evacuate the system, use a vacuum pump capable of producing a vacuum with a maximum pressure of 1 mm (0.039 inches) mercury (133 microns) absolute pressure. Proceed as follows:

1. Connect an accurate high vacuum gauge, such as a Stoke's or Zimmerli gauge, to the system. Do not use compound gauges.
2. Connect the vacuum pump to both the high and low sides of the system. Leave the compressor suction and discharge valves closed. Evacuate the system to 2.5 mm (0.098 inches) mercury (333 microns) absolute pressure. Keep ambient air temperatures above 60 degrees F (15.6 degrees C) during the evacuation.
3. Break the system vacuum with oil-pumped dry nitrogen. Open the compressor suction and discharge service valves and re-evacuate the system to 2.5 mm (0.098 inches) mercury (333 microns) absolute pressure.
4. After the system has been double evacuated to 2.5 mm (0.098 inches) mercury (333 microns) absolute pressure, close the vacuum-pump suction valve and stop the pump. Allow the system to stand under a vacuum a minimum of 12 hours and recheck the vacuum. Notify the Architect in time for him to verify the test pressure at beginning and end of time limit, before proceeding to charge the system.

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3.6 CHARGING

A. Charge the system with refrigerant through the liquid-line charging valve. Use a clean strainer-drier in the charging line, along with a pressure gauge and shut-off valve to control pressures. Before starting the compressor, ascertain that the oil sight glass, if provided, is 75 percent full, and suction and discharge valves back-seated.

3.7 FINAL START-UP PROCEDURE

A. Check out operating and safety controls in accordance with the compressor manufacturer's recommendations.

B. Recheck the oil level in the sight glass at frequent intervals. It should not drop below 50 percent level.

C. Adjust compressor suction unloaders, if provided, for proper evaporator-compressor balance to maintain the scheduled minimum discharge temperature.

D. Reinspect the system after it has been in normal operation for at least 72 hours. At this time, instruct the Owner in the operation and maintenance of the equipment, as required in the equipment section.

3.8 LUBRICATION

A. If it becomes necessary to add oil to the system, use only the oil recommended by the compressor manufacturer.

3.9 PIPING SYSTEM APPLICATIONS

A. Provide built-up piping or pre-insulated piping for the following equipment as indicated:

1. Equipment:

a. Ductless split-systems

2. Piping NPS1 (DN 25) and larger shall be built-up piping.
3. Piping smaller than NPS 1 (DN 25) may be built-up piping or pre-insulated tubing.

END OF SECTION

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SECTION 23 3113 - METAL DUCTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. HVAC metal supply, return, and exhaust ductwork and plenums in pressure classes from -2 to +10 inches w.g. (-500 to +2490 Pa).

B. Joint and sealing materials.

C. Air duct leakage testing.

1.2 RELATED SECTIONS

A. Duct identification: Section 23 0500.

B. Balancing: Section 23 0593.

C. Insulation: Section 23 0713.

D. Duct support: Section 23 3114.

E. Duct accessories: Section 23 3300.

F. Louvers: Division 08.

1.3 REFERENCES

A. ASHRAE

1. ASHRAE Handbook of Fundamentals.

B. SMACNA

1. HVAC DCS: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
2. RIDCS: SMACNA Round Industrial Duct Construction Standards.
3. HVAC Air Duct Leakage Test Manual.

C. UL 181: Factory-Made Air Ducts and Air Connectors.

1.4 DEFINITIONS

A. Seam: Joining of two longitudinal (parallel to the direction of airflow) edges of duct surface material. All other duct surface connections are joints.

B. Joints: Transverse joints (perpendicular to the direction of airflow); branch and subbranch intersections; duct collar tap-ins; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

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1.5 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Do not change the layout or configuration of the duct system except as specifically approved in writing. Accompany requests for modifications with calculations showing that the proposed design will provide the original design results without increasing system total pressure.

1.6 SUBMITTALS

A. Product data: For each type of product, include a description, characteristics, materials, composition, finishes, and performance. Include the following:

1. Acoustical duct lining, adhesive, and sealants.
2. Factory-fabricated ducts and fittings.
3. Joint and sealing materials.

B. Product application schedules:

1. Schedule of duct systems with applicable pressure classes and leakage classes.
2. Schedule of sealing methods for each type of seam and joint.

C. Shop drawings:

1. Fabrication, assembly, and installation for each duct system: Indicate duct dimensions, sheet metal thickness, reinforcement spacing, and seam and joint construction; and components and attachments to other work.
2. Calculations required as specified in the article “System Performance Requirements” above.

D. Test reports: Air Duct Leakage Test Summary: Submit data on forms as indicated in the SMACNA HVAC Duct Leakage Test Manual. (See sample form at end of section.)

1.7 QUALITY ASSURANCE

A. Specified and scheduled duct construction exceeds SMACNA requirements. Comply with specifications and schedules, and for materials or methods not specified or scheduled, comply with SMACNA HVAC DCS and RIDCS.

B. Comply with NFPA 90A and 90B.

C. Where shop-fabricated ductwork and fittings are permitted, products shall meet or exceed the quality of material, quality of construction, and performance of the basis of design factory-fabricated product.

D. Where shop-fabricated ductwork and fittings are proposed, contractor shall provide a listing of ten comparable projects completed within the last five years using shop-fabricated ductwork and fittings of the type proposed as evidence of quality and performance.

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PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design products: Subject to compliance with requirements, provide specified or noted products, or comparable product by one of the following or approved equal:

1. Factory-fabricated ducts and fittings:

a. Eastern Sheet Metal
b. Hamlin Sheet Metal
c. LaPine Metal Products
d. Linx Industries
e. McGill Airflow Corp.
f. MKT Metal Manufacturing
g. Phoenix Metals
h. Semco Mfg. Inc.
i. SPIRAmir

2. Manufactured joint connectors:

a. Ductmate Industries
b. C.L. Ward & Family Inc.

B. Special use ducts and fittings: Scheduled manufacturers and named products are intended to set a standard for materials, quality of construction, and performance.

2.2 MATERIALS

A. Metal sheets:

1. Galvanized steel sheets: Lock-forming quality, ASTM A 653/A 653M, coating designation G90 (Z275).

B. Tie rods: Galvanized steel, minimum diameter 0.25 inch (6 mm) for ducts up to 36 inches (900 mm); 0.375 inch (9 mm) for ducts over 36 inches (900 mm).

2.3 SHOP-FABRICATED OR FACTORY-FABRICATED DUCTS AND FITTINGS

A. Single-wall, rectangular duct and fittings:

1. Fabricate according to SMACNA HVAC DCS.

2.4 JOINT AND SEALING MATERIALS

A. Flexible joint material for connections to vibrating equipment: Specified in Section 23 3300, Duct Accessories.

B. Duct joint and seam sealants: UL classified, fire-resistive, conforming to NFPA 90A and 90B, high pressure type (up to 10 inches (2490 Pa) SMACNA pressure class), the following products are the basis of design:

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1. Indoor application: Hardcast “Iron Grip” (IG-601) brush-on water-based vinyl acrylic sealing mastic.
2. Silicone sealant (clear): Dow Corning 795, ASTM C920, Type S, Grade NS, Class 25, single component, indoor/outdoor application, UV resistive.
3. Flange gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

PART 3 - EXECUTION

3.1 COORDINATION

A. Before fabricating ductwork, make field measurements and coordinate layout of ductwork shown on the drawings with building components and work of other trades. Resolve conflicts and obtain written approval for deviations before fabrication or buying ductwork.

B. Provide for and install control dampers, manual volume dampers, backdraft dampers, duct accessories and similar equipment furnished under this or other sections of the specifications.

C. Coordination with other work:

1. Louvers: Slope ductwork down toward the louver. Provide connections as indicated below:

a. Ductwork connection full size of louver: Provide angles, flanges, or damper collars as required to connect the ductwork to the louver.
b. Ductwork connections smaller than the full size of the louver: Blank off any unused portion of the louver with double-wall insulated metal panels with metal faces constructed of the same material as the connecting duct, and 1.5 inch (38 mm) thick minimum fiberglass insulation. Seal edges of panel insulation with sheet metal channels. Connect ductwork to insulated metal panel with using angles or flanges.
c. Damper connection to louver: Provide metal angle or channel frames as required for mounting ATC dampers and manual dampers to louvers.

2. Electrical panels and equipment:

a. Do not install ductwork over electrical panels and equipment unless otherwise indicated.
b. Where ductwork must be installed over electrical panels and equipment, provide aluminum sheet metal drain troughs under piping with drains piped to a safe location.

3. Accessories with frames: Where ATC dampers and other accessories with frames are mounted in ductwork, connect ductwork to frames in a manner to provide 100 percent free area for air passage. Seal ductwork connections to frames with gaskets or duct sealant. Secure connections with pop rivets or sheet metal screws spaced no more than 3 inches (75 mm) on centers around both sides of entire frame.

3.2 INSTALLING METAL DUCTWORK

A. Dimensions indicated on drawings are outer dimensions of ducts. Dimensions indicated for double-wall ducts are outer dimensions of outer wall.

B. Construct ductwork using the Duct Construction Schedule on the drawings. Schedule includes duct system pressure class requirements, minimum sheet metal gauges, leakage allowances, and maximum reinforcement spacing. These requirements exceed the requirements of SMACNA HVAC DCS. Engineered duct systems using metal gauges or reinforcing less than required in the schedules on the drawings are not acceptable.

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C. Material: Construct ductwork of galvanized steel, except where another material is noted on drawings or specified.

D. Joints: Provide one of the following duct joints, except where other criteria are noted on the drawings or specified. Snap-lock or flat-lock seams are not acceptable.

1. Joint connections constructed in accordance with SMACNA HVAC DCS,
2. Manufactured duct connection system basis of design: Ductmate Industries “Ductmate,” selected to assure compliance with leakage factors indicated on the drawings.

E. Provide duct systems complete with built-in accessories as specified herein, in other sections of the specifications, as indicated on the drawings, and, where not otherwise indicated, in accordance with SMACNA HVAC DCS.

F. Thoroughly clean duct and duct fittings before they are installed, and keep them clean until the acceptance of the completed work. Use a duct cap cover on all unfinished ends to prevent moisture, dirt particles, dust, and debris from entering the installed ductwork during construction.

G. Install metal ductwork neat in appearance. Interior surfaces shall be smooth and free of obstructions. Duct lines shall be true and smooth.

H. contractor has the option to eliminate reducing transitions and extend ductwork full size, providing space is available and conflict with work of other trades does not occur.

I. Make bends and turns in ductwork using offsets and curved or square elbows as indicated on the drawings. Provide full radius elbows (centerline radius equals 1.5 times duct width). Provide turning vanes in square elbows. Make 90-degree branch duct connections using 45-degree entry fittings unless otherwise indicated.

J. Generally, it is intended that horizontal ductwork be a minimum of 10 inches (255 mm) above suspended ceiling (where applicable) to allow removal of ceiling panels and ceiling-mounted light fixtures and devices. Coordinate duct installation to achieve that clearance wherever possible.

K. Unless otherwise indicated, exposed ductwork shall be mounted as high as possible.

L. Brace large ductwork connected to fans and air-handling units with metal angles to prevent vibration and duct damage, and to reduce noise.

M. Construct gravity duct systems (nonfan-powered), such as pressure relief ducts and transfer ducts, in accordance with SMACNA HVAC DCS minimum one inch pressure class unless otherwise scheduled.

N. Cross break or bead ducts of dimensions of 12 inches (305 mm) and over in pressure classes under 2 inches (500 Pa).

O. Where ducts will be exposed, remove labels and clean surfaces. Where required, prepare surface for painting.

P. Single-wall plenums, casings, and access doors: Construct in accordance with SMACNA HVAC DCS.

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3.3 SEALING DUCTWORK

A. Seal all longitudinal and transverse joints, seams, and connections with the following exceptions:

1. Sealant may be omitted from welded joints and seams provided duct leakage is within the required tolerance.
2. Sealant may be omitted from locking-type joints and seams (other than snap-lock and button-lock) in ductwork with a pressure class below 2 inches of water column (500 Pa) where permitted by code requirements and provided duct leakage is within the required tolerance.

B. Sealing leakage performance: Seal ductwork to meet duct leakage factors scheduled on the drawings.

C. Sealing procedures:

1. Prior to sealing, ductwork shall be clean and dry, free of oil or grease.
2. Apply sealant in accordance with the manufacturer's recommendations.
3. Allow time for sealant to dry or cure, in accordance with manufacturer's recommendations, before leak testing.

D. Sealant material:

1. Galvanized steel ductwork: Brush-on or pressure sensitive sealant, as applicable.
2. Aluminum ductwork: Silicone sealant.
3. Stainless steel and carbon steel ductwork: Not applicable.

3.4 AIR DUCT LEAKAGE TESTS

A. Continuously examine ductwork during construction to ascertain that it is sealed properly.

B. General test procedures:

1. Leakage test procedures shall be in accordance with SMACNA Leakage Test Manual.
2. After installation and prior to insulating, test all ductwork for air leakage. Ducts to be tested, test pressures, and leakage factors (maximum volume of leakage per 100 square foot (9.3 square meter) of duct surface area) shall be as scheduled on the drawings.
3. The ductwork quantity to be tested exceeds SMACNA leakage test manual recommendations.
4. Conduct tests before any equipment is connected that would be subject to damage from the test pressure. Provide temporary blank-offs or caps.
5. Notify parties whose presence is necessary for the test; and in all cases, the and testing and balancing subcontractor in writing at least two normal work days prior to the actual test.
6. While system is under test pressure, survey joints for audible leaks. Mark leakage points, shut down blower, and make repairs. Retest after duct sealant has dried or cured.
7. If test duct sections exceed the allotted leakage levels, locate sources of leakage, make repairs and repeat test procedures until acceptable leakage levels are demonstrated.

END OF SECTION
Leakage test form follows Section

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PROJECT NAME _____ PROJECT NO. _____ PAGE _____ OF

_____

AIR DUCT LEAKAGE TEST SUMMARY

AIR SYSTEM _____ LEAKAGE CLASS (GL) _____

FAN CFM (Q) _____ SPECIFIED TEST PRESSURE (Pt) _____

DUCT CONSTRUCTION PRESSURE CLASS (P_c) _____

DESIGN DATA				FIELD TEST DATA RECORD							
SUBJECT DUCT	SURFACE AREA (FT^2)	ALLOWABLE LEAKAGE		DIAMETER		PRESSURE "W.G."		DATE	PERFORMED BY	WITNESSED BY	ACTUAL CFM
		FACTOR (CFM/100 FT^2)	CFM (TEST SECTION)	ORIFICE	TUBE	DUCT	ACROSS ORIFICE				
TOTAL SYSTEM											
TEST SECTION(S)											

SECTION 23 3114 - HANGERS AND SUPPORTS FOR DUCTWORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Duct hangers and supports.

B. Fasteners.

1.2 RELATED SECTIONS

A. HVAC Duct Insulation: Section 23 0713.

1.3 REFERENCES

A. ASTM International

1. ASTM A 307: Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
2. ASTM A 492: Standard Specification for Stainless Steel Rope Wire
3. ASTM A 603: Standard Specification for Metallic-Coated Steel Structural Wire Rope
4. ASTM F 3125: Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated

B. American Welding Society

1. AWS-D.1.1: Structural Welding – Steel

C. Metal Framing Manufacturer’s Association

1. MFMA-4: Metal Framing Standards Publication
2. MFMA-103: Guidelines for the Use of Metal Framing

D. Manufacturer’s Standardization Society

1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

E. SMACNA

1. HVAC Duct Construction Standards - Metal and Flexible

1.4 SUBMITTALS

A. Product data:

1. Provide manufacturer’s literature showing compliance with specifications for each type of framing system, fastener and accessory materials.
2. Provide a schedule of building attachment types and associated attachment hardware and methods.

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PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. General: Comply with requirements of SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

B. Threaded rod: Continuously threaded, size and spacing in compliance with SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

1. Zinc-plated or galvanized carbon steel for indoor applications.
2. Stainless steel for outdoor and corrosive applications.

C. Nuts and washers: Provide the same material used for threaded rods.

D. Straps: Match duct material, size and spacing in compliance with SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

E. Duct attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.2 FASTENERS

A. Mechanical expansion anchors:

1. Self-drilling type expansion shields or machine bolt drop-in anchors for drilled holes. Fasteners to floor slabs shall be vibration and shock resistant. Load applied to fasteners shall not exceed 25 percent of manufacturer's stated load capacity in 3500 psi (24,000 kPa) concrete. Provide zinc-coated anchors for indoor applications and stainless-steel anchors for outdoor applications.
2. Basis of design: ITT Phillips Anchors "Red Head."

B. Fasteners to wood construction: Lag bolts.

C. Bolts, nuts, and washers: ASTM A 307, or ASTM F 3125 where high strength is required.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible.

B. Provide hangers, supports, fasteners, and attachments as required to properly support ductwork from the building structure.

C. Provide support complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Hanger Spacing: Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for maximum hanger spacing. Provide hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1220 mm) of each branch intersection.

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E. Where required, provide structural steel shapes or metal framing system channels and hardware to transfer load from a support location to multiple locations in the structure to get support from an appropriate location or to increase the strength of the connection to the structure.

F. Support horizontal rectangular ductwork from above with trapeze hangers and threaded rod or straps where possible, unless otherwise indicated.

1. Ducts 54 inches (1370 mm) wide and under:

a. Support with straps.
b. Strap hangers shall extend down sides of ducts, and attach to underside with at least two sheet metal screws per strap.

G. Where ductwork is exposed, hang ductwork as follows:

1. Rectangular ductwork:

a. Provide straps.

3.2 BUILDING ATTACHMENTS

A. Attaching to concrete slabs and composite slabs:

1. Obtain approval from the structural engineer and confirm allowable loads prior to supporting ductwork from concrete slabs or composite slabs. Where approved, provide one of the following as required:

a. Mechanical expansion anchors and steel bolts or rods.
b. Screws designed for attachment to concrete.
c. Powder actuated fasteners.

B. Attaching to wood construction:

1. General: Obtain approval from the structural engineer and confirm allowable loads prior to supporting ductwork from wood beams. Where approved, provide lag bolts.
2. Trusses: Follow roof truss manufacturers' recommendations for attachment locations, loads, spacing, and methods of attachment.
3. Joists: Provide MSS SP-58 Type 34 side beam connectors.

END OF SECTION

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SECTION 23 3300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Flexible connections.

B. Manufactured units:

1. Air turning vanes.

C. Dampers.

D. Duct clamps.

1.2 RELATED SECTIONS

A. Louvers: Division 08.

B. Diffusers, registers, and grilles: Section 23 3713.

1.3 REFERENCES

A. AMCA 210: Laboratory Methods of Testing Fans for Rating.

B. ASTM E 477: Test for Measurement of Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

C. ASTM E 2016: Standard Specification for Industrial Woven Wire Cloth.

D. NFPA 90A: Installation of Air Conditioning and Ventilating System.

E. NFPA 90B: Installation of Warm Air Heating and Air-Conditioning Systems.

F. NFPA 701: Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

G. SMACNA HVAC DCS: HVAC Duct Construction Standards, Metal and Flexible.

1.4 SUBMITTALS

A. Product data: Each type of duct accessory included in the project.

1. Include manufacturer's written installation instructions for each type of fire damper, combination fire/smoke damper, and smoke damper.

B. Shop drawings: Detail equipment assemblies and indicate dimensions, loadings, required clearances, method of field assembly, components, locations, and size of each field connection. Detail these accessories:

1. Special fittings and manual and automatic volume damper installations.

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C. Certifications: Certified test data for dynamic insertion loss; sound power levels; airflow performance data, and static pressure loss.

D. Operation and maintenance data: Include operating and maintenance data for the following in the project Operation and Maintenance Manual as specified in Division 01 with supplemental requirements as specified in Section 23 0101.

1. Dampers.

1.5 QUALITY ASSURANCE

A. Work of this section shall comply with NFPA 90A and 90B, and SMACNA HVAC DCS.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers' names and specific products are described in the articles below to set a standard for materials, quality of construction, options and details, and performance. Provide named products, or equal products by other named manufacturers.

2.2 FLEXIBLE CONNECTIONS

A. Flexible joint fabric: Woven glass fabric with coating, complying with NFPA 701 for fire retardance and NFPA 90A for use in duct systems.

1. For use indoors:

a. Coated with polychloroprene (DuPont "Neoprene"), 30 ounces per square yard (850 g per 0.8 square meter).
b. Basis of design: Ventfabrics "Ventglas."

2.3 MANUFACTURED UNITS

A. Air turning vanes: Double vane type, constructed in accordance with SMACNA HVAC DCS, from the same material as the duct.

2.4 DAMPERS

A. Manual volume dampers:

1. 12 inches (305 mm) or less in height:

a. Constructed from 16-gauge metal with hemmed edges, 0.125-inch (3-mm) maximum gap between duct and damper all around.
b. Control shaft: 0.375-inch (9.5-mm) square minimum.
c. Regulator: Locking type, provide with 2-inch-high (50 mm) minimum base for mounting on externally insulated duct. Where duct insulation is thicker than 2 inches (50 mm), provided a taller base coordinated with the duct insulation.
d. End bearing: Fastens to the outside of the duct with screws and prevents air leakage by encasing the rod and bearing with a metal cover and neoprene gasket.
e. Basis of design:

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(1) Regulator: Young Regulator Co. Model No. 443B.
(2) End bearing: Young Regulator Co. Model No. 429 FD.

B. Counterbalanced airfoil backdraft dampers (for use in fan discharge):

1. Frame: Galvanized steel channel frame with factory-applied rust-inhibitive coating.
2. Blades: 18-gauge minimum galvanized-steel airfoil type, with EPDM blade seals and neoprene jamb seals, maximum width 7 inches (178 mm), steel shaft with ball bearings, interconnected with linkage. Field adjustable counterbalance.
3. Seals: EPDM blade seals and stainless steel jamb seals.
4. Maximum leakage: 20 CFM/SF (101.6 L/s per square meter).
5. Basis of design: Ruskin Type CBS8.

2.5 DUCT CLAMPS

A. Nonmetallic duct clamps for flexible duct connections:

1. Heavy-duty adjustable nylon strap type for 12-inch (305-mm) diameter and smaller flexible ductwork, complying with UL 181.
2. Basis of design: HellermannTyton Corporation

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Duct accessories shall be mounted or installed properly in accordance with the manufacturer's instructions and as indicated on the drawings.

3.2 INSTALLING FLEXIBLE CONNECTIONS

A. Flexible connections: Install using flexible joint fabric where duct connects to motor-driven equipment, and in other locations shown on drawings. Securely clamp flexible connection to duct and collar with duct clamps, providing 1 inch (25 mm) slack. Stitch seams with fiberglass thread.

1. Nonmetallic clamps: Install in accordance with manufacturer’s recommendations, using manufacturer's special tools.

3.3 INSTALLING MANUFACTURED UNITS

A. Install necessary devices to balance the air flow to produce air quantities at outlets as indicated on the drawings.

B. Install turning vanes in 90-degree square elbows.

3.4 INSTALLING DAMPERS

A. Install dampers at locations indicated on drawings and where required to properly balance the systems and to deliver the air quantities indicated. Each damper shall have substantial operators of proper size with locking facilities.

END OF SECTION

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SECTION 23 3400 - HVAC FANS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Exhaust fans.

B. Accessories.

1.2 RELATED SECTIONS

A. UL label, demonstration, training, and equipment installation: Section 23 0500.

B. Motors: Section 23 0513.

C. Equipment hangers and supports: Section 23 0529.

D. Vibration control supports: Section 23 0548.

E. Backdraft dampers: Section 23 3300.

1.3 REFERENCES

A. ASHRAE 90.1: Energy Standard for Sites and Buildings Except Low-rise Residential Buildings.

1.4 SUBMITTALS

A. Product data: For each type of fan, include the following:

1. Product description, rated capacities, operating characteristics, materials, finishes, and furnished specialties and accessories.
2. Certified fan curves with system operating conditions indicated. Include static pressure, brake horsepower, and static efficiency plotted against air volume.
3. Verification that products comply with ASHRAE 90.1 fan efficiency requirements.
4. Dampers, including housings, linkages, and operators.
5. Fan speed controllers.
6. Certified fan sound power ratings.

B. Product schedule: Provide a fan schedule with the following as a minimum:

1. Equipment identification tags.
2. Unit electrical characteristics.
3. Equipment model numbers, types, nominal sizes, and arrangements.
4. Operating conditions and flow rates.
5. Motor types, electrical characteristics, and accessories.
6. Furnished specialties and accessories.
7. Verification of compliance with any additional information scheduled on the drawings.

C. Shop drawings:

1. Unit shop drawings: Include the following for each type of fan:

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a. Dimensioned plans, elevations, and sections of complete assembled units with accessories.
b. Required service clearances.
c. Weights, loads, and support and attachment details.
d. Details of equipment components and assemblies, and any required field assembly.
e. Location and size of each field connection.
f. Diagrams for power, signal, and control wiring, differentiating between manufacturer-installed and field-installed wiring.

D. Samples: Manufacturer's complete line of color chips.

E. Operation and maintenance data: Include operating and maintenance data for each fan in the project Operation and Maintenance Manual as specified in Division 01 with supplemental requirements as specified in Section 23 0101.

1.5 QUALITY ASSURANCE

A. UL label: As specified in Section 23 0500, Common Work Results for HVAC.

B. Fans shall meet the energy performance requirements of ASHRAE 90.1.

C. Fans shall be tested and rated in accordance with the applicable AMCA Standard Test Code and Certified Rating Program and bear AMCA Certified Air Rating Seal.

D. Make fan selections to the right of the peak static pressure point and not on any flat portion of the fan curve. Generally, fan selection shall be in the 50 to 80 percent range of wide open volume.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Scheduled units are the basis for design of the project. The manufacturers listed also provide units of acceptable quality. If units by any of these manufacturers should be proposed, verify that they meet requirements specified in Division 01 and the article "Product Options" in Section 23 0101, and submit shop drawings and product data as specified in Part 1 above.

B. Exhaust fans, or approved equal:

1. Aerovent, a Twin City Fan Company
2. Acme Engineering and Manufacturing
3. Greenheck Fans.
4. Jenco Fan.
5. Loren Cook, Inc.
6. Penn Barry.
7. Twin City Fans and Blowers.

2.2 GENERAL REQUIREMENTS

A. Provide type, size, configuration, capacity, class, and current characteristics indicated on the drawings.

B. Units shall be factory-assembled, -wired, -finished, and -tested, and shipped in one piece.

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C. Motors:

1. Provide motors that meet requirements in Section 23 0513, Common Motor Requirements for HVAC Equipment.
2. Where electronically commutated motors are schedule, provide a controller with both of the following:

   a. Provide with a potentiometer for adjustment of constant speed operation, field-adjustable with a screwdriver to adjust the fan speed, and low voltage input terminals to receive a control signal from the building automation system to start and stop the fan motor.

3. Provide single-phase constant speed motors for directly driven units with solid-state variable speed control connected downstream on the load side of the disconnect switch, unless otherwise indicated on the drawings.

D. Fans shall be statically and dynamically balanced.

E. Shaft bearings: Unless otherwise indicated, provide the following:

1. Self-aligning ball bearings.
2. Rigidly supported from the fan structural base or frame.
3. Grease lubricated.
4. Extended lubrication lines to an easily accessible location.

2.3 EXHAUST FANS

A. In-line fan (square): Fan housings and other parts shall be aluminum or steel. Provide support brackets for mountings as shown on drawings. Directly driven units shall have motors out of air stream and shall be prewired to an external twist-lock receptacle.

1. Wheel: Backward-inclined, non-overloading, airfoil aluminum blades, inlet cones.
2. Direct drive or belt-driven as scheduled.
3. Motor and fan support:

   a. Direct-drive: Motor mounted on steel base within fan casing.
   b. Moving parts shall be provided with vibration isolation.

2.4 ACCESSORIES

A. Backdraft dampers:

1. Provide each fan with self-operating aluminum backdraft damper and frame. Damper blades shall operate in unison and shall be counterbalanced or otherwise provided with facilities to positively open under fan suction and to close tight when subject to backdraft.
2. Dampers may be provided by the fan manufacturer as an accessory, but must have a maximum leakage rate of 20 CFM/SF (101.6 L/s per square meter). Where this leakage rate cannot be obtained with a manufacturers' fan accessory, provide a backdraft damper in compliance with Section 23 3300, Duct Accessories.

B. Identification: Each fan shall be identified with a fan number no less than 0.5 inch high, as shown in the fan schedule, on an aluminum strip riveted to hood of roof fans and on the motor side of frame for wall fans.

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PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install equipment as indicated on the drawings. Comply with requirements in Section 23 0500.

B. Provide bird screens for fans without ducted inlets.

3.2 EXHAUST FANS

A. In-line fans:

1. Suspend from structure above.
2. Provide vibration isolation. Comply with requirements in Section 23 0548.

3.3 ADJUSTING

A. Coordinate with air balancing to adjust fan speed to obtain the airflow and static pressure required.

3.4 DEMONSTRATION AND TRAINING

A. Provide demonstration and training as specified in Section 23 0500.

END OF SECTION

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SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wall-mounted grilles.

1.2 RELATED SECTIONS

A. Balancing: Section 23 0593.

B. Louvers: Division 08.

1.3 REFERENCES

A. NFPA 90A: Standard for the Installation of Air-Conditioning and Ventilating Systems.

1.4 SUBMITTALS

A. Product data:

1. Each type of diffuser, register, and grille, including the following:

a. Frame style
b. Accessories
c. Mounting details
d. Available materials and finishes
e. Performance data including throw, static-pressure drop, and noise ratings

B. Shop drawings:

1. For each diffuser, register, and grille, provide a schedule including the following:

a. Location
b. Quantity
c. Type
d. Size
e. Function
f. Material
g. Finish

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Grilles, registers and diffusers, or approved equal:

1. Hart and Cooley Inc.
2. Krueger.
3. Metalaire.
4. Nailor Industries, Inc.

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5. Price Company.
6. Titus Products.

2.2 DIFFUSERS, REGISTERS, AND GRILLES

A. Devices of one of the named manufacturers, with performance data, characteristics, features, and accessories of the model or type specified or indicated on the drawings. Model numbers specified below are Krueger except as noted otherwise.

B. See architectural drawings for type of walls and ceilings where diffusers, grilles, and registers are required. Coordinate margin and frame of each device with the substrate in which it will be installed. Where devices are installed in suspended ceilings, assure that they will fit correctly in the type of suspension supports shown or specified.

C. Materials and finish:

1. Construction:

a. Either aluminum or steel where mounted in walls near ceiling.

2. Finish:

a. White enamel unless indicated otherwise.

2.3 RETURN AND EXHAUST GRILLES AND REGISTERS

A. Wall-mounted near ceiling: Grilles, fixed horizontal face bars set at 35 to 45 degrees deflection, minimum 1.25-inch (32-mm) margin.

1. Basis of design:

a. Grilles: Krueger S-80H (steel); S-580H (aluminum).

PART 3 - EXECUTION

3.1 INSTALLING GRILLES

A. Securely attach grilles in place. Do not install the grilles and registers until duct interiors have been painted as specified in Section 23 0500, Common Work Results for HVAC.

B. Install all air control devices complete with the accessories specified, securely attached in position. Make operating devices accessible.

END OF SECTION

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SECTION 23 8127 - DUCTLESS SPLIT-SYSTEM UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Interior units.

B. Exterior units.

C. Controls.

1.2 RELATED SECTIONS

A. Refrigeration service and compressor warranty: Section 23 0100.

B. UL label, demonstration, training, and equipment installation: Section 23 0500.

C. Motors: Section 23 0513.

D. Refrigerant piping: Section 23 2300.

E. Disconnect switches: Division 26.

1.3 REFERENCES

A. AHRI 210/240: Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment.

B. ASHRAE 15: Safety Standard for Refrigeration Systems.

C. ASHRAE 90.1: Energy Standard for Sites and Buildings Except Low-rise Residential Buildings.

1.4 PERFORMANCE REQUIREMENTS

A. Design of the HVAC system, including associated work of other design disciplines and trades, is based on scheduled and specified equipment. If a different item of equipment should be proposed, as permitted under the article “Acceptable Manufacturers” below, ascertain that it will:

1. Perform to the scheduled and specified capacities.
2. Make no additional demands on other systems such as electricity.
3. Meet or exceed all specified requirements.
4. Electrical power connections for the basis-of-design unit require the indoor unit to be wired through the outdoor unit. Other manufacturers may require separate power connections, which the contractor shall provide as required.

1.5 SUBMITTALS

A. Product data:

1. Equipment: For each indoor unit and outdoor unit, include the following:

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a. Product description, rated capacities, operating characteristics, materials, finishes, and furnished specialties and accessories.
b. Refrigerant charge quantity and type.
c. Verification of compliance with ASHRAE 90.1.

B. Product schedule: Provide a ductless split-system schedule with the following as a minimum:

1. Equipment identification tags.
2. Equipment model numbers, types, nominal sizes, and arrangements.
3. Unit electrical characteristics.
4. Operating conditions.
5. Operating capacities at operating conditions, accounting for any deration required by refrigerant piping length.
6. Furnished specialties and accessories.
7. Verification of compliance with any additional information scheduled on the drawings.

C. Shop drawings:

1. Equipment shop drawings: Include the following for each indoor unit and outdoor unit:

a. Dimensioned plans, elevations, and sections of complete assembled units with accessories.
b. Required service clearances.
c. Weights, loads, and support and attachment details.
d. Details of equipment components and assemblies.
e. Details of and any required field wiring or field assembly.
f. Location and size of each field connection.
g. Diagrams for power, signal, and control wiring.

2. Refrigeration system shop drawings:

a. Provide design of refrigeration piping for remote condensing units prepared by manufacturer of the refrigeration compressor. Show oil traps and accessories specified in Section 23 2300, Refrigerant Piping, as well as those required by the manufacturer.
b. Provide a condensing unit capacity curve showing that direct expansion coil capacity balances with the corresponding condensing unit.

D. Samples: Color chips, showing manufacturer’s complete line of finishes.

E. Operation and maintenance data: Include operating and maintenance data for the following in the project Operation and Maintenance Manual as specified in Division 01 with supplemental requirements as specified in Section 23 0101.

1. Interior units.
2. Exterior units.
3. Controls.

1.6 QUALITY ASSURANCE

A. UL label: As specified in Section 23 0500, Common Work Results for HVAC.

B. Comply with ASHRAE 15 for equipment design, construction, leak testing, and installation.

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C. Ductless split-systems shall meet the energy performance requirements of ASHRAE 90.1.

D. Certify unit capacity in compliance with AHRI 210/240.

1.7 WARRANTY

A. Provide special warranty as required in Section 23 0100 for refrigeration equipment, including compressors.

1.8 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 and location of intended use. Deliver and store in a location directed by the Owner, or as indicated below.

1. For each interior unit with a washable filter, furnish one extra washable filter per unit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled Mitsubishi Electric Corporation P Series unit, or comparable product by one of the following or approved equal:

1. Daikin
2. Mitsubishi Electric Corporation
3. LG
4. Trane

2.2 GENERAL REQUIREMENTS

A. Provide type, size, configuration, capacity, and current characteristics indicated on the drawings.

B. Units shall be factory-assembled, -piped, -wired, -finished, and -tested, and shipped in one piece.

C. Provide motors that meet requirements in Section 23 0513, Common Motor Requirements for HVAC Equipment.

D. Provide each unit with factory-installed means of disconnect in compliance with NFPA 70 (NEC) and applicable local codes. Where the equipment nameplate refers to a fuse or a maximum fuse size, provide a fused disconnect switch. In the event a factory installed disconnect is not available, or a fused disconnect switch is required but is not available from the manufacturer, provide an approved means of disconnect for field mounting.

E. Refrigerant:

1. R-410A.
2. Ship with a shipping charge of refrigerant or nitrogen and seal.
3. Provide a full charge of refrigerant and oil in the field.
4. See Section 23 2300 for refrigerant piping work.

F. Test, rate, and certify system performance in accordance with AHRI 210/240.

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G. Heat pump units: Include reversing valves and defrost controls. When heat is called for, the reversing valve reverses the refrigerant flow, the interior coil operates as a condenser, heat is circulated into the room, and the outdoor coil operates as an evaporator.

2.3 INTERIOR UNIT

A. Frames: Steel angles or aluminum extrusions, welded construction.

B. Panels:

1. Insulated with 0.5-inch (13-mm) thick, 2 lbs per cubic foot (32 kg per cubic meter) density glass fiber insulation, with an R value no less than 15.
2. Fasteners: Concealed, captive, easily operated for access without tools.
3. Finish: Baked enamel.

C. Grilles:

1. Aluminum.
2. Finish: Brushed.
3. One-piece construction. Foam gasket providing airtight seal between grille and cabinet. Supply grille adjustable in three directions. Return air grille hinged for access to filter.

D. Cooling coil: Aluminum fins extruded on to copper tubing with quick connections to pre-charged tubing. Pressure tested at 1.5 times working pressure. Provide expansion device.

E. Drain pan: Insulated steel or plastic, with connections to exterior of cabinet.

1. Slope to drain in two directions, minimum 0.25 inch in 1 foot, to 0.75-inch drain connection.
2. Provide access for cleaning.

F. Fan assembly:

1. Wheel: Centrifugal.
2. Direct drive.
3. Motor support: vibration isolators.

G. Filter: Washable. Coordinate piping and electrical connections so they do not interfere with filter access.

2.4 EXTERIOR UNIT

A. Cabinet:

1. Steel.
2. Finish: Baked enamel.
3. Weatherproof construction.

B. Refrigeration circuit:

1. Compressors: Welded shell; rotary screw or scroll type.
2. Condenser:

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a. Condenser coil: Constructed of copper tube and aluminum fins, factory leak-tested at 1.5 times working pressure, and dehydrated. Provide subcooler and accumulator.
b. Fan assembly:

(1) Propeller: Statically and dynamically balanced.
(2) Motor: speed-controlled.

c. Direct drive.

3. Equipped with refrigerant; access valves in suction and liquid lines; filter dryer, sight glass, and pressure fittings for charging and evacuation.

2.5 CONTROLS

A. Wall-mounted hard-wired controllers shall incorporate the following features:

1. Operation mode setting (Heat, Auto, Cool)
2. Temperature setting: The LCD indicator displays the set temperature in units of 2 degrees F.
3. Room temperature (intake air) display
4. 24-hour on/off timer: Operation can be set to start or stop after a specified time in 1-hour increments from 1 to 24. The remaining time is indicated on the LCD display.
5. Fan speed indicator: Displays the fan speed setting (high or low).
6. Vane control: The angle of the air outlet vanes can be adjusted to one of four positions by pressing the air discharge Up/Down button.
7. Auto air swing vanes: The air outlet vanes swing up and down for uniform air distribution.
8. Self-diagnostic display: When unit stops, the display indicates where the trouble is located.
9. Memory feature for storing instructions.
10. Low ambient control: Provide head pressure control and accessories required to operate at temperatures down to 0 degrees F (minus 18 degrees C).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units as indicated on the drawings. Comply with requirements in Section 23 0500.

B. Support:

1. Indoor units:

a. Ceiling-mounted units: Suspend from structure above.
b. Wall-mounted units: Support via attachment to wall.

2. Outdoor units:

a. Roof-mounted units: Provide a roof curb or rails and mount on curb or rails.
b. Units mounted at grade: Mount on structural foundation. See drawings for details.

C. Vibration isolation:

1. Indoor ceiling-mounted units: Provide vibration isolation using neoprene washers or grommets at threaded rod connections to the unit or using neoprene vibration isolation hangers.

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D. In rooms with ceilings, provide associated piping, wiring, and conduit concealed above ceilings.

E. In rooms without ceilings, provide associated piping, wiring, and conduit with a neat, finished appearance.

F. In a finished space, provide associated piping, wiring, and conduit behind finished surfaces.

G. For wall-mounted units in occupied areas, provide line set covers matching indoor terminal unit color. Conceal all exposed refrigerant line sets and condensate drain piping.

1. Line set covers not required for units serving utility spaces, such as elevator machine rooms, storage rooms, and electrical rooms.
2. Basis of design: Aerco, Inc. “Slim-Duct-MD”, Rectorseal “Slimduct”, or Diversitech “Speedichannel.”

H. Provide accessories required for low ambient operation.

I. Filters: Provide temporary protection and wash filters as specified in Section 23 4100.

3.2 SYSTEM CONTROLS INSTALLATION

A. Provide the entire system with required controls, including wall-mounted controller, designed and installed by the equipment manufacturer to provide a complete working system.

B. Provide wiring in compliance with the requirements of the Division 23 Section “Control System Wiring.”

3.3 REFRIGERATION SYSTEM START-UP AND SERVICE

A. Provide refrigeration system start-up by a factory-trained service and maintenance agency. Comply with requirements in Section 23 0100.

B. Provide refrigeration system service during the project correction period by a factory-trained service and maintenance agency. Comply with requirements in Section 23 0100.

3.4 DEMONSTRATION AND TRAINING

A. Provide demonstration and training as specified in Section 23 0500.

END OF SECTION

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SECTION 23 8229 - RADIATORS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Radiators.

1.2 RELATED SECTIONS

A. Equipment installation: Section 23 0500.

1.3 SUBMITTALS

A. Product data: For each type of radiator, include the following:

1. Product description, rated capacities, operating characteristics, materials, finishes, and furnished specialties and accessories.

B. Product schedule: Provide a radiator schedule with the following as a minimum:

1. Equipment identification tags.
2. Equipment model numbers, types, nominal sizes, and arrangements.
3. Unit electrical characteristics.
4. Operating conditions and flow rates.
5. Operating capacities at operating conditions and flow rates.
6. Motor types and electrical characteristics.
7. Furnished specialties and accessories.
8. Verification of compliance with any additional information scheduled on the drawings.

C. Shop drawings: Include the following for each type of radiator:

1. Dimensioned plans, elevations, and sections of complete assembled units with accessories.
2. Required service clearances.
3. Weights, loads, and support and attachment details.
4. Details of equipment components and assemblies.
5. Details of and any required field wiring or field assembly.
6. Location and size of each field connection.
7. Diagrams for power, signal, and control wiring.

D. Samples: Manufacturer's complete line of color chips.

E. Operation and maintenance data: Include operating and maintenance data for each radiator in the project Operation and Maintenance Manual as specified in Division 01 with supplemental requirements as specified in Section 23 0101.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Provide type, size, configuration, and capacity indicated on the drawings.

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B. Units shall be factory-assembled, -finished, and -tested, and shipped in one piece.

2.2 RADIATORS

A. Construction:

1. Electric wall panel type radiator constructed of welded steel with powder coat finish (color selected by the Architect).

B. Provide units of convection capacity, size, length, model, voltage and wattage indicated on drawings.

C. Basis of design: Runtal North American, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units as indicated on the drawings. Comply with requirements in Section 23 0500.

3.2 DEMONSTRATION AND TRAINING

A. Provide demonstration and training as specified in Section 23 0500.

B. Support via attachment to wall with manufacturer’s wall mounting bracket.

END OF SECTION

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SECTION 23 8238 - ELECTRIC RESISTANCE TERMINAL UNITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electric propeller unit heaters.

1.2 RELATED SECTIONS

A. UL label, demonstration, training, and equipment installation: Section 23 0500.

B. Motors: Section 23 0513.

C. Disconnect switches: Division 26.

1.3 SUBMITTALS

A. Product Data: For each type of electric resistance terminal unit, include the following:

1. Product description, rated capacities, operating characteristics, materials, finishes, and furnished specialties and accessories.

B. Product schedule: Provide an electric resistance terminal unit schedule with the following as a minimum:

1. Equipment identification tags.
2. Equipment model numbers, types, nominal sizes, and arrangements.
3. Unit electrical characteristics.
4. Operating conditions and flow rates.
5. Operating capacities at operating conditions and flow rates.
6. Motor types and electrical characteristics.
7. Furnished specialties and accessories.
8. Verification of compliance with any additional information scheduled on the drawings.

C. Shop drawings: Include the following for each type of electric resistance terminal unit:

1. Dimensioned plans, elevations, and sections of complete assembled units with accessories.
2. Required service clearances.
3. Weights, loads, and support and attachment details.
4. Details of equipment components and assemblies.
5. Details of and any required field wiring or field assembly.
6. Location and size of each field connection.
7. Diagrams for power, signal, and control wiring.

D. Coordination drawings: Unit shown on drawings is based on the dimensions of the design basis unit specified in Part 2 below. If another acceptable manufacturer’s unit should be proposed, ascertain that it will fit in the available space. Include, if necessary, scale drawings similar to the contract drawings, including plans, elevations, sections, and diagrams, showing any changes in wiring, arrangement, or access necessary to accommodate the proposed unit. Show complete dimensions of complete assembled unit with accessories.

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E. Samples: Manufacturer's complete line of color chips.

F. Operation and maintenance data: Include operating and maintenance data for each electric resistance terminal unit in the project Operation and Maintenance Manual as specified in Division 01 with supplemental requirements as specified in Section 23 0101.

1.4 QUALITY ASSURANCE

A. UL label: As specified in Section 23 0500, Common Work Results for HVAC.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide the scheduled units or comparable models of one of the following or approved equal:

1. Electric propeller unit heaters.

a. Berko Electric Heating
b. General Electric Co.
c. Markel Products, Inc.
d. Qmark
e. Vulcan Radiator Corp.

2.2 GENERAL REQUIREMENTS

A. Provide type, size, configuration, capacity, and current characteristics indicated on the drawings.

B. Units shall be factory-assembled, -piped, -wired, -finished, and -tested, and shipped in one piece.

C. Provide motors that meet requirements in Section 23 0513, Common Motor Requirements for HVAC Equipment.

D. Provide each unit with factory-installed means of disconnect in compliance with NFPA 70 (NEC) and applicable local codes. In the event a factory installed disconnect is not available, provide an approved means of disconnect for field mounting.

2.3 ELECTRIC PROPELLER UNIT HEATERS

A. Type, capacity, and current characteristics are indicated on the drawings.

B. Enclosure:

1. Constructed of 18 gauge die-formed furniture grade steel.
2. Provide a discharge grille with individual adjustable louvers.
3. Resiliently mounted fan and motor guard.

C. Mounting:

1. Designed for either wall-mounting or ceiling suspension mounting.
2. Include mounting device for wall-mounted or ceiling mounting applications as required.

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D. Finish: Baked enamel.

E. Fan assembly:

1. Propeller: Aluminum, statically and dynamically balanced.
2. Motor: TEFC, sleeve-bearing type.
3. Direct drive.

F. Heating element: Metal sheath finned-tube.

G. Controls:

1. Temperature control:

a. Built-in 24-volt transformer relay and remote factory-furnished wall-mounted thermostat.

2. Automatic reset, thermal overheat protection.

H. Provide unit with a disconnect switch for field installation.

I. Basis of design: Marley MUH

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate with other trades to ensure that recess or bracing in walls is constructed in locations and with dimensions required for installation of recessed or surface-mounted units.

3.2 INSTALLATION, GENERAL

A. Install units as indicated on the drawings. Comply with requirements in Section 23 0500.

B. Install manufacturer's access fitting for access to electrical connections, controls, and other fittings.

3.3 INSTALLING PROPELLER UNIT HEATERS

A. Suspend from structure above.

B. Provide vibration isolation using neoprene washers or grommets at threaded rod connections to the unit or using neoprene vibration isolation hangers.

3.4 ADJUSTING

A. For ducted cabinet unit heaters, coordinate with air balancing subcontractor to adjust fan speed to obtain the airflow and static pressure required. If necessary, provide parts required to complete balancing.

3.5 DEMONSTRATION AND TRAINING

A. Provide demonstration and training as specified in Section 23 0500.

END OF SECTION

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SECTION 26 0101 - ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for electrical work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Green Globes certification and construction waste management: Division 01.

C. Commissioning requirements: Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 26.

B. Visit the site and study aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of labor, equipment and materials, and the performance of operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for necessary signatures and paperwork, permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Electrical work of this project includes, as a brief general description, the following:

1. Lighting and lighting controls.
2. Power distribution.
3. Raceway provisions for voice/data and audio/video communications systems.
4. Raceway provisions for security systems.
5. The project includes commissioning under the direction of a Commissioning Agent (CxA).
6. The project will be Green Globes certified.

F. See Division 01 for requirements related to Green Globes certification, commissioning, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

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1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 26 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for coordination and additional costs as specified in article “Substitutions” below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
2. Where specification permits “equal” products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 26 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

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F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project, and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. Equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. Materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

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B. Plan and coordinate work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electrical work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of conduit, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent electrical foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.

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4. Exclusively electrical items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.
5. Product data sheets shall be 8.5-inches by 11-inches cut sheets for operating and maintenance manual.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

a. Contract Drawings.
b. Specifications.
c. Addenda.
d. Change Orders and other Modifications to the Contract.
e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

a. Manufacturer's name and product model and number.
b. Product options, substitutions, or alternates utilized.
c. Changes made by addenda and modifications.

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5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

    a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
    b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
    c. Field changes of dimension and detail.
    d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
3. Prepare binder covers with printed title “OPERATION AND MAINTENANCE INSTRUCTIONS,” and title of project. Print on spine of binder “O & M INSTRUCTIONS.” If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
4. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
5. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
6. Part 1: Directory, listing names, addresses, and telephone numbers of electrical engineers; contractor; electrical subcontractors; and major electrical equipment suppliers.
7. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

    a. Significant design criteria.
    b. List of equipment.
    c. Parts list for each component, including recommended spare parts list.
    d. Operating instructions.
    e. Maintenance instructions for equipment and systems.
    f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

8. Part 3: Project documents and certificates, including the following:

    a. Shop drawings and product data.
    b. Photocopies of certificates.
    c. Photocopies of warranties, guarantees, and bonds.
    d. Test reports: Copies of the results of tests required under sections of specifications.

9. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.

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10. Submit final volumes revised within ten days after final inspection.
11. Submit operation and maintenance data in electronic format using USB flash drive with storage media.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code (NFPA).
4. International Building Code (IBC).
5. International Energy Conservation, Fire, and Electrical Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. American Association of State Highway and Transportation Officials (AASHTO)
2. American National Standards Institute (ANSI)
3. American Society for Testing and Materials (ASTM)
4. International Code Council (ICC)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. Maryland Occupational Safety and Health Act (MOSHA)
7. National Electrical Code (NEC) (NFPA 70)
8. National Electrical Manufacturer’s Association (NEMA)
9. National Fire Protection Association (NFPA)
10. The Occupational Safety and Health Act (OSHA)
11. Underwriters Laboratory Inc. (UL)
12. Illuminating Engineering Society of North America (IESNA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for contents within these areas. Provide security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

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C. Store electrical construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Electrical equipment such as motor controllers, panelboards and circuit breakers stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.
6. Seal off return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect electrical materials and products from weather events and accidents of construction.

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F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in “Cutting and Patching” below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 ENVIRONMENTAL REQUIREMENTS

A. Waste management: Recycle waste materials, including packaging materials, in accordance with Division 01 Section Construction Waste Management Requirements.

1.19 WARRANTY

A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty. In addition, provide added special warranties as specified in individual sections.

B. During the warranty (correction) period, the Contractor shall promptly correct any work found to be defective or otherwise not in accordance with the requirements of the Contract Documents, on receipt of written notice from the Owner. Except as otherwise required in General Conditions and Division 01, the warranty (correction) period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner.

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers’ standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

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E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.20 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of conduits. Close superfluous openings and remove debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

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3.4 COMMISSIONING

A. Comply with requirements of ‘Commissioning” in Part 1 above.

END OF SECTION

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SECTION 26 0500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 26.

B. Basic materials and equipment required for electrical work.

C. Date sensitive equipment.

D. Operating instructions.

E. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 26 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 26 0101.

C. Painting: Division 09.

D. Green Globes certification and construction waste management: Division 01.

E. Commissioning requirements: Division 01.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.

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2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

1.5 SUBMITTALS

A. Green Globes submittal:

1. Product data for Adhesives and Sealants VOC Limits 3.7.2.1.1: For adhesives and sealants, include printed statement of VOC content.
2. Product data for Building Materials and Building Envelope 3.1.2.3: For wood products such as plywood equipment backboards, include printed statement of non-urea-formaldehyde component present in material.

B. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.

B. Electrical control panels, equipment, materials and devices provided or installed as work of Division 26 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. The project shall be Green Globes certified. See requirements specified in Division 01 and individual sections for Green Globes requirements, waste and air quality control.

D. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

E. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Techniques, testing, and operating instructions specified in this section apply to products specified in other sections of Division 26.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

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2.2 MATERIALS

A. Electrical equipment backing panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 0.5 inch (13 mm) nominal.

1. One side finished.
2. No added urea formaldehyde resins.

B. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
e. Wood floor plates that are installed over concrete slabs-on-grade.

C. Nameplates: Laminated plastic, engraved, white letters on black background, except where other colors are noted or specified.

1. Size: Minimum 0.75 inch (19 mm) by 2.5 inches (64 mm).
2. Letter size: Minimum height 0.1875 inch (5 mm).
3. Fasteners: Vandalproof brass screws or rivets.

D. Aircraft cable: 0.25-inch (6-mm) steel wire rope, galvanized, construction 7 by 19 strands, minimum 7000 lbs (31138 N) breaking strength.

E. Adhesives, sealants, paints and coatings applied within building waterproofing envelope: Comply with low-emitting requirements in Division 01 Section "Indoor Air Quality Requirements."

2.3 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

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PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic, and do not indicate all fittings or offsets in conduit or all pull boxes, access panels, or other specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No conduit shall be run below the head of a window or door.

D. Equipment and conduits installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Install conduit exposed to view parallel with the lines of the building and as close to walls, columns, and ceilings as may be practical, maintaining adequate clearance for access at parts requiring servicing.

B. Install conduit a sufficient distance from other work to permit a clearance of not less than 0.5 inch (13 mm) between its finished covering and adjacent work.

C. Pull boxes and other appurtenances which require operation or maintenance shall be easily accessible. Do not cut or form handholes for operation or maintenance of appliances through walls or ceilings.

D. Install plywood backing panels with finished face exposed.

3.3 TESTS

A. During the progress of the work and after completion, test the branch circuits and distribution system, and the low-voltage alarm and signal systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

D. Tests shall demonstrate the following:

1. Lighting, power, and control circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.

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3. The resistance to ground of each non-grounded circuit is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Circuits are operable. Demonstration shall include functioning of each control not less than ten times, and continuous operation of each lighting and power circuit for not less than 0.5 hour.

E. Test circuit breakers larger than 100 amps at full voltage.

F. Make voltage built-up tests with a voltage sufficient to determine that no short circuits exist.

G. Immediately repair defects and retest until systems are operating correctly.

H. Submit test reports.

3.4 OPERATING INSTRUCTIONS (DEMONSTRATION)

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electrical systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

1. Instructions by manufacturer's technical representative for each type of equipment shall include the performance of the recommended preventive maintenance procedures for that equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

END OF SECTION

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SECTION 26 0501 - EXCAVATION AND FILL FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Trenching, backfilling, and compacting for electrical work underground inside the building and extending five feet beyond exterior building walls, and outside the building as shown on drawings.

B. Restoring and reseeding grassed areas.

1.2 RELATED SECTIONS

A. Cutting and patching: Division 01 and Section 26 0101.

B. Conduit: Section 26 0533.

C. Service entrance: Section 26 0541.

D. Identification for electrical systems: Section 26 0553.

1.3 REFERENCES

A. ASTM D 1557: Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/cu ft (2700 kN-m/cu m)).

1.4 SUBMITTALS

A. Shop drawings: At the same scale as the contract drawings, showing field verified locations of utilities, and proposed detailed trenching plan.

B. Product data: Seed and mulch.

C. Certifications: Test reports showing that compaction meets specified requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Backfill: Earth materials, free from perceptible amounts of wood, debris, or topsoil, free of frost at the time of placement, and not containing marl or other elements which tend to stay in a plastic state.

B. Grass seed: Fresh new-crop seed, 90 percent pure and 85 percent germination.
Mix: 70 percent Kentucky Bluegrass, 25 percent Red Fescue and 5 percent Red Top.
Only strains of Kentucky Bluegrass found adaptable to Maryland shall be acceptable.

C. Mulch: Free of sticks, weeds, or other foreign matter; either licorice root, tan root, or tan bark; fibrous by-product of extraction. Use only one type throughout the project.

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2.2 EQUIPMENT

A. Mechanical tampers for compacting backfill: Capable of exerting a blow equal to 250 pounds per square foot (12 kPa) of area of the tamping face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Contact local utility company underground information service (SMECO Utility) before beginning excavation outside buildings.

B. The general locations of underground utilities are indicated on the drawings and are not to be assumed to be accurate or complete. Before beginning work, field check the area with the most accurate instruments available, such as Fisher Labs' Pipe and Cable Locators.

3.2 INSTALLATION

A. Perform all excavating, cutting of paved areas, trenching, sheeting, shoring, backfilling, and compacting required for the proper installation of the work.

B. Where obstructions are encountered, obtain written approval and make necessary changes in line, grade or location.

C. Protect existing utilities from damage during excavation and backfilling. Repair damaged new or existing work at no addition to the contract sum. Bracing, shoring and other protection of existing utilities is part of this work.

D. Do not damage or remove existing shrubs or trees including their root systems, without prior notification to the Architect.

E. Provide temporary roadways over trenches with railings and other safeguards, including amber blinker lamps or other warnings for night use.

F. Note the depths of footings. In cases where conduit is in close proximity to or below footings and where the natural earth under footings is disturbed, after the line is installed the voids shall be filled up to bottoms of such footings with solid concrete.

3.3 CUTTING

A. Cut concrete and asphalt concrete with masonry saw prior to breaking it into smaller pieces for removal.

B. Cut sidewalks perpendicular to the length at the closest existing joint that is a minimum of 24 inches back from either side of the top of the new trench.

3.4 TRENCHING

A. Excavations inside the building shall be carefully planned. Stockpile excavated earth so as not to interfere with other construction. Dig trenches to the proper depths, providing extra depressions where required for hubs of pipes.

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B. Excavations outside the building shall generally follow the routes indicated on the drawings. Stockpile topsoil separately for later replacement. Excavations shall be of sufficient depths to provide, unless indicated otherwise on the drawings, a minimum cover as follows:

1. Electrical conduit: Depth required by NFPA 70 (NEC).

C. Trenches shall be of necessary depth and width for the proper laying of conduit with a minimum of 8 inches (205 mm) on each side of the joint.

1. The sides shall be as nearly vertical as practicable. Unless local regulations are more strict, trenches 4 ft. (1220 mm) and deeper shall have shored sides as required by OSHA trenching regulations.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for each section of conduit on undisturbed soil at every point along its entire length, except for bell holes.
3. No greater length of trench shall be left open, in advance of the completed structure placed in it, than can be completed in that day's operation.
4. Except where rock is encountered, do not excavate below the depths required. Where rock excavation is required, excavate to a depth of at least 6 inches (150 mm) below the trench depth and fill the overdepth with compacted crusher run or bank run stone or sand. Unauthorized overdepths in excavation shall be backfilled with crushed stone, slag or gravel, thoroughly compacted.
5. Whenever wet or otherwise unstable soil is encountered, it shall be removed to the depth and extent directed, and the trench backfilled to the proper grade with crushed stone, slag or gravel.

D. Should springs be encountered within the work area, or soft soil conditions at the elevations required for load bearing, immediately notify the Architect and do not place any portion of the work on such surfaces until instructions are received.

E. Furnish and maintain pumps, flumes, gutters, and appurtenances if required to keep the excavations free from water. Water shall be directed to a point remote from building operations, shown on the approved shop drawing.

F. Excavation for manholes and similar structures shall be sufficient to leave a minimum of 12 inches (305 mm) and a maximum of 24 inches (610 mm) clearance on all sides. Fill over-depth excavation with concrete.

3.5 BACKFILL

A. Place no backfill until the adjacent construction or the utility to be covered has been inspected, tested, and approved.

B. Installing underground warning tape: Install in backfill above exterior buried lines not encased in concrete. Select legend and color appropriate for type of line. Install metallic lined tape for non-metallic lines. Install approximately 12 inches (305 mm) below grade.

C. Electrical systems backfill:

1. Backfill and compact in 8-inch (200-mm) layers, to level finished grade with the excavated materials approved for backfilling.

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2. Surplus earth shall be mounded up on excavation and left to settle. When directed by the Architect, surplus earth shall be removed and excavations leveled off to proper grade. Where direct burial cables are placed in trenches, first cover the cables with clean earth.

D. Structure backfill:

1. Do not backfill against structures with cement mortar joints until the mortar is at least twelve hours old.

3.6 COMPACTION

A. Test in accordance with the requirements of ASTM D 1557.

B. Compact under slabs, roads, and sidewalks to a 95 percent density.

C. Compact unpaved areas to a 90 percent density.

D. Backfill and compact trench in unpaved areas to within 4 inches (102 mm) of existing grade. Furnish and install compacted select topsoil for the final layer to finish even with existing grade. Remove surplus earth and rake unpaved areas for final planting.

E. Take particular care in compaction of earth under joints of mechanical piping.

3.7 SEEDING

A. Seed disturbed grass areas at the rate of 5 pounds (2.27 kg) per 1000 sq. ft. (92.9 sq. m), with the seed mix specified.

B. Uniformly distribute seed with an approved machine to ensure a covering of plus or minus 1/4 inch (6 mm). Sow half of the seed in one direction and the rest at right angles.

C. Do not seed during windy weather or when ground is wet or otherwise untillable. Seed between the dates of March 1st to May 1st or August 15 to October 15 unless otherwise approved in writing.

3.8 MULCHING

A. Mulch seeded areas immediately following seeding with fibrous mulch evenly applied at an average rate of 2 tons per acre (4483 kg per hectare) so as to provide a loose depth of not less than 2 inches (50 mm).

B. Wet down mulch, unless a heavy rain wets it, to the Architect’s satisfaction, immediately after application.

END OF SECTION

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SECTION 26 0504 - ELECTRICAL DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Extent and location of demolition are shown on the drawings.

1.2 RELATED SECTIONS

A. Demolition: Division 02.

1.3 REFERENCES

A. EPA 40 CFR 273: Environmental Protection Agency; Code of Federal Regulations; Title 40 - Protection of Environment; Standards for Universal Waste Management.

1.4 QUALITY ASSURANCE

A. Demolition shall be carried out as expeditiously as possible, in accordance with accepted practice and applicable building code provisions.

1.5 PROJECT CONDITIONS

A. If, in the course of the work, workers unexpectedly encounter a material not identified for special removal but which they suspect to be asbestos, to contain lead or PCBs, or to present some other hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

B. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.

C. Locate, identify, and protect mechanical and electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

A. In areas where lamp ballasts are to be removed, protect floors and other surfaces with plastic sheeting.

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B. Coordinate removal and storage of fluorescent lamps and ballasts. Protect lamps to prevent breaking them during removal.

C. Protect existing building and equipment that is to remain, particularly to prevent entry of either dust or water. Ensure weathertightness at all times. Keep materials on hand to patch and maintain protection.

3.2 DEMOLITION

A. Comply with demolition and disposal requirements of Division 02.

B. Perform removal work neatly with the least possible disturbance to the building.

C. Provide temporary barriers, danger signals, and appurtenances for protection of personnel and equipment during removal operations.

D. Demolish, remove, demount, and disconnect inactive and obsolete conduit, fittings and specialties, equipment, and fixtures.

E. Remove the anchors, bolts, and fasteners associated with conduit and equipment to be removed.

3.3 REMOVAL OF FLUORESCENT LAMP BALLASTS

A. Where fluorescent light fixtures are shown on the drawings to be removed, remove ballasts.

B. If a ballast is stenciled “No PCBs”, dispose of it as general demolition debris. If ballast has no such identification, assume that it contains PCBs.

C. Workers removing ballasts shall be: informed as to the danger of skin contact with PCBs; informed that PCB-containing ballasts contain paper or cardboard impregnated with PCBs inside the casings; instructed to handle ballasts so as not to damage the casings; and shall wear protective gloves.

D. Examine ballasts for evidence of leaking PCBs. Black, tarry material may contain PCBs. Where leakage has contaminated materials outside the ballast itself, dispose of the contaminated materials by the same methods used to dispose of the ballasts, except that nonporous surfaces such as smooth metal or plastics may be properly decontaminated and then treated as clean material.

3.4 DISPOSAL

A. Dispose of equipment and materials removed, and rubbish and waste material, as work progresses. Do not allow demolition debris to accumulate on site. Remove products of demolition from the building daily.

END OF SECTION

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SECTION 26 0507 - FIRESTOPPING FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Through-penetration firestopping in fire-rated construction.

B. Through-penetration smoke-stopping in smoke partitions.

1.2 RELATED SECTIONS

A. Conduit: Section 26 0533.

1.3 REFERENCES

A. Underwriters Laboratories

1. UL Fire Resistance Directory
2. UL 1479: Through Penetration Firestops.

B. American Society for Testing and Materials Standards:

1. ASTM E 814: Standard Test Method for Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

A. Assembly: Particular arrangement of materials specific to given type of construction described in referenced documents.

B. Barriers: Time-rated fire walls, smoke barrier walls, time-rated ceiling/floor assemblies and structural floors.

C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gasses and smoke.

D. Penetration: Opening or foreign materials passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.

E. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other sections and may or may not be required.

F. System: Specific products and applications, classified and numbered by the rating agency to close specific barrier penetrations.

1.5 SYSTEM DESCRIPTION

A. Design requirements:

1. Fire-rated construction: Maintain barrier and structural floor fire resistant ratings including resistance to cold smoke at all penetrations.

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2. Smoke barrier construction: Maintain barrier and structural floor resistance to cold smoke at all penetrations.

1.6 SUBMITTALS

A. Product data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.

B. Shop drawings: Submit firestop assemblies and devices for all openings and through penetrations in fire-rated construction. Indicate dimensions, description of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, plus the following specific requirements.

1. Details of each proposed assembly identifying intended products and applicable rating agency classification.
2. Manufacturer or manufacturer's representative shall provide qualified engineering judgments and drawings relating to conditions where rated assemblies do not exist.

C. Quality control submittals:

1. Statement of qualifications.

D. Certifications: Letters or forms showing acceptance by local authorities for systems without acceptance by a rating agency.

1.7 QUALITY ASSURANCE

A. Products and assemblies shall be tested and labeled by an independent, nationally recognized testing and labeling authority.

B. Installer's qualification: Firm experienced in installation or application of systems similar in complexity to those required for this project, plus the following:

1. Acceptable to or licensed by manufacturer, state, or local authority where applicable.
2. At least 2 years' experience with systems.
3. Successfully completed at least 5 projects of comparable scale, using these systems.

C. Local and state regulatory requirements: Obtain acceptance for proposed assemblies not conforming to specific rating agency classifications or rated assemblies.

D. Materials shall have been tested to provide fire rating at least equal to that of the construction in which they are to be installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Coordinate delivery with scheduled installation date, allow minimum storage at site.

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B. Storage and protection: Store materials in a clean, dry, ventilated location. Protect from soiling, abuse, moisture and freezing when required. Follow manufacturer's instructions.

1.9 PROJECT CONDITIONS

A. Existing conditions:

1. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
2. Proceed with installation only after penetrations of the substrate and supporting brackets have been installed.

B. Environmental requirements:

1. Furnish adequate ventilation if using solvent.
2. Furnish forced-air ventilation during installation if required by manufacturer.
3. Keep flammable materials away from sparks or flame.
4. Provide masking and drop cloths to prevent contamination of adjacent surfaces by firestopping materials.
5. Comply with manufacturing recommendations for temperature and humidity conditions before, during and after installation of firestopping.

1.10 WARRANTY

A. General project warranty and correction period, as required in general conditions and Division 01, requires repair or replacement of materials or systems which fail in joint adhesion, co-adhesion, abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance, or general durability or appear to deteriorate in any other manner not clearly specified by submitted manufacturer's data as an inherent quality of the material for the exposure indicated.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers and products: Those listed in the UL Fire Resistance Directory for the UL System involved, or rated for the application by Warnock Hersey or by another acceptable rating agency.

2.2 THROUGH-PENETRATION FIRESTOPPING OF FIRE-RATED CONSTRUCTION

A. Provide systems or devices listed and labeled by a rating agency, and conforming to the construction type, penetrant type, annular space requirements and fire rating involved in each separate instance. The system shall be symmetrical for wall applications. Systems or devices shall be asbestos-free.

1. Additional requirements: Firestopping shall withstand the passage of cold smoke either as an inherent property of the system, or by the use of a separate product included as a part of the rated system or device, and designed to perform this function.
2. Additional requirements: Firestopping sealants shall be red in color to facilitate field verification of firestopping application.

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2.3 SMOKE-STOPPING AT SMOKE PARTITIONS

A. Through-penetration smoke-stopping: Any system complying with the requirements for through-penetration firestopping in fire-rated construction is acceptable, provided that the system includes the specified smoke seal or will provide a smoke seal. The length of time of the fire resistance may be disregarded.

2.4 PENETRATIONS BY CABLE TRAYS

A. Where cable trays penetrate fire-rated construction, provide firestopping materials that may be easily removed to allow installation and removal of cables from the tray. Provide materials similar to fire blocks, fire-stopping pillows, or fire-stopping bags.

2.5 ACCESSORIES

A. Fill, void or cavity materials and forming materials: Classified for firestopping use, or included in a rated firestopping assembly, by a rating agency.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

1. Verify barrier penetrations are properly sized and in suitable condition for application of materials.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean surfaces to be in contact with penetration seal materials, of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or the required fire resistance.

3.3 INSTALLATION

A. Provide firestop devices or assemblies for every opening and penetration in floors or fire-rated construction.

B. Install penetration seal materials in accordance with printed instructions of the rating agency and in accordance with manufacturer’s instruction.

C. Ensure an effective smoke barrier in each sealed penetration. Install smoke stopping as specified for firestopping.

D. Protect materials from damage on surfaces subject to traffic.

E. Where large openings are created in walls or floors to permit installation of conduits, cables, or other items, close unused portions of opening with firestopping material tested for the application.

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3.4 FIELD QUALITY CONTROL

A. Examine penetration seals to ensure proper installation before concealing or enclosing them.

B. Keep areas of work accessible until inspection and acceptance by applicable authorities.

C. Before substantial completion, patch and repair firestopping cut or penetrated by other construction work.

3.5 ADJUSTING AND CLEANING

A. Clean up spills of liquid components.

B. Neatly cut and trim materials as required.

C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

END OF SECTION

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SECTION 26 0519 - WIRES AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wires and cables rated 600 volts and less.

B. Type AC and Type NM cables are not permitted.

C. Type MC cable as permitted in Part 3.

1.2 RELATED SECTIONS

A. Underground ducts and utility structures: Section 26 0544.

B. Conduits: Section 26 0533.

C. Lighting controls: Section 26 0923.

D. Lighting: Section 26 5100.

1.3 REFERENCES

A. ANSI/NEMA WC 70 – Power Cables rated 2000 Volts or Less for Distribution of Electrical Energy.

B. ASTM B3 – Standard Specification for Soft or Annealed Copper Wire.

C. ASTM B8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors.

D. UL 44 – Standard for Thermoset-Insulated Wires and Cables.

E. UL 83 – Standard for Thermoplastic-Insulated Wires and Cables.

F. Additional UL Standards as indicated.

1.4 SUBMITTALS

A. Product data:

1. Each type of wire and cable, including accessories.
2. Include copies of UL certifications showing compliance with requirements in “Quality Assurance” below.

1.5 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. Products and installation shall comply with NFPA 70 and other applicable national, state, and local electrical codes.

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1.6 DELIVERY, STORAGE, AND HANDLING

A. General requirements: Deliver, store, and handle wire and cable in accordance with the manufacturer's instructions.

1. Wire and cable shall be packaged in a manner that protects them during ordinary handling and shipping. Ship from manufacturer with ends temporarily sealed against moisture.
2. Protect wire and cable during storage (both onsite and offsite).

a. Store in a clean and dry location. Elevate from surfaces where water can accumulate, and cover cable rolls to protect against weather.

3. Handle wire and cable as recommended by the manufacturer. Do not pull from the center or periphery of the cable reel.
4. Damaged wire and cable shall be removed from the project site.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE (600-Volts Max.)

A. Conductors: UL listed and NEMA WC 70 compliant; Copper, 98 percent conductivity, suitable for 600-volt duty; rated 90-degree Celsius temperature for wet/dry applications; solid bare annealed copper for No. 10 and smaller complying with ASTM B 3, and stranded for No. 8 and larger complying with ASTM B 8.

B. Conductor insulation: Type THHN/THWN-2: Comply with UL 83; PVC insulation, nylon jacket.

C. Conductor identification: Markings along outer braid denoting conductor size, voltage classification, type of insulation, and manufacturer's trade name, and color code. Identification shall extend to branch circuits and outlets. Use the color-coding system tabulated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

1. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
2. Colors on conductors No. 8 and larger, or No. 4 and larger grounded and grounding conductors: Colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor.

COLOR CODE (600 volts maximum)				
VOLTAGE	NEUTRAL	PHASE		
		A	B	C
120 volts, 2-wire	White	Black, Red, or Blue depending on phase		
277 volts, 2-wire	Gray	Brown, Orange, or Yellow depending on phase		
208 volts, single-phase, 2-wire		Black/Red, Red/Blue, or Blue/Black		
208/120 volts wye, 3-phase, 4-wire	White	Black	Red	Blue
480/277 volts wye, 3-phase, 4-wire	Gray	Brown	Orange	Yellow

D. Wires used solely for grounding purposes shall be green, where insulated.

E. Control wiring shall be coded with colors different from those used to designate phase wires.

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2.2 WIRING ACCESSORIES

A. Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service where installed.

B. Twist-on wire connectors (dry locations):

1. Color-keyed.
2. Basis of design: Ideal Industries, Inc., Wingnut®, 3M Company "Scotchlok", or King Innovation.

C. Twist-on wire connectors (damp and wet locations):

1. Connectors shall be listed under UL 486D.
2. Basis of design: Ideal Industries, Inc., UnderGround®, models 60, 64, or 66 as appropriate; King Innovation DryConn®; or 3M Company.

D. Compression connectors:

1. Color-keyed.
2. Basis of design: 3M Company "Scotchlok"™ compressor connectors, "10000" series for copper conductors or Thomas & Betts (Blackburn) or Ilsco or approved equal.

E. Compression connectors (damp and wet locations):

1. Protect the connectors with a waterproof system, UL-listed for direct burial and 600 volts.
2. Basis of design: 3M Company 8420 series, Thomas & Betts Model DBSK82, or Ilsco or approved equal.

F. Compression taps:

1. Series CT-2 tap with CT-2C cover, or Series 54710 color-keyed compression taps,
2. Basis of design: Burndy Corporation "Versitap" or OZ/Gedney or approved equal

G. Power distribution blocks:

1. Basis of design: Hubbell Burndy “U-Blok.” or approved equal

H. Multi-tap connectors, clear insulated:

1. Basis of design: Burndy Corporation "UNITAP" or Ilsco "Cleartap" or approved equal

2.3 UNDERGROUND CONDUCTORS

A. Underground cable, Type THHN / THWN-2: Single-conductor, underground cable.

1. Cable: UL 83 listed; NEMA WC 70 construction; 600-volt, single-conductor. Solid copper No. 10 and smaller, stranded copper No. 8 and larger; and with PVC and nylon jacket insulation.
2. Cable: UL 83 and UL 1569 listed; 600-volt, single- or multi-circuit Type MC Cable, multi-conductor with ground conductor; steel interlocked armor.

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B. Conductors: Solid copper No. 10 and smaller, and stranded copper No. 8 and larger; conforming to ASTM B 3 or B 8.

C. Conductor Insulation: Type THHN/THWN insulated single conductors including ground conductor.

D. Fittings:

1. UL 514B listed, steel or malleable iron fittings. Zinc die-cast fittings shall not be acceptable.
2. Basis of design: KonKore/Atkore International or approved equal.

2.4 METAL-CLAD CABLE, TYPE MC LUMINARY CABLE

A. Cable: UL 66, UL 83, UL 1569, and UL 2556 listed; 600-volt, single- or multi-circuit Type MC luminary cable; multi-conductor with power conductors, control conductors, and ground conductor; aluminum or steel interlocked armor.

1. Power conductors: Solid copper, Type THHN insulation, No. 10 and No. 12 AWG.
2. Control conductors: Solid copper, Type TFN insulation, twisted pair No. 16 AWG.

B. Fittings:

1. UL 514B listed, steel or malleable iron fittings. Zinc die-cast fittings shall not be acceptable.
2. Basis of design: KonKore/Atkore International or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide wire and cable indicated in accordance with national, state, and local electrical codes.

B. Conceal wire and cable in new construction and in locations with finished walls, ceilings, and floors unless otherwise noted on drawings.

C. Wire and cable serving systems over 100 volts shall be installed in raceways, except where otherwise noted on drawings.

D. Wire and cable serving systems rated below 100 volts shall be installed in raceways, except where otherwise noted in individual specification sections. Refer to paragraph “INSTALLING CABLE RATED BELOW 100 VOLTS” below for additional information.

3.2 INSTALLING INTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 120-volt branch circuits:

a. Homerun from first outlet to panel: No. 12 when run is 50 feet or less; No. 10 when run is between 50 feet and 100 feet; No. 8 when run is more than 100 feet.
b. First outlet to other outlets: No. 12.

2. Exit light and emergency lighting circuits: No. 10. Do not install in raceways, outlet boxes, or other locations with non-emergency wiring systems.

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3. Other systems (over 100-volts): Minimum No. 12 unless specified or shown on drawings to be smaller.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

1. Feeders: Type THHN/THWN-2, single conductors in raceway.
2. Branch circuits, concealed in ceilings, walls, and partitions:

a. Unless otherwise indicated, utilize Type THHN/THWN-2, single conductors in raceway.
b. Metal-clad cable, Type MC cable - Refer to section “INSTALLING MC CABLE” below for acceptable locations.

3. All other applications: Provide Type THHN/THWN-2, single conductors in raceway or wire and cable type as indicated.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors or solderless connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

D. Wiring in high ambient temperature areas shall be of types required by NFPA 70 including over boilers and breechings, in fixture channels, in kitchen hoods, and on rooftops.

E. Wires shall be neatly shaped in panels, wireways, boxes, and appurtenances.

3.3 COORDINATION WITH DEVICES AND EQUIPMENT

A. Where conductor size or parallel conductors shown on drawings connect to terminals on devices or equipment which is not sized for the connection:

1. Provide a junction box as near the equipment as possible, but no more than 10 feet (3 m) away. Obtain approval of location before installing.
2. Provide conductor(s) sized to the ampacity of the equipment, from equipment to junction box.
3. In the junction box, splice the conductors from the equipment to the conductors of sizes, or parallel conductors, shown on the drawings.

3.4 INSTALLING EXTERIOR WIRING

A. Sizes: Minimum sizes shall be as follows, unless a larger size is indicated on the drawings.

1. 600-volt branch circuits: Copper, No. 10 minimum.
2. Exterior lighting circuits: Copper, No. 10 minimum.

B. Wiring methods and locations: Wires and cables shall be installed based on the following requirements, unless otherwise noted.

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1. Feeders and branch circuits, exposed and underground: Type, THHN/THWN-2, single conductors in raceway.

C. Splicing shall be done in outlet boxes and junction boxes and not in conduit. Treat these boxes as wet locations.

1. Conductors No. 8 and larger: Terminated, spliced and taped, wherever practical, with compression connectors. Use tools recommended by the manufacturer.
2. Splices in conductors No. 10 and smaller, including lighting fixtures: Made with wire connectors.
3. Taps in conductors No. 6 and larger: Made with compression taps or power distribution blocks.

3.5 INSTALLING CABLE RATED BELOW 100 VOLTS

A. Install in raceway, unless otherwise indicated in individual specification sections.

B. Where individual specification sections allow cable to be installed either in raceway or on J-hooks, install as follows:

1. Wiring method:

a. Wiring in walls, in concrete floors, above inaccessible ceilings, where exposed in finished spaces, exposed on walls, and wherever it may not be accessible or may be subject to physical damage: Install cables in raceway.
b. Wiring exposed in ceilings of unfinished spaces: Install cables in raceway.
c. Wiring concealed above accessible suspended ceilings: Install cables on J-hooks.
d. Wiring in ceiling spaces of communications equipment rooms: Install cables on cable trays or J-hooks.
e. Wiring within enclosures, consoles, cabinets, desks, and counters: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and/or distribution spools.

2. Conceal raceway and cables, except in unfinished spaces, and in open ceiling spaces.
3. Cable not in raceways:

a. Do not install in hangers used for pipes, electric conduits, or ceiling hangers, nor support it in any way by attachments to pipes, conduits, or ceiling hangers.
b. Install without damaging conductors, shield, or jacket. Cables shall not run through structural members or be in contact with pipes, ducts, or other potentially damaging items.
c. Install away from potential EMI sources, including electrical power lines and equipment.
d. Install parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

4. Cable support with J-hooks:

a. Install J-hooks at intervals not exceeding 60 inches.
b. Secure cables on J-hooks with Velcro cable straps. No plastic cable ties. Avoid cinching cables.
c. Provide separate J-hooks for each low-voltage system.

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5. Each cable run shall contain an ‘S’ loop or other means to accommodate expansion or contraction.
6. Where ceiling plenums are used for passage of air by heating and air conditioning system, install cable in conduit or use UL listed plenum cable.

C. For cable installed in conduit, comply with requirements for raceways and boxes specified in Section 26 0533, Conduits, and Section 26 0534, Boxes.

1. Provide separate conduit systems for each low-voltage system.
2. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

a. Pull cables simultaneously if more than one is being installed in same raceway.
b. Use pulling compound or lubricant, if necessary. Use compounds that will not damage conductor or insulation.
c. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage cables or raceway.

D. Avoid installing near hot utilities, which might adversely affect system performance or result in damage to the cable. If cable must be placed close to such utilities, keep it separate and protect with insulation.

E. Cable bends shall have a radius not less than the value recommended by the cable manufacturer.

F. Tag cables connected to electronic equipment, to show function and the location of other end. Securely fasten labels to the cable.

3.6 INSTALLING MC CABLE

A. Install in compliance with NFPA 70.

B. Sizes: Cables larger than No. 8 shall not be permitted.

C. Locations: Type MC cable may be used for branch circuits concealed in accessible ceiling spaces, in drywall partitions, or within casework.

1. Light fixture whips from junction box in ceiling to recess mounted lighting fixtures. Whips shall not exceed 12 feet in length.
2. MC cable may be used in metal stud walls between wiring devices and from wiring device up to ceiling and nearest junction box.
3. Provide junction box in accessible ceiling space of each room and terminate MC cables in room at box.
4. MC cabling shall not be used between ceiling junction boxes and homeruns back to panelboard. Homeruns shall be wire in raceway.
5. Do not install in masonry partitions or masonry walls.

D. Connect cable with wiring accessories specified above.

E. MC cable run to switches shall have a neutral conductor. This conductor is not indicated on the drawings.

3.7 INSTALLING MC LUMINARY CABLE

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A. Install in compliance with NFPA 70.

B. Locations: Type MC luminary cable may be used only above ceilings for LED lighting fixtures with dimmable drivers controlled by a Class 2, low-voltage 0-10VDC controller; connections between the controller and lighting fixtures within a space.

C. Connect cable with wiring accessories specified above.

D. Cable larger than No. 10 shall not be permitted.

E. Maximum length: 12 feet.

END OF SECTION

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SECTION 26 0521 - WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Power and control wiring for equipment.

1.2 RELATED SECTIONS

A. Equipment: Installed items requiring electricity, specified in other sections or shown on drawings.

B. Motors: Section 23 0513.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduits, wires and cables, devices, and accessories as specified in other sections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide power wiring from motor starters to each motor and its manual controlling device. Interlock and control wiring related to the automatic temperature control system shall be provided under Section 23 0902, Control Systems Wiring.

1. Make flexible or liquid tight connections as specified in Section 26 0533, Conduits.

B. Except where provided with equipment, furnish and install manual pushbutton stations and pilot lights, with wiring. Where stations and pilot lights are grouped at central locations, mount them under a common faceplate.

C. Rough in and connect to food service, equipment furnished under other sections and equipment furnished by Owner. Make connections as indicated on drawings with exact locations and details determined by approved shop drawings of the equipment.

1. Under equipment sections, equipment will be set in position and the electrical devices and components furnished loose. Assemble, install, and wire under this section.
2. Accomplish rough-in from walls with flush outlet boxes and from floors by means of conduit couplings finishing flush with finished floor.

D. Certain equipment, as indicated, will be furnished with control panels and auxiliary control components. Mount the panels, furnish and install source wiring and disconnects, and completely connect controls and motors.

E. Provide source wiring, connections, and disconnects for mechanical heating, ventilating, and air-conditioning (HVAC) equipment specified in Division 23. Refer to sections of Division 23 for equipment and controls.

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1. Provide weathertight enclosures for disconnects for outdoor equipment.
2. Mount starters where required, and provide proper size overload protection.
3. Where capacitors are required for power factor correction as specified in 23 0513, Common Motor Requirements for HVAC Equipment, connect the capacitors.

F. Roof exhaust fans will be equipped with factory-wired disconnects located adjacent to the motor under the ventilator hoods as specified in Section 23 3400, HVAC Fans. Exhaust fans shall be controlled by various means as indicated on drawings.

1. For fans shown to be manually controlled, furnish and install a manual motor starting switch with pilot light, located where indicated.
2. Where necessary for larger and three-phase motors, provide magnetic starters.
3. Where fans are provided with electrically operated dampers, provide wiring and relays for single-phase damper operators on three-phase motors.

G. Cabinet unit heaters will be equipped with a manual motor starting switch with overload protection, located within the cabinet. Provide source wiring to line side of this switch. Automatic control of these units will be as described in Control Sequences.

H. Where a Division 23 section requires installation of equipment under supervision of equipment manufacturer’s representative, coordinate electrical installation to cooperate with representative’s requirements.

I. Provide power sources for Owner-furnished equipment.

J. Provide power and control wiring for emergency generator, controllers, transfer switches, and remote annunciator panel.

END OF SECTION

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SECTION 26 0526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Grounding and bonding electrical systems and equipment.

B. Ground system test.

1.2 REFERENCES

A. IEEE STD 142

B. NFPA 70

C. ASTM F467 and F468

D. UL 467

1.3 DEFINITIONS

A. Area served by a separately-derived system: The area within the building that contains any part of a circuit of the system.

B. IBT: Intersystem Bonding Termination Grounding Busbar.

1.4 SUBMITTALS

A. Product data: Ground rods and connections

B. Certifications: System test.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Ground conductor, unless specifically noted otherwise, shall be copper, 98 percent conductivity, solid for No. 10 AWG and smaller and stranded for No. 8 AWG and larger.

B. Grounding busbar: Predrilled rectangular bars of electro-tin plated copper, 0.25 inches (6.3 mm) thick, 12 inch (300 mm) long, unless otherwise indicated on drawings, with 0.3125 inch or 0.4375 inch (7.9 mm or 11.1 mm) diameter holes horizontally spaced 1 to 1.125 inches (25.4 to 28.6 mm) apart.

1. Intersystem bonding termination grounding busbar (IBT) and telecommunications main grounding busbar (TMGB) shall be 4 inches (101.6 mm) wide, with four rows of holes. Telecommunications main grounding busbar shall comply with ANSI/TIA/EIE J-STD-607.
2. Other grounding busbars shall be 2 inches (50.8 mm) wide with two rows of holes. Each telecommunications ground busbar (TGB) shall comply with ANSI/TIA/EIA J-STD-607.
3. Stand-off insulators for busbar shall be flame-resistant fiberglass-reinforced thermoset polyester, UL recognized per UL Standard 891.

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C. Ground rods: Copper bonded steel, 0.75 inch diameter by 10 feet long, one end pointed and the other end tinned, equal to the product of Erico International Corporation or approved equal.

D. Mechanical type ground connectors:

1. Connectors: IEEE 837 and UL 467 compliant, equal to FCI Burndy G Series, listed for use for specific types, sizes, and combinations of conductors and connected items.
2. Nuts, bolts, and washers: Silicon bronze alloy type B per ASTM F467 and F468.

E. Exothermic type ground connections: Exothermic welding systems shall be equal to "Cadweld," manufactured by Erico International Corporation or approved equal.

F. Lugs: Lugs shall be two- or four-hole, equal to Burndy Hylug series or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide the complete grounding of conduit systems, electrical equipment, conductor and equipment enclosures, motors, transformers, and neutral conductors in accordance with applicable codes. Grounded phase and neutral conductors shall be continuously identified. Continuity of metal raceways shall be insured by double locknuts.

B. Furnish and install main grounds for secondary electrical service to cold water main in accordance with NEC requirement. In addition to the cold water ground, provide ground rods as indicated or as required by NEC and applicable codes.

C. Grounding busbar: Busbars shall stand off the wall a minimum of 2 inches (50.8 mm). Mount 6 inches (152.4 mm) above finished floor unless otherwise indicated. Insulate the busbar from its supports.

1. Conductors connecting busbar to other busbars, and to the grounding electrode system shall be attached to busbar with exothermic welds.
2. Connect other conductors to busbar using lugs.

D. Install copper grounding jumpers of 3/0 copper cable around each main water valve in the building. Install copper grounding jumpers around conduit expansion fittings. Jumpers shall be of adequate current carrying capacity corresponding to size of conduit.

E. Ground system connections which are beneath the floor and in a concealed or inaccessible location shall be brazed or welded. Brazing and welding shall be "CADWELD."

F. Separately-derived 120/208-volt three phase wye electrical systems originating in transformers shall be grounded at the transformer neutral terminal:

1. The grounding electrode for the system shall be whichever one of the following that is closest to the transformer:
2. Building's grounding electrode.
3. Steel structural member of the building conforming to NEC requirements for grounding electrodes.
4. First five feet of the water service piping to the building.

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G. Separately-derived three phase wye electrical systems originating in generators shall be grounded at the generator neutral terminal:

1. The grounding electrode for the outdoor generator shall be a ground rod.
2. The grounding electrode for the indoor generator shall be whichever one of the following that is closest to the generator:

a. Building's grounding electrode.
b. Steel structural member of the building conforming to NEC requirements for grounding electrodes.
c. First five feet of the water service piping to the building.

H. Bonding separately-derived systems:

1. Each metal water piping system, not used as the electrical system's grounding electrode, in the area served by the electrical system shall be bonded to the electrical system's neutral by a system bonding jumper.
2. If exposed structural metal is not used as the grounding electrode for the system, bond exposed structural metal in the area served by the electrical system to the system's neutral by a system bonding jumper.
3. If a metal water piping system in the area served by the electrical system is bonded to exposed structural metal by a NEC-compliant bonding jumper, then only one of the two (piping or structure metal) need to be bonded to the electrical system's neutral.

I. Bonding straps and jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to equipment mounted on vibration isolation hangers and supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connections for outdoor locations; if a disconnect-type connection is required, use a bolted clamp secured with a minimum of two bolts and lock washers.

J. Bonding interior metal ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

3.2 EQUIPMENT GROUNDING AND BONDING

A. Provide insulated equipment grounding conductors to all feeders and branch circuits.

B. Air-duct equipment circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water heater, heat tracing, and antifrost heating cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

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3.3 IDENTIFICATION

A. Comply with requirements in Section 26 0500, Common Work Results for Electrical, for instruction signs. The label or its text shall be green.

3.4 GROUNDING SYSTEM TEST

A. Ensure that grounding system is continuous and that resistance to earth is not more than 10 ohms.

B. Test each ground rod for resistance to earth before making connections to rod; tie grounding system together and test for resistance to earth.

C. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall.

D. Submit written results of each test including location of rods as well as resistance and soil conditions at time measurements were made.

END OF SECTION

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SECTION 26 0528 - EQUIPMENT FOUNDATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Equipment foundations (housekeeping pads).

B. Outdoor equipment foundations.

1.2 RELATED SECTIONS

A. Service entrance: Section 26 0541.

1.3 SUBMITTALS

A. Product data: Concrete mix, grout, reinforcement, and accessories.

B. Certifications: Test report showing strength of concrete.

PART 2 - PRODUCTS

2.1 CONCRETE

A. Concrete:

1. Indoor: 3,000 psi compressive strength at 28 days.
2. Outdoor: 4,500 psi compressive strength at 28 days.

2.2 GROUT

A. Non-shrink grout: Premixed, consisting of non-metallic aggregate, cement, water-reducing and plasticizing agents; capable of developing minimum compressive strength of 7,000 psi in 28 days.

1. Five Star Products, Inc. "Five-Star Grout"
2. L&M Construction Chemicals, Inc. "Crystex"
3. Sonneborn "Sonogrout"

2.3 METAL REINFORCEMENT

A. Reinforcing bars: Deformed steel bars in accordance with ASTM A615, Grade 60, clean and free from loose rust, scale, or other coatings that will reduce bond.

B. Welded wire fabric reinforcing: ASTM A 185 No. 6 steel wire spot-welded at intersections and of size 6 by 6 inch mesh.

C. Metal accessories: Include spacers, chairs, bolsters, ties, and other devices necessary for properly placing, spacing, supporting and fastening reinforcement in place.

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PART 3 - EXECUTION

3.1 INSTALLING EQUIPMENT FOUNDATIONS (HOUSEKEEPING PADS)

A. Provide 4-inch-high concrete foundations (housekeeping pads) for floor-mounted equipment unless otherwise noted. Furnish foundations, bolts, sleeves, and appurtenances and install as recommended by equipment manufacturer. Anchor the concrete foundations by dowels inserted into the floor slab. Provide welded wire fabric reinforcement.

B. Unless otherwise specified, install concrete work in accordance with the requirements of Division 03.

C. Equipment shall be properly aligned. Level and grout equipment where necessary. Support conduit independently of equipment and so as not to cause a strain or thrust.

D. Coordinate exact locations and configurations of equipment, foundations, and supports with the approved shop drawings of the equipment.

3.2 INSTALLING OUTDOOR EQUIPMENT FOUNDATIONS

A. Provide equipment foundations of size and thickness indicated.

B. Place reinforcement accurately in position shown, securely fasten, and support to prevent displacement before or during pouring. Clean, bend, place, and splice reinforcement in accordance with approved shop drawings. Lap ends and sides of mesh reinforcement in slabs not less than one mesh.

1. Coverage of main reinforcing shall be as follows: Slabs, 0.75 inch (19 mm); concrete poured against earth, 3 inches (75 mm); other locations, 2 inches (50 mm).

C. Properly align, level, and grout equipment.

END OF SECTION

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SECTION 26 0533 - CONDUITS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Conduit and accessories, aboveground and below ground where not in duct banks.

1.2 RELATED SECTIONS

A. Exterior ductbanks and handholes: Section 26 0544.

B. Firestopping: Section 26 0507.

C. Boxes: Section 26 0534.

D. Trenching: Section 26 0501.

1.3 DEFINITIONS

A. FMC: Flexible metal conduit.

B. LFMC: Liquid-tight flexible metal conduit.

1.4 SUBMITTALS

A. Product data:

1. Each type of conduit included in the work, and related fittings.
2. Accessory materials.
3. Hangers and fasteners.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, the following listed manufacturers provide products of acceptable quality or approved equal:

1. Steel conduit and tubing:

a. AFC Cable Systems, Inc. (FMC and LFMC)
b. Allied Tube & Conduit; a Tyco International Ltd-Co.
c. O-Z/Gedney, Unit of General Signal
d. Wheatland Tube Co.

2. Steel conduit fittings:

a. Appleton Electric Co.
b. Cooper Crouse-Hinds.
c. Hubbell, Inc.; Killark Electric Manufacturing Co.
d. O-Z/Gedney; Unit of General Signal.

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e. Spring City Electrical Manufacturing Co.
f. Thomas & Betts Corporation.

3. Nonmetallic conduit, tubing and fittings:

a. Allied Tube & Conduit; a Tyco International Ltd. Co.
b. Arnco Corp.
c. Beck Manufacturing
d. CANTEX Inc.
e. Certainteed Corp.; Pipe and Plastics Group
f. Lamson & Sessions; Carlon Electrical Products

4. Wireways and fittings:

a. Hoffman Engineering Co.
b. Lamson & Sessions, Carlon Electrical Products
c. Square D Schneider Electric

5. Conduit hangers and supports:

a. Thomas & Betts "Kindorf"
b. Tyco Power-Strut
c. Unistrut Diversified Products

6. Fasteners:

a. Caddy Fasteners by Erico Products Inc
b. ITW Ramset "Red Head"
c. Wej-It Fastening Systems

2.2 CONDUIT AND FITTINGS

A. Galvanized steel conduit: Hot-dip galvanized with threads galvanized after cutting, one of the following:

1. Rigid full weight, heavy-wall steel conduit (RGS) conforming to UL 6 and ANSI C80.1.
2. Intermediate steel conduit (IMC) conforming to UL 1242 and ANSI C80.6.

B. Steel conduit fittings: Cast malleable iron fittings with smooth finish and full threaded hubs. Include steel or malleable iron locknuts, bushings, and other fittings.

1. Insulating bushings: Equal to Thomas and Betts Series 22.
2. Hub fittings with recessed sealing ring and nylon insulated throat equal to Thomas and Betts Series 370.
3. Fittings for exposed locations: Conduit outlet bodies, zinc or cadmium plated.

C. Electrical metallic tubing (EMT): Hot-dip galvanized or sherardized thin-wall steel conduit conforming to UL 797 and ANSI C80.3.

D. Connectors and couplings for EMT: Concrete- or rain-tight, compression type, made of zinc- or chromium-plated steel, equal to Thomas & Betts Series 5123. Connectors shall have nylon insulating throats.

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E. Flexible metal conduit (Type FMC): Made of sheet metal strip, interlocked construction, conforming to UL 1.

F. Liquidtight flexible metal conduit (Type LFMC) shall conform to UL 360.

G. Connectors for flexible metal conduit: Equal to angle wedge "Tite-Bite" with nylon insulated throat, Thomas & Betts Series 3110 and 3130.

H. Liquidtight type connectors: UL 14814A. Fittings: With nylon insulated throat, equal to Thomas & Betts Series 5331.

I. Plastic conduit: Polyvinyl chloride (PVC) Schedule 40, rated for use with 90-degree conductors, for exposed, underground, and encased applications, complying with NEMA Specification TC-2, UL 651, and ANSI C33.91.

J. Plastic conduit fittings and cement:

1. Fittings: Complying with NEMA TC 3, UL 514, and ANSI C33.91.
2. Cement: Solvent cement made by the manufacturer of the conduit and fittings.

K. Wireways: Steel wireway with hinged cover, complying with UL 870 Standard for Wireways, Auxiliary Gutters, and Associated Fittings, equal to Square D "Square-Duct" or Pentair/Hoffman "Angled Trough".

1. Cover: Front accessible opening along complete length of wireway.
2. Finish: Gray polyester powder finish inside and out.

L. Fittings for wireways: Made with removable covers to permit installation of a complete system with access to wires throughout the system, UL listed with the wireways. Connections: Threaded screws at every connector.

M. Weatherproof expansion fittings: With bonding jumpers, equal to O-Z/Gedney types AX and TX.

2.3 SLEEVES FOR RACEWAYS

A. Steel pipe sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

1. Sleeves for exterior walls: Anchor flange welded to perimeter.

B. Sleeves for rectangular openings: Galvanized sheet steel of length to suit application. Minimum thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm): 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to or more than 50 inches (1270 mm) and 1 or more sides equal to or more than 16 inches (400 mm): 0.138 inch (3.5 mm).

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0507.

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2.4 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annual space between sleeve and conduit.

1. Sealing elements: EPDM or NBR 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: Stainless steel. Include two for each sealing element.
3. Connecting bolts and nuts: Stainless-steel of length required to secure plates to sealing elements. Include one for each sealing element.

2.5 ACCESSORY MATERIALS

A. Pull rope: Polypropylene, thickness, tensile strength, and work load selected to meet project load requirements.

B. Caps and plugs: Equal to Thomas & Betts Series 1470.

C. Lubricant: Equal to Ideal Industries, Inc. "Yellow 77". UL approved.

D. Bituminous protective coating: Coal tar based, self-priming on steel, applied in a wet film thickness at least 22.0 mils (559 microns) per coat.

E. Rust inhibitive paint: Alkyd based, equal to Benjamin Moore Super Spec HP D.T.M Alkyd Low Lustre, white, black or bronzetone, applied in a wet film thickness of at least 2.9 mils.

2.6 CONDUIT HANGERS

A. Adjustable hangers: Equal to Kindorf C-149 lay-in hanger or C-150 Clevis hanger.

B. Trapeze hangers: Constructed of channels with Kindorf C-105 notched steel straps.

C. Channels: Steel, 1.5 inches (38 mm) wide with 7/8-inch (22-mm) continuous slot, gages and weights equal to Kindorf 900 series.

D. Beam clamps: Equal to Kindorf E-160 or E-230 adjustable type, for connecting hanger rod to steel beam.

E. Hangers for conduit 1.0 inch (27 mm) and smaller, through or below bar joists: "Hang-on" hangers attached to joists with Minerallac scissor clips or two-piece stud clips.

F. Finish: All hangers, assemblies, plate washers, rods, locknuts, channels, bolts, and appurtenances shall be hot-dip galvanized.

2.7 FASTENERS

A. General: Select fasteners such that load applied does not exceed one-fourth of manufacturer's load capacity in 3500 psi (24000 kPa) concrete.

B. Fasteners to concrete: Self-drilling type expansion anchors, or machine bolt drop in anchors for drilled holes. Fasteners to concrete ceilings shall be vibration- and shock-resistant.

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C. Fasteners to drywall or cavity wall: Toggle bolts, hollow-wall drive anchors, or nylon anchors as required.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Provide complete, separate and independent raceway system for each of the various wiring systems including, but not limited to, the following:

1. Lighting
2. Power
3. Exit Lighting*
4. Emergency Lighting System*
5. Fire Detection and Alarm System
6. Low Voltage Control System
7. Control Wiring
8. Communications Systems
9. Sound Systems
10. Security Systems

*These wiring systems may be installed in common raceways.

B. Wire raceway systems completely, except where otherwise indicated, as shown on drawings and as required for satisfactory operation of each system.

C. Where wireways are required or used to facilitate the installation, amply size them to accommodate conductors, in accordance with NFPA 70.

D. Types and locations of conduits are scheduled at the end of the section.

E. Do not install conductors or pull rope during installation of conduit.

F. Where conduit is connected to a cabinet, junction box, pull box, or auxiliary gutter, protect the conductors with an insulating bushing. Provide locknuts both inside and outside the enclosure. Where conduit is stubbed up to above ceilings for future wiring, close ends with bushings.

G. Bituminous protective coating:

1. Coat exposed threads on steel conduits in concrete slabs at couplings and fittings, after joints are made up.
2. Coat metallic conduits below grade not in concrete, and where emerging from below grade or slabs, four inches above and below grade or slab.

H. Rust-inhibitive paint:

1. Exposed threads of exterior conduit.
2. All unfinished metal components.

I. Make turns in conduit runs with manufactured elbows or using machines or tools designed to bend conduit. Turns shall be not less than the various radii permitted by NFPA 70.

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J. Sizes:

1. Do not use conduit smaller than 0.75 inch (21 mm).
2. Feeder conduits shall be as large as indicated, or as required by NFPA 70 (whichever is larger). Do not install more than one feeder in a single conduit.
3. Conduit sizes shown on drawings are based on Type THHN/THWN wire.

K. Make vertical runs plumb and horizontal runs level and parallel with building walls and partitions.

L. Ground conduits as required by NFPA 70.

M. Where conduits pass through building expansion joints, and wherever relative movement could occur between adjacent slabs, equip with weatherproof expansion fittings and bonding jumpers.

N. Where conduits through roof cannot be installed inside equipment or pipe curbs, flash them in accordance with the SMACNA Architectural Manual.

1. Coordinate flashing details and materials with manufacturer and installer of roofing system.
2. Pitch pockets are not permitted.

O. Run conduits concealed in new construction except where connecting to surface-mounted cabinets and equipment, and in electrical and mechanical equipment spaces. Install conduit above suspended ceilings and within walls and partitions.

P. From each flush-mounted lighting or power panelboard, provide at least four 0.75-inch empty conduits, to terminate in furred ceiling space above. On floors above ground floor, provide two additional 0.75-inch conduits terminating in furred ceiling space below. Cap these conduits.

Q. Immediately after each run of conduit is completed, test it for clearance, smooth the joints, and close at each end with caps or plugs to prevent entrance of moisture or debris.

R. Conduit installed outdoors or at indoor locations exposed to continuous or intermittent moisture shall provide a liquidtight seal. Use steel or malleable iron hub fittings. Coat exposed threads with bituminous protective coating.

S. Install no conduit in these locations:

1. Setting beds for terrazzo or tile.
2. Concrete toppings, unless specifically approved by Structural Engineer.

T. Conduit in concrete decks above grade: Not permitted.

U. Where conduit is stubbed up through concrete slab, exterior walls, or bearing walls, provide galvanized steel conduit elbows.

V. Install insulated bushings on ends of conduit stubs and sleeves.

3.2 INSTALLING PULL BOXES, JUNCTION BOXES, OUTLET BOXES

A. Install as specified in Section 26 0534, Boxes.

B. Install pull or junction boxes in long runs of conduits or where necessary to reduce the number of bends in a run.

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1. Select inconspicuous locations. Do not install until locations have been approved by the Architect.
2. Install boxes flush with wall or ceiling surfaces, with flat covers. Where removable ceiling units are used, locate boxes above ceilings.

C. Verify door swings with door frame installed before locating switch outlets.

3.3 INSTALLING FLEXIBLE CONDUIT

A. Installation shall comply with NFPA 70.

1. Minimum length: Two feet (610 mm).
2. Maximum length: Six feet (1830 mm).

B. Make immediate connections to recessed lighting fixtures, speakers, and other equipment in suspended ceilings with flexible metal conduit. Include sufficient slack to permit removal of fixture or equipment.

C. Make immediate connections to motors and transformers with liquidtight flexible conduit. Include sufficient slack to reduce the effects of vibration.

D. In wet locations, install liquidtight type, in such a manner that liquids tend to run off the surface and not drain toward the fittings.

E. Where fittings are brought into an enclosure with a knockout, install a gasket assembly consisting of an O ring and retainer on the outside.

3.4 INSTALLING PULL ROPE AND CONDUCTORS

A. After conduit is installed, fish pull rope. After completion of the work of this project, pull rope shall remain in conduits identified as to be left empty.

B. Do not use a pull rope that has a tensile strength of more than one of the conductors of a two-wire circuit, more than two of the conductors of a three-wire circuit, or more than three of the conductors of a four-wire circuit.

C. Do not pull conductors into the conduits until the system is entirely completed and wet building materials are dry.

D. Use only a lubricant approved for use with conductor materials and pull rope materials.

3.5 INSTALLING SLEEVES

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Section 26 0507.

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. 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.

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D. Cut sleeves to length for mounting flush with both surfaces of walls.

E. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

F. Size pipe sleeves to provide 0.25-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

G. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

H. Interior penetrations of non-fire-rated walls and floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint.

I. Fire-rated-assembly penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Section 26 0507.

J. Exterior-wall penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal 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.

3.7 INSTALLING CONDUIT HANGERS

A. Single runs of overhead conduits 1.25-inch (35-mm) size and larger shall be supported by adjustable hangers, using 0.375-inch (10-mm) rods for conduits up to 2.0 inch (53-mm) size and 0.5-inch (13-mm) rods for conduits larger than 2.0 inches (53-mm).

B. Support groups of conduits run in parallel on trapeze hangers suspended from 0.5-inch (13-mm) hanger rods.

C. Space hangers not over 5 feet (1.5 m) apart for non-metallic conduits, and not over 10 feet (3 m) apart for metal conduits. Support conduits within 3 feet of each outlet, junction or pull box.

D. Below bar joist construction, support hangers from a length of structural channel, welded to the top chords of at least two joists.

E. Where large numbers of conduits are grouped together, stagger individual hangers so as not to concentrate the load on a few joists.

F. Where hanger rods are attached to structural beams, use adjustable beam clamps.

G. Attach hanger rods to concrete with expansion bolts and anchors.

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3.8 INSTALLING UNDERGROUND CONDUIT, GENERAL

A. Depth:

1. Buried under building slabs: Top of conduit no less than 12 inches below the vapor barrier. Seal around conduits where they penetrate the vapor barrier.
2. Outside building: Top of conduit no less than 24 inches below finish grade.

B. Slope: At least 3 inches in 100 feet away from buildings and toward manholes or other drainage points.

C. Cleaning: At the completion of each run, in each conduit, first run a testing mandrel not less than 12 inches (305 mm) long with diameter 0.25 inch (6.35 mm) less than the inside diameter of the conduit; then draw through a stiff-bristled brush until all particles are removed. Immediately install conduit plugs.

D. Except at conduit risers, make changes in direction of runs, either vertical or horizontal, by long sweep bends. Bend may be made up of one or more curved or straight sections or combinations. Use manufactured bends with a minimum radius of 36 inches.

E. Where underground nonmetallic conduit runs penetrate floor slabs, exterior walls, or bearing walls, penetrations shall be made with metallic elbows. Coat metallic elbows with bituminous protective coating.

3.9 INSTALLING UNDERGROUND CONDUIT WITHOUT CONCRETE ENCASEMENT

A. Run conduit in straight lines except as necessary.

B. Trenches: At least three inches (80 mm) clearance on each side of the conduit.

C. Warning tape: Install in backfill approximately 12 inches (300 mm) below grade.

D. Under existing roads and paved areas not to be disturbed, jack rigid steel conduit into place.

3.10 SCHEDULE OF LOCATIONS

A. RGS with screw joint couplings:

1. Conduits in concrete slabs except where noted to be plastic.
2. First five feet of conduit extending outside building.
3. Under roads and paved areas where existing pavement is not to be disturbed, extending at least five feet beyond edges of pavement.
4. Elbows penetrating floor slabs, exterior walls, or bearing walls.

B. IMC with screw joint couplings: Wiring to exterior equipment, except as noted above to be rigid galvanized steel.

C. EMT: Sizes 4 inches and smaller except as noted above.

D. FMC and LFMC: Where noted elsewhere in this section.

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E. Plastic with solvent cement joints:

1. For exterior circuits, directly buried, except first five feet from building.
2. Where noted under concrete slab, concrete encased, except elbows penetrating floor slabs, exterior walls, or bearing walls shall be galvanized steel conduit.
3. Where noted under concrete slab, direct buried.
4. Where noted in concrete slabs.
5. For concrete encased duct banks.

END OF SECTION

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SECTION 26 0534 - BOXES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Boxes with covers.

1.2 RELATED SECTIONS

A. Conduits: Section 26 0533.

B. Outlet boxes where required for special systems: Provided by the equipment manufacturers of the various systems.

1.3 SUBMITTALS

A. LEED submittal: Comply with Section 01 8113.

1. MR Credit 3: BPDO – Sourcing of Raw Materials.

a. Recycled Content: Metal boxes and conduits.

B. Product data: Each type of box included in the project.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, the following listed manufacturers provide products of acceptable quality or approved equal:

1. Boxes:

a. Appleton/EGS Electrical Group
b. RACO/Hubbell Electrical Products
c. Steel City/Thomas & Betts

2. Floor boxes:

a. Hubbell, Inc., Kellems
b. Mono-systems, Inc.
c. Steel City/Thomas & Betts
d. Wiremold

2.2 MATERIALS

A. Outlet, switch, and junction boxes:

1. Sheet metal: NEMA OS 1, sherardized or galvanized stamped.
2. Cast-metal, where required for weather-exposed, or exposed locations: NEMA FB 1, aluminum, Type FD, with gasketed cover.

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2.3 BOXES FOR WALLS AND PARTITIONS

A. Outlet boxes in concrete construction: Octagonal, two-piece type, of sufficient depth to keep conduits not closer than 1 inch to surface.

B. Toggle / snap switch and receptacle wall boxes in masonry partitions and walls: Square cornered tile wall boxes 3.5 inches deep, or 4-inch square boxes with raised tile wall device covers. The device covers shall be of extra depths required to suit the block or brick construction in which they are placed.

C. Toggle / snap switch and receptacle wall boxes in metal stud partitions: 4 inches square by 1.5 inches minimum deep boxes with 0.75-inch raised tile wall device covers finishing flush with finished wall surface.

D. Lighting controls station wall boxes in metal stud partitions: 4 inches square by 2.25 inches minimum deep boxes with 0.75 inch raised tile wall device covers finishing flush with finished wall surface.

E. Wall- and partition-mounted boxes for low voltage systems: Same as specified above for toggle / snap switches and receptacles, except 2.25-inch minimum deep boxes.

2.4 JUNCTION AND PULL BOXES

A. Junction boxes for branch circuits: Sheet metal, NEMA OS 1, sherardized or galvanized stamped.

B. Junction and pull boxes in feeder conduit runs: Galvanized, of size required for conduit arrangement and not less than the size required by NFPA 70, and furnished with screwed covers.

C. Junction and pull boxes at exterior locations: NEMA type 3R

2.5 FLOOR BOXES

A. Equal to Wiremold Evolution Series Floor Box, Model EFB6S-OG, complete in-floor multi-service box consisting of floor box housing, flush style removable cover, and wiring devices.

1. Finish: Nickel Color

PART 3 - EXECUTION

3.1 INSTALLATION

A. Boxes in metal stud walls or partitions shall be securely supported by metal channels spanning between two studs and attached to same

B. Provide box at each outlet, switch, and appurtenance. Each box shall be of a type suitable for the duty intended and shall be installed in accordance with the manufacturer's instructions.

1. Where conduit is weather-exposed or exposed, provide cast-aluminum boxes.

C. Coordinate locations of boxes with installation of conduit as specified in Section 26 0533.

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D. Do not install boxes back-to-back (through the wall) in partitions.

E. Firmly secure the boxes in place, plumb, level, and with front of device cover even with finished wall surface.

F. Outlet boxes used for supporting lighting fixtures: Furnish with malleable iron fixture studs of "No-Bolt" type, secured by locknut. Provide structural channel supports for boxes occurring in ceilings. Outlets in ceilings directly on bottom of joists shall be supported independent of ceiling construction. Outlets in suspended ceilings shall not be supported from ceiling construction. Special supports for boxes shall be as directed and approved by the Architect.

G. Where service fittings will not permit ganging of boxes for floor outlets, outlets shall be as close as practicable.

H. Provide a single cover plate where two or more devices are grouped together in one box.

I. Verify door swings with door frame installed before locating switch outlets.

J. Outlet boxes in fire-rated assembly:

1. Clearance between boxes and wallboard shall not exceed 0.125 inch (3.2 mm).
2. Surface area of individual outlet box does not exceed 16 square inches (103 sq cm).
3. Entire surface area of boxes shall not exceed 100 square inches (645 sq cm) per 100 square feet (9.3 sq m) of wall surface.

3.2 IDENTIFICATION

A. Identification on outside covers of pull and junction boxes in ceiling space or exposed on walls: Paint with colored enamel or mark with permanent waterproof black marker, or both, as specified.

1. Fire alarm system: Red.
2. Other special systems: Mark with system type, such as Data, Public Address, or Security.
3. Power and lighting: Panelboard designation and circuit number(s).

END OF SECTION

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SECTION 26 0541 - SERVICE ENTRANCE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Service entrance for electric service, 120/240 volts, 1-phase, 4-wire.

1.2 RELATED SECTIONS

A. Temporary power for construction: Division 01.

B. Trenching: Section 26 0501.

C. Electrical underground ductbank: Section 26 0544.

D. Equipment foundations: Section 26 0528.

1.3 PAYMENT PROCEDURES

A. New electric service will be installed by Baltimore Gas & Electric Co. (the Power Company).

B. Submit the bill on completion of this part of the work. Owner will directly pay the Power Company.

1.4 SUBMITTALS

A. Product data: Each type of device or equipment required for the installation.

B. Shop drawings: Submit shop drawings and other information as required to the Power Company.

C. Certifications: Copy of certification for installation required by Power Company.

1.5 COORDINATION

A. New electric service will be installed by Southern Maryland Electric Cooperative (the Power Company). Contact the designated power company service representative and verify the status of the project service application. If the current service application has expired, resubmit the service application using load data from the original application.

B. New communications service(s) will be installed by Verizon and Comcast. Contact the service company representative(s) to coordinate installation of the new service(s).

C. Arrange a project site meeting to verify that the proposed service entrance configuration is acceptable to the service company. Participants of the meeting shall include the service company representative, the Owner, the Contractor and the Architect/Engineer.

D. Contact "Miss Utility" (1-800-257-7777) prior to any excavation or underground work. The location and depth for all utilities shall be verified.

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PART 2 - PRODUCTS

2.1 CONDUITS

A. Power Company will provide primary and secondary cables, transformers, and meters, as described in the article "Installation by Power Company," below.

B. Conduits: As specified and scheduled in Section 26 0533, Conduits.

C. Ductbanks: As specified in Section 26 0544, Underground Ducts and Utility Structures, and in accordance with Power Company requirements.

D. Fittings: As required by installation and by Power Company requirements, and as specified in Section 26 0533, Conduits.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate installation with Power Company.

B. Coordinate installation with communications service company.

C. Coordinate installation with installation of gas lines and other underground utilities specified in Division 23.

3.2 INSTALLATION BY POWER COMPANY

A. Primary power from Power Company lines to a point underground at the property line.

B. Primary and secondary cables, transformer, and terminations to building main switchboard, including meters.

3.3 INSTALLATION INCLUDED IN WORK OF THIS PROJECT

A. Concrete encased ductbank from property line to power company transformer as indicated on the drawings, minimum 4 inches, as specified in Section 26 0544, Underground Ducts and Utility Structures, including markers or underground warning tape and in accordance with Power Company requirements.

B. Concrete encased ductbank from transformer to C/T Cabinet location as indicated on the drawings, minimum 4 inches, as specified in Section 26 0544, Underground Ducts and Utility Structures, including markers or underground warning tape, and in accordance with Power Company requirements.

C. Where conduit enters a transformer or meter cabinet, provide bellmouth fittings on conduit ends 2 inches above the concrete slab.

D. Manholes as shown on the drawings: Specified in Section 26 0544, Underground Ducts and Utility Structures.

END OF SECTION

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SECTION 26 0544 - UNDERGROUND DUCTS AND UTILITY STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Ducts in directly buried ductbanks.
2. Ducts in concrete-encased ductbanks.
3. Handholes.

1.2 REFERENCES

A. Society of Cable Telecommunications Engineers (SCTE):

1. SCTE 77: Specification for Underground Enclosure Integrity. Light duty and pedestrian traffic only. Includes Tiers for specific applications, and static vertical wheel load ratings:
2. Tier 5: Sidewalk applications with a safety factor for occasional nondeliberate vehicular traffic.
3. Tier 8: Sidewalk applications with a safety factor for nondeliberate vehicular traffic.
4. Tier 15: Driveway, parking lot, and off-roadway applications subject to occasional nondeliberate heavy vehicular traffic.

1.3 SUBMITTALS

A. Product data: For the following:

1. Polymer concrete handholes.
2. Conduit and ducts, including elbows, bell ends, bends, fittings, and solvent cement.
3. Ductbank materials, including spacers and miscellaneous components.
4. Warning tape.

B. Product certificates: For concrete and steel used in underground precast handholes, according to ASTM C 858.

C. Product test reports: Indicate compliance of handholes with ASTM C 857 and ASTM C 858, based on factory inspection.

1.4 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 ANSI C2.

C. Comply with NFPA 70.

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1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver ducts to project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

B. Store precast concrete units at project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

C. Lift and support precast concrete units only at designated lifting or supporting points.

1.6 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 at least two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

1.7 COORDINATION

A. Coordinate layout and installation of ducts and handholes with final arrangement of other utilities and site grading, as determined in the field.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

A. Available manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to, the following or approved equal:

1. Nonmetallic ducts and accessories:

a. ARNCO Corp.
b. Beck Manufacturing Inc.
c. Cantex, Inc.
d. CertainTeed Corp.; Pipe & Plastics Group.
e. ElecSys, Inc.
f. Electri-Flex Co.
g. IPEX, Inc.
h. Lamson & Sessions; Carlon Electrical Products.
i. Manhattan/CDT
j. Spiraduct/AFC Cable Systems, Inc.

2. Precast polymer concrete enclosures for underground construction:

a. Armorcast Products Company.
b. NewBasis.
c. Quazite/Strongwell (Hubbell Power Systems, Inc.).
d. Synertech (Division of Oldcastle Precast).

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2.2 CONDUIT

A. Conduit and fittings are specified in Section 26 0533.

2.3 DUCTS

A. Rigid nonmetallic conduit: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by the same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.4 HANDHOLES

A. Polymer concrete handholes: Molded of sand and aggregate bound with polymer resin, and reinforced with steel, with 6-inch square cable entrance at each side and weatherproof cover with nonskid finish and legend. Unit, when buried, shall be designed to support SCTE 77 Tier 15 loading.

B. Cover legend: "ELECTRIC".

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Underground ducts for electrical cables higher than 600 V: Type EPC-40-PVC concrete-encased ductbank.

B. Underground ducts for electrical feeders and branch circuits 600 V and below: Type EPC-40-PVC, concrete-encased ductbank, where indicated.

C. Underground ducts for electrical feeders and branch circuits 600 V and below: Type EPC-40-PVC, directly-buried ductbank, except use Type EPC-40-PVC, concrete-encased ductbank, under roads, paved areas, and retaining walls.

D. Handholes: Underground precast polymer concrete enclosures.

3.2 EARTHWORK

A. Excavation and backfill: Comply with Section 26 0501, Excavation and Fill for Electrical Work, but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

3.3 CONDUIT AND DUCT INSTALLATION

A. Slope: Pitch ducts a minimum slope of 1:300 down toward handholes and away from buildings and equipment.

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B. Curves and bends: Use manufactured rigid steel elbows for stub-ups at equipment and at building entrances. Use manufactured long sweep bends with a minimum radius of 25 feet, both horizontally and vertically, at other locations.

C. Use solvent-cement joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.

D. Building entrances: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall. Use fittings manufactured for this purpose. Follow the appropriate installation instructions below:

1. Concrete-encased ducts: Install reinforcement in ductbanks passing through disturbed earth near buildings and other excavations. Coordinate ductbank with structural design to support ductbank at wall without reducing structural or watertight integrity of building wall.
2. Waterproofed wall and floor penetrations: Install a watertight entrance-sealing device with sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.

E. Concrete-encased, nonmetallic ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts and secure separators to earth and to ducts to prevent floating during concreting. Stagger spacers approximately 6 inches between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concreting: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application. Pour each run of envelope between handholes or other terminations in one continuous operation. If more than one pour is necessary, terminate each pour in a vertical plane and install 0.75-inch reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Reinforcement: Reinforce ductbanks where they cross disturbed earth and where indicated.
4. Forms: Use walls of trench to form side walls of ductbank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
5. Minimum clearances between ducts: 3 inches between ducts and exterior envelope wall, 2 inches between ducts for like services, and 4 inches between power and signal ducts.
6. Depth: Install top of ductbank at least 24 inches below finished grade in nontraffic areas and at least 30 inches below finished grade in vehicular traffic areas, unless otherwise indicated.

F. Directly-buried ducts: Support ducts on duct spacers, spaced as recommended by manufacturer and coordinated with duct size, duct spacing, and outdoor temperature. Install as follows:

1. Separator installation: Space separators close enough to prevent sagging and deforming of ducts.
2. Install expansion fittings as shown on shop drawings.

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3. Trench bottom: Continuous, firm, and uniform support for ductbank. Prepare trench bottoms as specified in Section 26 0501, Excavation and Fill for Electrical Work.
4. Backfill: Install backfill as specified in Section 26 0501, Excavation and Fill for Electrical Work. After installing first tier of ducts, backfill and compact. Repeat backfilling after placing each tier. After placing last tier, hand-place backfill to 4 inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, complete backfilling normally.
5. Minimum clearances between ducts: 3 inches between ducts for like services and 6 inches between power and signal ducts.
6. Depth: Install top of ductbank at least 24 inches below finished grade, unless otherwise indicated.

G. Warning tape: Bury warning tape approximately 12 inches above concrete-encased ductbanks. Align tape parallel to and within 3 inches of the centerline of ductbank.

H. Stub-ups: Use rigid steel conduit for stub-ups to equipment. For equipment mounted on outdoor concrete bases, extend steel conduit a minimum of 5 feet from edge of base. Install insulated grounding bushings on terminations. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.

I. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.

J. Pull rope: Install in ducts, including spares.

3.4 HANDHOLE INSTALLATION

A. Elevation: Install handholes with depth as indicated.

B. Polymer handhole installation: Unless otherwise indicated, comply with ASTM C 891.

1. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
2. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

3.5 FIELD QUALITY CONTROL

A. Testing: Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.

B. Duct integrity: Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of the duct. If obstructions are indicated, remove obstructions and retest.

C. Correct installations if possible and retest to demonstrate compliance. Remove and replace defective products and retest.

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3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

END OF SECTION

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SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes electrical identification materials and devices required to comply with ANSI, NFPA, and OSHA standards.

B. This section addresses identification of electrical equipment, raceways, boxes, conductors, and other related electrical system components.

1.2 SECTION INCLUDES

A. Identification of power conductors and control cables.

B. Identification of equipment and instructions.

C. Miscellaneous identification products.

1.3 RELATED SECTIONS

A. Sections 26 0519, Wires and Cables, and 26 0533, Conduits.

1.4 REFERENCES

A. ANSI Z535.4: Standard for Product Safety Signs and Labels.

B. ANSI/IEEE C2: National Electrical Safety Code.

C. NFPA 70: National Electrical Code.

D. NFPA 70E: Standard for Electrical Safety in the Workplace.

E. OSHA 29 CFR 1910.144: Safety Color Code for Marking Physical Hazards.

F. OSHA 29 CFR 1910.145: Specifications for Accident Prevention Signs and Tags.

G. UL 969: Standard for Marking and Labeling Systems.

1.5 SUBMITTALS

A. Product data: For each type of electrical identification product.

B. Identification schedule: An index of nomenclature for electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products. Non-rigid samples shall be mounted on 8.5-inch by 11-inch sheets with annotation explaining proposed use.

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1.6 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with OSHA standards.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.7 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other sections requiring identification applications, drawings, shop drawings, manufacturer's wiring diagrams, and the operation and maintenance manual; and with those required by codes, standards, and safety regulations. Use consistent designations throughout Project.

B. Coordinate installation of identification materials and devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identification materials and devices with location of access panels and doors.

D. Install identifying materials and devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following manufacturers, or approved equal or approved equal:

1. Brady USA, Inc.
2. Carlton Industries
3. Ideal Industries, Inc.
4. Panduit Corporation
5. Presco
6. Seton Identification Products
7. Thomas and Betts Company
8. Utility Safeguard

2.2 GENERAL PRODUCT REQUIREMENTS

A. Except where otherwise indicated, provide manufacturer’s standard identification products of category and type suitable for each application. Where more than one identification method is specified for an application, the Installer shall select and utilize each material in a consistent manner.

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2.3 CONDUCTOR AND CABLING IDENTIFICATION

A. Adhesive labels: Preprinted, flexible, self-adhesive vinyl with legend overlaminated with a clear weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

B. Marker tapes: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

2.4 EQUIPMENT IDENTIFICATION

A. Engraved plastic nameplates: Laminated plastic, engraved, white letters on black background, except where other color schemes are noted or specified.

1. Size: Minimum 0.75 inches by 2.5 inches.
2. Letter size: Minimum height of 0.375 inches.
3. Mechanically fastened, except adhesive mounted where necessary due to substrate.

a. Mechanical fastener: Punched or drilled, with vandal-proof stainless steel or brass screws or rivets.

B. Baked-enamel signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.

C. Exterior, metal-backed, signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate (CAB) signs with galvanized steel backing; punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.

D. Adhesive film label: Machine-printed, black letters on white background, through thermal transfer or equivalent process, with clear weatherproof and UV-resistant covering. Minimum letter size height of 0.375-inch (10 mm).

2.5 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Underground warning tape: Permanent, bright-colored, continuous-printed, vinyl tape for use with underground cables, conduits, and ductbanks. Comply with ANSI Z535.

1. Not less than 6-inches wide by 4 mils thick.
2. Tape Material:

a. Made of metal detectable polyester or vinyl.
b. Compounded for permanent direct-burial service. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to destructive substances commonly found in soils.

3. Printed legend with black lettering, indicating type of underground line.

a. Provide inscriptions for power cabling with red-colored tape: Example – “CAUTION – BURIED ELECTRIC LINE BELOW”.
b. Provide inscriptions for low-voltage system cabling with orange-colored tape: Example – “CAUTION – BURIED FIBER OPTIC LINE BELOW”.

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B. Wiring device tape labels:

1. Adhesive film label: Machine-printed, black letters on clear background, through thermal transfer or equivalent process. Minimum letter size height of 0.25-inch.

a. Labeling for electrical devices and components such as receptacles, switches, control device stations, manual motor starters, network and phone jacks, junction and pull boxes, etc.

C. Warning labels and signs:

1. Self-adhesive warning labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configures for display on front cover, door, or other access to equipment unless otherwise noted.
2. Baked-enamel warning signs: Preprinted, aluminum signs, punched or drilled for fasteners with corner grommets; with colors, legend, and size required for application.
3. Fasteners: Self-tapping, stainless-steel screws or, stainless-steel machine screws with nuts, flat and lock washers.

D. Tape markers: Vinyl, pressure-sensitive, with clear vinyl overlay.

1. Working space, floor markers: Minimum 2-inch (50mm) wide, 5 mil (0.125 mm) thick, with black and white stripes.

E. Cable ties: Fungus-inert, self-extinguishing, one-piece, self-locking, color-coded, nylon cable ties suitable for the application (general purpose, UV-stabilized outdoor, or plenum rated).

F. Paint: Formulated for the type of surface, location, and intended use.

G. Stenciling: Nonfading, waterproof, ink or paint. Black or color-coded.

H. Adhesive: Heavy-duty, thermo-resistant, industrial grade adhesive, for adhesion to any surface without identification curling, peeling, or falling off.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification products at locations for most convenient viewing without interference with operation and maintenance of equipment.

1. For finished public spaces, coordinate identification product mounting locations with Architect

C. Apply identification products to surfaces after equipment finish work has been completed.

D. Clean surfaces before applying identification products, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

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F. 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 exceeds 16-inches overall.

3.2 APPLICATION

A. Miscellaneous:

1. Access doors and panels: Apply engraved nameplate labels at access doors identifying concealed electrical item. Do not locate labels in finished, public spaces.

B. Junction and pull boxes:

1. Label each junction and pull box, identifying circuit designation or type of system.

a. Exposed boxes: Place label on coverplate, externally visible.
b. Concealed boxes: Place label or tag on inside cover of box.
c. Junction boxes concealed above suspended ceilings or exposed in non-occupied spaces may be marked with permanent ink marker in lieu of printed labels.

d. Boxes with conductors greater than 600V: Apply labels identifying nominal system voltage on cover and minimum of one fixed side. One label shall be visible from the floor where boxes are installed exposed.
e. Fire alarm system boxes shall have red finish. Boxes shall be prefinished prior to installation.

C. Wiring and cabling identification:

1. Power circuit conductor identification, 600 V or less: Apply color-coded identification for cables, feeders, and power circuit conductors exposed in accessible vaults, junction and pull boxes, utility structures, and equipment enclosures. Apply color-coding scheme as indicated below throughout the building's network of feeders and circuits, unless otherwise required by the authority having jurisdiction.

a. Colors on conductors No. 10 and smaller, or No. 6 and smaller for grounded and grounding conductors: Solid colored insulation.
b. Colors on conductors No. 8 and larger, or No. 4 and larger for grounded and grounding conductors: Apply colored tape wrapped a minimum of 6 inches (150 mm) on either end of conductor and in boxes where splices or taps are made.
c. Conductors used solely for grounding purposes shall be green, if insulated.
d. Where multi-conductor cables are used, use same color coding system for identification of wiring.

COLOR CODE (600 volts maximum)			
VOLTAGE	NEUTRAL	PHASE	
		A	B
240/120 volts, single-phase, 3-wire	White	Black	Red

2. Power circuit conductor identification, greater than 600 volts: Apply nonmetallic tags or aluminum, wraparound marker bands where cables, feeders, and power circuits are exposed in vaults, junction and pull boxes, and utility structures. Apply securely fastened legend identifying circuit or feeder designation.

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3. Conductors for future use: Attach tags with circuit designation for conductors to be extended for future use.
4. Control and low-voltage system wiring shall be coded with colors and markings different from those used to designate phase wires.

D. Wiring device labels: For wiring devices such as receptacles, devices installed in surface raceway assemblies, and other wiring devices operating at or greater than 120 volts.

1. Apply adhesive film labels on inside of wiring device identifying circuit designation serving device.

E. Equipment identification: Install unique designation label consistent with contract documents and shop drawings.

1. Labeling instructions:

a. Engraved plastic laminate nameplates, unless otherwise indicated.
b. Unless otherwise required, provide a single line of text with 0.5-inch high lettering on 1.5-inch high label. Where two or more lines are required, use single label with increased height.
c. For multi-section or multi-compartment equipment, apply labels identifying each compartment or section.
d. For fusible equipment, identify fuse type and size on the front cover.
e. For enclosed circuit breaker equipment, identify device trip rating where rating is not visible.
f. Where equipment has more than one source of power (i.e., transfer switch, separate control power source), the location and circuit designation of each power source shall be clearly identified at the equipment location.

2. Apply nameplates and labels to equipment according to the below identification schemes:

a. Identify equipment designation; voltage rating; phase and number of wires; and designation and location of load served. Apply products to the following equipment:

(1) Panelboards
(2) Switchboards

b. Identify equipment designation; primary and secondary voltage ratings; phase and number of wires; circuit designation and location of primary source; and designation and location of load served. Apply products to the following equipment:

(1) Disconnect switches
(2) Enclosed circuit breakers
(3) Contactors
(4) Motor starters and combination motor starter-disconnects
(5) Variable frequency drives
(6) Transformers

c. Identify equipment designation; voltage rating; phase and number of wires; and capacity rating. Apply products to the following equipment:

(1) Generator: Capacity rating in kilowatts (kW).

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(2) Transfer switches: Capacity rating in amperes; identify the location and circuit designation of each power source at the equipment location.

d. Identify equipment designation; and circuit designation and location of primary source. Apply products to the following equipment:

(1) Monitoring and control equipment
(2) Control stations
(3) Fire alarm control panels and auxiliary equipment

3. Nameplates shall incorporate white lettering on colored backgrounds based on the following color-coding scheme:

a. Normal Power System: Black background.
b. Emergency Power System (Life-Safety Branch): Red background.
c. Standby Power System (Optional Standby Branch): Blue background.

F. Warning and caution labels and signs:

1. Apply warning and caution labels on equipment in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements including arc-flash hazard warning labels and special clearance requirements.
2. Apply warning and caution labels and signs at locations where safe operation and maintenance of electrical system equipment is of concern.
3. Apply warning signs on electrical room doors in accordance with NFPA 70 and 70E, ANSI, and OSHA requirements. Where doors are located in finished, public areas, located sign on the inside of the door. Coordinate mounting requirements with door type.

G. Service-entrance equipment: Provide field marking of service entrance equipment maximum available fault current values in accordance with NFPA 70 requirements.

H. Underground warning tape: Apply underground warning tape above underground ductbanks, conduit, or direct-buried cable.

3.3 FIELD QUALITY CONTROL

A. Coordinate names, abbreviations, colors, and other designations with construction documents, submittals, and applicable code and standards requirements. Utilize consistent designations and identification techniques throughout project.

B. Install identification products at locations that are clearly visible at normal viewing angles and without interference with operation and maintenance of the equipment.

C. Install identification products in a neat and clean, workmanship-like manner where products are securely attached and oriented parallel to equipment edges.

END OF SECTION

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SECTION 26 0573 - OVERCURRENT PROTECTIVE DEVICE STUDIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Electrical system fault-current and protective device study:

1. Fault-current analysis.
2. Arc-flash hazard analysis.

1.2 RELATED SECTIONS

A. Sections in Division 26, including Section 26 2416, Panelboards.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
2. IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
3. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
4. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
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 C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.

C. National Fire Protection Association (NFPA):

1. NFPA 70 – National Electrical Code, latest edition.
2. NFPA 70E – Standard for Electrical Safety in the Workplace.

D. Occupational Safety and Health Administration (OSHA):

1. OSHA 29 Code of Federal Regulations (CFR) Part 1910, Subpart S.

1.4 SUBMITTALS

A. Product data: For computer software to be used to perform studies.

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B. Product certificates: For coordination-study and fault-current analysis computer software programs, certifying compliance with IEEE 399.

C. Qualifications:

1. Submit evidence indicating individual and organization compliance with requirements indicated in “Quality Assurance” below.

D. Preliminary electrical system study: Submit for review before distribution equipment shop drawings have been submitted, and before equipment order has been released to the manufacturer.

1. If formal completion of the study may delay the project schedule, Architect/Engineer may approve use of the preliminary draft for ordering equipment.
2. If approved for use in ordering equipment, preliminary draft shall include sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

E. Final electrical system study:

1. Submit final report for review and record.
2. Incorporate changes resulting from deficiencies and corrections of preliminary draft report.

F. Reports:

1. Electrical system study report: Submit reports required above including the following items:

a. General report information: Scope, definitions, descriptions, assumptions, and other information necessary to properly interpret results of the report.
b. Tabulated summary comparing protective device ratings and calculated available fault-current levels.
c. Tabulated summary of protective device settings including circuit breaker, fuse, and relays.
d. Fault-current analysis calculations.
e. Arc-flash hazard calculations including details of the incident energy and flash protection boundary calculations.
f. Recommendations for system improvements.
g. System one-line diagram.
h. Input and output data used for each component and for study calculations.

2. Submit final reports as electronic files in portable document format (.pdf) to Owner. Submit program base files in file format compatible with software utilized by Owner.

1.5 QUALITY ASSURANCE

A. Electrical system study shall be performed by one or more independent qualified organizations, and under the supervision and approval of a Registered Professional Engineer skilled in performing and interpreting the power system studies.

B. Qualifications of organization performing electrical system study: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices:

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1. Registered Professional Engineer shall be a full-time employee of the equipment manufacturer or of an approved engineering firm.
2. Registered Professional 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.

C. Qualifications of computer based software: Widely available, complying with standards, guides, and codes as referenced above.

D. Comply with IEEE 399 for general study procedures.

E. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Computer software: Subject to compliance with requirements, utilize product by one of the following or approved equal:

1. EDSA Micro Corporation
2. Operation Technology, Inc.
3. SKM Systems Analysis, Inc. (Basis of Design)

2.2 COMPUTER SOFTWARE REQUIREMENTS

A. Comply with IEEE 399.

B. Computer software program shall be capable of performing fault-current analysis of project electrical distribution system.

C. Computer software program shall be capable of plotting and diagramming time-current characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

D. Computer software program shall be capable of performing arc fault hazard analysis using equations as established by IEEE 1584 and requirements presented in NFPA 70E, Annex D.

E. Software shall include a comprehensive equipment library of manufacturer-based and IEEE / ANSI based equipment to accurately model the electrical distribution system.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine project submittals for compliance with electrical distribution system requirements outlined on the drawings and in electrical specification sections.

3.2 SYSTEM DATA COLLECTION

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A. The Contractor shall furnish all data required to perform the power system studies. The Engineer performing the fault analysis, 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 ensure 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. The Engineer performing the studies shall gather and tabulate input data necessary to support each study including the following:

1. Product data for each component of the electrical distribution system.
2. Utility available fault contribution and impedance values.
3. Drawings, one-line, and riser diagrams showing system configuration, equipment designations, feeder lengths, and other applicable system characteristics.

3.3 SYSTEM FAULT CURRENT ANALYSIS

A. Calculate the maximum available short-circuit momentary current and interrupting duties in amperes rms symmetrical for electrical power distribution system components. The calculation shall be performed for current immediately after initiation and for a three-phase bolted fault at each of the following locations:

1. Electric utility’s supply termination.
2. Branch circuit panelboards.

B. Study the project’s electrical distribution system from normal and alternate power sources throughout electrical distribution system.

C. For grounded systems, provide line-to-ground fault current values for areas as defined above for the three-phase, bolted fault, short-circuit study.

D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241, and IEEE 242.

E. Study Report:

1. Input data: Gather and provide the following input data, in tabular or graphic form, used to perform fault calculations and other studies in this section.

a. Utility three-phase and line-to-ground available contribution with associated X/R ratios.
b. Short-circuit reactance of rotating machines with associated X/R ratios.
c. Cable type, construction, size, quantity per phase, length, impedance and conduit type.
d. Transformer primary & secondary voltages, winding configurations, kVA rating, impedance, and X/R ratio.
e. Circuit breaker types and sizes.

2. Methods and assumptions: Indicate calculation methods and assumptions that may have been used to perform analysis.
3. Results: Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram. Provide the following in a table format:

a. Source fault impedance and generator contributions

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b. X/R ratios
c. Asymmetry factors
d. Motor contributions
e. Short circuit KVA
f. Symmetrical and asymmetrical fault currents

4. Equipment evaluation and conclusions:

   a. Verify interrupting ratings and withstand ratings are equal to or higher than calculated fault current levels.
   b. Verify adequacy of phase conductors at maximum three-phase, bolted fault currents.
   c. Verify adequacy of equipment grounding conductors and grounding electrode conductors for grounded systems at maximum ground-fault currents.

5. Recommendations: List recommendations for equipment with inadequate ratings. Notify Architect in writing of existing equipment improperly rated for the calculated available fault current of the system.

3.4 AVAILABLE FAULT CURRENT LABELS

A. Provide a machine printed adhesive label on the enclosure for each switchboard and panelboard. The label shall include the following information, at a minimum:

   1. Available fault current
   2. Calculation date

B. Labels will be based on calculated maximum available short-circuit momentary current 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. Labels shall be in compliance with NFPA 70E and OSHA standards.

3.5 SYSTEM ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (such as switchgear and panelboard) where work could be performed on energized parts.

C. The arc-flash hazard analysis shall include electrical equipment locations where work such as examination, adjustment, service, or maintenance could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering 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.

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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).

1. 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. 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.

L. Incident energy and flash protection boundary calculations:

1. Arcing fault magnitude
2. 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

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3.6 ARC FLASH WARNING LABELS

A. The Contractor and organization performing the Arc Flash Hazard Analysis 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 shall include the following information, at a minimum:

3. Location designation
4. Nominal voltage
5. Flash protection boundary
6. Hazard risk category
7. Incident energy
8. Working distance
9. Engineering report number, revision number and issue date

D. Labels shall be machine printed, with no field markings.

E. Labels shall be in compliance with NFPA 70E and OSHA standards.

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 600V, 480V, and applicable 208V panelboard, one arc flash label shall be provided.
2. For each switchboard, one arc flash label shall be provided.

3.7 FIELD QUALITY CONTROL

A. Field adjustment: Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

B. Make modifications to equipment as required to accomplish conformance with studies.

C. Notify Architect in writing of any required equipment modifications.

END OF SECTION

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SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Toggle / snap switches for lighting.

B. Occupancy sensors.

C. Time-based control devices.

D. Photocells.

E. Lighting contactors.

F. Emergency lighting control transfer relay device

G. Conductors and cables

H. Dimmer Switches

1.2 RELATED SECTIONS

A. Section specifying requirements for LEED rating is specified in Division 01.

B. Identification for electrical systems: Section 26 0553.

C. Interior lighting: Section 26 5100.

D. Exterior lighting: Section 26 5600.

E. Commissioning requirements: Divisions 01 and 23.

1.3 REFERENCES

A. IECC: International Energy Conservation Code.

B. NECA 1: Standard Practices for Good Workmanship in Electrical Construction.

C. NFPA 70: National Electrical Code.

1.4 SUBMITTALS

A. Product data: Each type of device used in the project.

B. Bill of materials: Provide detailed list of components and quantities.

C. Shop drawings: Detail assemblies of standard and project specific components. Indicate dimensions and arrangement of components.

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1. Floor plans: Identify locations of lighting control system components; interconnection of components. Utilize reflected ceiling plans to show location, orientation, and coverage area of sensors.
2. Wiring diagrams: Power, signal, and control wiring, differentiating between manufacturer-installed and field-installed wiring, provided on a schematic diagram.
3. Include representative views of components, including button layouts, engraving, colors, and other physical characteristics pertinent to each device.

D. Field quality control test reports.

E. Qualifications of factory certified field service engineer.

F. Operation and maintenance data: For lighting control system and associated components, provide product data, shop drawings, and test reports in operation and maintenance manual. In addition to items specified in Division 01, include list of replacement parts and assemblies.

1.5 QUALITY ASSURANCE

A. Comply with requirements for LEED certification specified in Division 01.

B. Devices shall be UL listed and labeled for their intended application.

C. Provide services from factory certified field service engineer to perform functional testing.

D. Qualifications for factory certified field service engineer:

1. Minimum experience of 2 years training in the electrical/electronic field.
2. Certified by the equipment manufacturer on the system installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store components indoors in a clean dry space with uniform temperature to prevent condensation. Protect switches from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor’s and subcontractors’ responsibilities are described in Divisions 01 and 23 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 TOGGLE / SNAP SWITCHES FOR LIGHTING

A. Manufacturers or approved equal:

1. Arrow Hart/Eaton Wiring Devices
2. Hubbell/Bryant Electric
3. Legrand/Pass & Seymour (P&S)

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4. Leviton Manufacturing Co.

B. Toggle / snap switches: Specification grade conforming to UL 20:

1. General-use: Single-pole, 3-way, and 4-way, 20 amperes, 120-volts:

a. Basis of design: P&S PS20AC1, PS20AC3 (3-way), PS20AC4 (4-way), industrial extra heavy-duty.

C. Device color: Brown

D. Device covers: Type 302 stainless steel.

1. Basis of design: P&S: Type 302 stainless steel, SS series.

2.2 OCCUPANCY SENSORS

A. Acceptable manufacturers or approved equal:

1. Acuity Brands Lighting, Inc.
2. Hubbell Control Solutions
3. Signify/Cooper Lighting LLC.

B. Sensor types:

1. Wall switch sensor: Wired, dual-technology, combination ultrasonic/passive infrared detector with override switch, capable of installation in a standard wall switch backbox.

a. Line-voltage: 120-volt dual-input, 60 hertz.
b. Device finish color: White, with matching decorator style device cover and mounting screws above and below device.

C. Characteristics:

1. Adjustable delayed off-time range: Between 30 seconds and 30 minutes, factory set to 20 minutes.
2. Fail on: Lights will go to full brightness if sensor fails.
3. Ultrasonic detector: Volumetric sound wave at 40 kHz frequency. Detector shall automatically adjust detection threshold to compensate for learned environmental behavior.
4. Infrared detector: Passive, with field-adjustable ambient light adjustment.

D. Auxiliary components:

1. Power pack: Universal 120-volt switched input, controlled through a high-current 20-ampere relay. Low-voltage output, less than or equal to 24 volts DC, for powering low-voltage occupancy sensors. Plenum rated enclosure.
2. Override switch: Low-voltage operating on voltage less than or equal to 24 volts DC, with a momentary contact actuator to send a signal to the associated power pack to change the current lighting state, and color to match device finish color specified above.

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2.3 TIME-BASED CONTROL DEVICES

A. Digital time clock / time switch: Equal to TORK/NSi Industries, catalog number EWZ201, UL 917 listed, electronic 7-day time switch, microprocessor-based, solid-state, two-channel control, with LCD display and automatic tracking of sunrise and sunset times in order to automatically turn lights ON at sunset and OFF at sunrise.

1. Input voltage: 120 volts AC.
2. Output dry contacts: 30 amperes at 120 volts AC; 20 amperes at 120 volts AC.
3. Scheduling: Twenty ON and OFF set points, capable of different schedules each day of the week.
4. Sunset astronomic: Adjusts daily to changes in sunset times. Adjustable from 10 to 60 degrees, northern or southern latitudes. Can be individually offset plus/minus 1-240 minutes from both sunset and sunrise times.
5. Daylight savings: Automatic adjustment.
6. Leap year: Automatic compensation.
7. Manual override: Until the next regularly scheduled ON or OFF, automatic operation then resumes.
8. Clock format: AM/PM.
9. Power outage backup: Permanent schedule retention. Capable of operating during a power outage for 4 days with an integral supercapacitor.
10. Enclosure: Polycarbonate indoor/outdoor NEMA 250 Type 3R with lockable hasp.

B. Spring-wound timers: Spring wound for mounting in flush box complete with properly marked cover plate. Time cycle 0 to 6 hours.

1. Basis of design: TORK, A500 series.

2.4 LIGHTING CONTACTORS

A. Lighting contactors: UL 508 listed, in NEMA 250 Type 1 enclosure, mechanically held, electrically operated, enclosed silver-alloy double-break contacts, coil-clearing contacts; withstand rating as indicated on the drawings; Hand/Off/Auto selector switch on cover.

1. Provide contactor with two-wire control relay for two-wire control of mechanically held lighting contactor.
2. Basis of design: Square D 8903.

2.5 CONDUCTORS AND CABLES

A. Wiring to supply side of remote-control power sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519, Wires and Cables.

B. Low-voltage control cable: Manufacturer’s standard multi-conductor cable with stranded-copper conductors not smaller than No. 22 AWG, plenum rated.

1. Class 2 control cables: Multi-conductor cable with copper conductors not smaller than No. 18 AWG.
2. Class 1 control cables: Multi-conductor cable with copper conductors not smaller than No. 14 AWG.

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C. Digital UTP cabling: Unshielded, twisted-pair cable with copper conductors, complying with TIA/EIA-568-B.2, Category 5E or Category 6 for horizontal copper cable.

1. Cable color: Green.

2.6 DEVICE PROGRAMMING REQUIREMENTS

A. Programming of lighting controls shall be performed by a factory certified field service engineer.

B. Refer to lighting controls diagrams and lighting controls schemes on the drawings.

2.7 DIMMER SWITCHES

A. Incandescent dimmers:

1. Each dimmer shall have an air gap switch.
2. Color: White with matching wallplate.
3. Gangable by breaking off fins and faceplate.
4. RFI filter.
5. Voltage-compensated.
6. UL listed.
7. Basis of design: Lutron Electronics Co. Models listed with wattage rating as scheduled below:

Watt Load	
Up to 500	NT 600
501 - 900	NT 1000
901- 1400	NT 1500
1401 - 1900	NT 2000

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install devices in complete compliance with the manufacturer's recommendations.

B. Provide a single cover plate where two or more devices are grouped together in one box.

C. Verify door swings with door frame installed prior to rough-in for switches.

D. Ground components according to Section 26 0526, Grounding and Bonding.

E. Fully document control device calibration settings after system programming with manufacturer's representative and submit this information as a part of the O&M manual.

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F. Devices shall be installed and programmed to meet the control intent.

G. Manufacturer's factory certified field service engineer shall provide start-up service, including physical inspection of lighting control system and connected wiring and final adjustments to meet specified performance requirements.

3.2 INSTALLING OCCUPANCY SENSORS

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

B. Provide line-voltage type detectors when a single wall device controls lighting within a single space.

C. Provide low-voltage type detectors when ceiling detector(s) controls a single space.

D. Coverage pattern: Verify coverage pattern of single detector or system of detectors to be capable of complete coverage of the space in which the lighting is intended to be controlled. Provide additional detectors as necessary to satisfy complete coverage.

E. Programming requirements:

1. Vacancy mode (manual on, automatic off).
2. Occupancy mode (automatic on, automatic off).

3.3 IDENTIFICATION

A. Materials: Refer to Section 26 0553, "Identification for Electrical Systems." Identify devices and wiring.

B. Lighting control stations:

1. Custom engraving: Provide custom engraving on each button of each control station, defining button’s function. Coordinate with owner for final approval of engraving.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's field service: Engage a factory certified field service engineer to test and inspect components, assemblies, and equipment installations, including connections.

B. Functional testing. Perform tests and prepare test reports for the following:

1. For occupancy sensors, confirm that the placement, sensitivity, and time-out settings are optimized to ensure lights turn off only after each space is vacated and do not turn on unless the space is occupied.

END OF SECTION

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SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Circuit breaker panelboards, distribution and lighting and appliance branch-circuit types.

B. Fusible branch circuit panelboards.

1.2 RELATED SECTIONS

A. Identification for electrical systems: Section 26 0553.

B. Overcurrent protective device studies: Section 26 0573.

C. Surge protective devices: Section 26 4313.

1.3 REFERENCES

A. ANSI/NECA 407: Recommended Practice for Installing and Maintaining Panelboards.

B. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

C. NEMA PB 1: Panelboards.

D. NEMA PB 1.1: Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

E. NETA ATS: Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

F. UL 50: Enclosures for Electrical Equipment.

G. UL 67: Panelboards.

H. UL 1449: Surge Protective Devices.

1.4 DEFINITIONS

A. Circuit breaker panelboards in this section:

1. Distribution panelboard: Capable of accepting up to 1200-ampere branch circuit breakers.
2. Branch circuit panelboards: Maximum branch circuit breaker amperage:

    a. 277/480-volt lighting panelboards: 125 amperes
    b. 120/208-volt panelboards: 100 amperes.

1.5 SUBMITTALS

A. Product data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated.

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B. Bill of materials: Provide detailed list of components.

C. Shop drawings: For each type of panelboard, include the following details:

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings in panel schedule format.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.

D. Coordination drawings: Floor plans, drawn to 1/4"=1'-0" scale, on which the following items are shown and coordinated with each other based on input from installers of the items involved:

1. Dimensioned concrete base; outline of equipment; and required clearances; relationship between components and adjacent architectural, structural, and mechanical elements.
2. Underground conduit stub-up locations, where applicable.
3. Overhead conduit riser locations.
4. Grounding cable locations and terminations.

E. Operation and Maintenance Data: For panelboards and components to include in operation and maintenance manuals. In addition to items specified in Division 01 and Section 26 0101, 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.
3. Copy of each printed panelboard schedule representing final version following.

1.6 QUALITY ASSURANCE

A. Do not submit equipment submittals prior to completing Short-Circuit and Coordination Study as indicated in Section 26 0573.

B. Source limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency accepted by the authority having jurisdiction, and marked for intended location and application; listed as a complete assembly.

1. UL label and local testing (where required): As specified in Section 26 0500, Common Work Results for Electrical.

D. Comply with referenced standards and listings previously identified including NEMA PB 1, NFPA 70, and UL 67.

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1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store equipment indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.9 PROJECT CONDITIONS

A. Environmental limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
    b. Altitude: Not exceeding 6600 feet (2000 m).

1.10 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Furnish spare breakers for panelboards as indicated in schedule on drawings.
3. Furnish spare fuses for fused switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Circuit breaker panelboards: Subject to compliance with requirements, provide circuit breaker panelboards manufactured by Schneider Electric; Square D products or comparable product by one of the following or approved equal:

1. ABB; General Electric products.
2. Eaton Corporation.
3. Schneider Electric; Square D products.

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B. Fusible branch circuit panelboards: Subject to compliance with requirements, provide fusible branch circuit panelboards manufactured by Eaton Corporation; Bussmann products or comparable product by one of the following or approved equal:

1. ABB; General Electric products.
2. Eaton Corporation; Bussmann.
3. Littelfuse, Inc.
4. Mersen
5. Schneider Electric; Square D products.

2.2 PANELBOARDS, GENERAL

A. UL listing: UL 67, listed and labeled.

B. Panelboards for service entrance shall be listed and labeled for service.

C. Integrated equipment short-circuit rating: Each panelboard, as a complete unit, shall have a short-circuit rating equal to or greater than the integrated equipment rating shown or scheduled on the drawings.

1. Rating shall be established by testing in accordance with UL 67, with the overcurrent devices mounted in the panelboard. Make short-circuit tests on the overcurrent devices and on the panelboard structure simultaneously, by connecting the fault to each overcurrent device with the panelboard connected to its rated voltage source. The source shall be capable of supplying specified panelboard short-circuit current or greater.
2. Testing of overcurrent devices only while individually mounted is not acceptable. Testing the bus structure by applying a fixed fault to the bus structure alone is not acceptable.
3. Mark each panelboard with its maximum short-circuit current rating at the supply voltage.
4. Series rating of panelboards with devices outside of the panelboard enclosure are not permitted.

D. Enclosures: Flush- or surface-mounted as indicated, NEMA PB 1, Type 1, UL 50, galvanized steel.

1. Size: Where multiple-width or multiple-section panelboards are indicated or required, each cabinet shall be the same width and height.
2. Provide enclosure type as indicated below or listed on drawings:

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.

E. Directory card: Inside panelboard door, mounted in transparent card holder with information as indicated in Part 3, Identification.

F. Provisions for future devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

G. Furnish each unit with a master nameplate, listing standard manufacturer information including voltage, ampacity, frequency, and short-circuit ratings; manufacturer's model and project designations.

2.3 CIRCUIT-BREAKER PANELBOARDS

A. Factory-assembled complete with breakers.

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B. Cabinets and fronts: Minimum 20 inches wide, wiring gutter space in accordance with UL 67, with minimum four-inch width on every side.

1. Cabinet front: Hinged trim with entire front hinged to cabinet box with piano hinge and screw fasteners for surface mounted cabinets.
2. Door: Required for sizes up to and including 600 amps.

    a. Lock: Flush, cylinder tumbler type, with catch and spring-loaded stainless steel door pull. All panelboards shall be keyed alike. Provide two keys per lock. Provide extra keys as required in "Extra Materials" in Part 1 above.
    b. Hinges: Steel, completely concealed.

C. Circuit breakers: UL 489; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Circuit Analysis performed under Section 26 0573, whichever is greater.

1. Breakers shall be 1-, 2- or 3-pole, with an integral crossbar to ensure simultaneous opening of all poles in multipole circuit breakers.
2. Operating mechanism: Over center, trip-free, toggle-type with quick-make, quick-break action. Handles shall have on, off, and tripped positions.
3. Circuit breakers shall be able to be installed in the panelboard without requiring additional mounting hardware or disturbing adjacent units, bars, or branch circuit connections.
4. Where indicated on the drawings, provide shunt-trip main breakers, standard main breakers, or lugs.
5. Main and branch circuit breakers shall have device ampacity rating engraved on the front or side of each breaker handle. The breaker rating shall be clearly visible without removing panelboard cover.
6. Circuit breakers shall be rated for use with 75 deg C wire (conductor temperature rating).
7. Thermal-magnetic circuit breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 amps and larger.
8. Adjustable instantaneous-trip circuit breakers: Magnetic trip element with front mounted, field-adjustable trip setting.
9. Electronic trip circuit breakers: RMS sensing; field-replaceable rating plug or field replicable electronic trip; and the following field-adjustable settings:

    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.

10. Ground-fault circuit interrupter (GFCI) type circuit breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
11. Tandem breakers are not permitted.

D. Bussing assembly and temperature rise: Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule, established by heat rise tests conducted in accordance with UL 67.

1. Conductor dimensions shall not be accepted in lieu of actual heat tests.
2. Current-carrying parts of the bus structure shall be hard-drawn copper, 98 percent conductivity.

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3. Provide a separate copper ground bus with screw terminals for branch wiring and feed-through lugs.

E. Additional connections: Where indicated on drawings, provide the following:

1. Feed-through lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
2. Sub-feed (double) lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

F. Distribution panelboards: Distribution panelboard shall be capable of accepting up to 800 ampere branch breakers, or as indicated on drawing panel schedules. Current characteristics shall be as scheduled on the drawings.

G. Branch circuit panelboards: Panelboard shall be capable of accepting up to 125-amp branch breakers.

1. Branch breakers serving exit lights, fire alarm, emergency lighting, security equipment shall be provided with handle-blocking devices which shall prevent accidental operation but not prevent tripping.

H. Energy reduction maintenance switch (ERMS):

1. Distribution panelboard shall contain an arc energy reduction maintenance switch (ERMS) for each circuit breaker rated 1200-amperes or larger including any provisional spaces indicated as “space and provision” and marked with 1200-ampere or greater frame size. The ERMS shall include the following features:

a. External override and circuitry which shall be connected to a breaker’s trip unit, and shall be adjustable between 2.5x – 10x trip unit sensor rating.
b. Operation: Enabled via a mode selector switch located adjacent the circuit breaker. A separate local LED status indicator light shall demonstrate switch is in the “normal” or “maintenance” mode. The selector switch shall be lockable and accessibly mounted on the front enclosure cover above or adjacent to each breaker position served or Enabled via electronic trip unit integral to circuit breaker. Confirmation of protection mode via LED indicator light.
c. An ERMS hazard warning label shall be provided indicating presence of the ERMS.

2. Provide trip unit settings for maintenance after performing arc flash study in accordance with the NFPA 70E. The arc flash study shall provide arc flash energy and hazard category with “normal” and “maintenance” device protection (trip unit) settings respectively including protective coordination curves.

2.4 FUSIBLE BRANCH CIRCUIT PANELBOARDS

A. Factory-assembled complete with branch fuse disconnect:

1. Emergency (life-safety) panelboard(s) shall be fusible branch circuit panelboards.
2. Main lug only, main fused switch, or main non-fused switch as indicated on the drawings, with main fused switch selectively coordinated with fusible branch switches.
3. Six spare single-pole 20-ampere fuses, unless otherwise noted.
4. UL Listed minimum interrupting rating of 200,000 rms symmetrical amperes at 600 volts AC.

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B. Cabinets and fronts: Minimum 20 inches wide, wiring gutter space in accordance with UL 67.

1. Cabinet front: Door-in-door construction, one or more latches as required for size, with outer door covering the gutter.
2. Door: Lock, two keys per lock, steel hinges, and circuit directory card on inside of door.

C. Branch fuse disconnects: UL 248, UL 98, and NEMA FU 1; voltage, continuous-current rating, and interrupting rating as indicated on the drawings or determined by the results of the Short-Current Analysis performed under Section 26 0573, whichever is greater.

1. Incorporating overcurrent protection fuse and disconnecting means into a single integrated finger-safe component (1-pole, 2-pole or 3-pole) mechanically interlocked to prevent removal of the fuse while fuse terminals are energized.
2. Interchangeable from 15 amperes to 100 amperes without requiring additional space.
3. Time-delay UL Listed Class CF power fuses (equivalent to Class J).
4. Visible circuit ON/OFF indication positions and open fuse indication.
5. Permanently installed lockout means in the OFF position.

D. Bussing assembly and temperature rise: Panelboard bus structure and mains shall have current ratings as shown on the drawings:

1. Sufficient cross section to meet UL 67 temperature rise requirements.
2. Current-carrying parts of the bus structure shall be hard-drawn copper, 98 percent conductivity.
3. Provide a separate copper equipment ground bar and neutral bus bar.

2.5 SURGE PROTECTIVE DEVICE (SPD)

A. As part of the panelboard, provide SPD specified in Section 26 4313, Surge Protective Devices where indicated on drawings. Note the requirement of that section for a single manufacturer to provide SPD of all types in the project.

2.6 SOURCE QUALITY CONTROL

A. With branch circuit breakers installed, short-circuit test panelboards as complete units, in accordance with requirements of UL 67.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach panelboards to the wall where indicated on the drawings. Install in accordance with NEMA PB 1.1 and manufacturer's written installation instructions.

1. Mounting height:

a. 72 inches (1829 mm) to top of panelboard.
b. Panelboards taller than 72 inches (1829 mm): Bottom edge no more than 4-inches (102 mm) above floor.
c. Top breaker maximum height: No more than 6-feet, 7-inches (2.0 m) above the floor or working platform.

B. Comply with applicable portions of NECA 407.

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C. Frame and mount printed circuit directory indicating type and location of equipment on each circuit.

D. Wiring in gutters: Arrange conductors into groups, and bundle and wrap with wire ties.

E. Install filler plates in unused spaces.

F. Spare conduits: Where panelboards are recessed in wall construction, stub four 1-inch (27 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. The quantity of empty conduit should be greater than or equal to 50 percent of the combined quantity of “spare” or “space and provision” entries indicated in the associated panel schedule.

3.2 CONNECTIONS

A. Connect panelboards and components to wiring and to ground as indicated.

B. Shared neutral conductors shall not be permitted, except where indicated.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

A. Materials: Refer to Division 26 Section "Identification for Electrical Systems." Identify units, auxiliary devices, controls, and wiring. Identify equipment ratings.

B. Nameplates: Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements. Provide identification nameplate for each panelboard and associated components located on front of assembly.

C. Identify field-installed wiring and components. Refer to Division 26 Section "Identification for Electrical Systems" for additional requirements.

D. Identify available fault current and calculation date. Refer to Division 26 Section "Overcurrent Protective Device Studies" for additional requirements.

E. Provide printed directory for each panelboard. Handwritten directories are not acceptable. Copying of panel schedules and descriptions on drawings is not acceptable. Circuit directory shall reflect final circuit installation. Include the following information:

1. Panelboard designation and room location.
2. Circuit breakers, size and number of poles.
3. Circuit or feeder description including destination room name(s) and number(s).
4. Clear description of type of load circuit serves.
5. Panelboard ratings: Main bus ampacity, main circuit breaker or main lug ampacity, AIC rating.
6. Incoming primary feeder size and source panelboard circuit designation.

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F. Room names and numbers on the panelboard circuit directories shall match names and numbers used by the Owner. Note that room names and numbers on the drawings may not match the Owner's final room name and numbering scheme.

3.4 FIELD QUALITY CONTROL

A. Make insulation-resistance tests of each panelboard bus, component, and connecting supply, feeder, and control circuit.

B. Make continuity tests of each circuit.

C. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.5 CLEANING

A. Clean interior and exterior of panelboards.

B. Refinish painted surfaces damaged during construction to match the rest of the panelboard.

END OF SECTION

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SECTION 26 2713 – ELECTRICITY METERING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section included energy meters required to capture energy consumption and demand from building electrical loads and overall gas load. Energy metering components include the following:

1. Energy meters with pulse output.
2. Pulse data collection modules.
3. Network Communication Gateway.
4. Current transformers.

1.2 RELATED SECTIONS

A. Wires and cables: Section 26 0519.

B. Conduits: Section 26 0533.

C. Panelboards: Section 26 2416.

1.3 REFERENCES

A. ANSI C12.1: American National Standard for Electric Meters - Code of Electricity Metering.

B. UL 916: Standard for Energy Management Equipment.

C. UL 61010-1: Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use

1.5 ACTION AND INFORMATIONAL SUBMITTALS

A. Product data: For energy metering components.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for energy metering components.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Bill of materials: Provide detailed list of energy metering components and software.

C. Shop drawings: For energy metering components.

1. Include plans, elevations, sections, and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation and maintenance. Coordinate nomenclature and presentation with a block diagram.

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D. Field quality-control reports.

E. Sample warranty: For manufacturer's special materials and workmanship warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data: For energy metering components, include in operation and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; and task descriptions.
2. Troubleshooting procedures.
3. Detailed spare parts list.
4. Operating and programming instructions.

a. Operator's manual with procedures for operating software including logging on and off, handling alarms, producing reports, and changing set points and variables.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store energy metering components indoors in clean dry space with uniform temperature to prevent condensation. Protect equipment from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 WARRANTY

A. Special materials and workmanship warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of energy metering that fail in materials or workmanship within specified warranty period.

1. Warranty period: Five years from date of substantial completion.
2. Warranty shall include parts, labor, and system calibration.

1.9 QUALITY ASSURANCE

A. Electrical components, devices, and accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency accepted by the authority having jurisdiction, and marked for intended location and application.

B. UL label and local testing (where required): As specified in Section 26 0500, Common Work Results for Electrical.

C. Installer qualifications: An authorized representative who is trained and approved by manufacturer.

D. Comply with referenced standards and listings previously identified including ANSI C12.1, NFPA 70, UL 916, and UL 61010-1.

1.10 COORDINATION

A. Coordinate features of electrical equipment (e.g., switchboard, panelboards) and energy metering components to form an integrated interconnection of compatible components. Match components and interconnections for optimum performance of specified functions.

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B. Coordinate meter network connection to Baltimore County Public Schools' (BCPS) network for integration into BCPS county-wide energy metering and verification system. Refer to specification 26 2714.

C. Coordinate output of gas meter provided under Division 23 and provide necessary hardware to integrate meter into overall system.

1.12 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Division 01 and specification 26 0800 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide energy meters and associated components and software manufactured by Schneider Electric, or comparable product by one of the following or approved equal:

1. Eaton Corporation
2. E-Mon / Honeywell
3. Leviton Manufacturing Co., Inc.
4. Schneider Electric; Square D products
5. Siemens Industry, Inc.

B. All products used are required to be compatible with BCPS county-wide energy metering and verification system. Refer to specification 26 2714.

2.2 SINGLE-UNIT ENERGY METER

A. Separately mounted, modular, permanently installed, solid-state instrument for energy monitoring.

1. Liquid crystal display (LCD) to access energy measurements and phase diagnostics.
2. 3-phase 4-wire wye configurations.
3. Metering loads between 100 amperes and 5000 amperes.
4. Paralleling up to three sets of current transformers per phase.
5. Minimum of plus/minus 0.5% accuracy of metered loads with solid core current transformers, and plus/minus 1.0% accuracy of metered loads with split core current transformers.
6. Isolated pulse output with output ranges from 10Wh to 1kWh.
7. Pulse output communication to pulse data collection module.
8. Recording Intervals: Refer to Energy Metering and Verification System, Specification 262714.

B. Parameters:

1. Real power consumption (kWh).
2. Peak power demand (kW), resettable.
3. Power Factor, instantaneous

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2.3 MULTI-UNIT ENERGY METERS

A. Multiple unit meter, permanently installed, solid-state instrument for energy monitoring.

1. Meters configurable for up to (8) 3-phase 4-wire wye loads.
2. Liquid crystal display (LCD) to access energy measurements and phase diagnostics.
3. Metering loads between 100 amperes and 5000 amperes.
4. Paralleling up to three sets of current transformers per phase.
5. Minimum of plus/minus 0.5% accuracy of metered loads with solid core current transformers, and plus/minus 1.0% accuracy of metered loads with split core current transformers.
6. Isolated pulse output with output ranges from 10Wh to 1kWh.
7. Pulse output communication to pulse data collection module.

B. Parameters:

1. Real power consumption (kWh).
2. Peak power demand (kW), resettable.
3. Power Factor, instantaneous

2.4 BRANCH CIRCUIT ENERGY METERS

A. Branch circuit meter, permanently installed, solid-state instrument for energy monitoring.

1. Supports up to 48, 1Ø branch circuits.
2. Liquid crystal display (LCD) to access energy measurements and phase diagnostics.
3. 1-phase, 2-wire, or 3-phase 4-wire wye configurations.
4. Metering loads up to 100 amperes
5. Paralleling up to three sets of current transformers per phase.
6. Minimum of plus/minus 0.5% accuracy of metered loads with solid core current transformers, and plus/minus 1.0% accuracy of metered loads with split core current transformers.
7. Isolated pulse output with output ranges from 10Wh to 1kWh.
8. Pulse output communication to pulse data collection module.

B. Parameters:

1. Real power consumption (kWh).
2. Peak power demand (kW), resettable.
3. Power Factor, instantaneous

2.5 NETWORK COMMUNICATION GATEWAY

A. MODBUS AND ETHERNET GATEWAY

1. RS-485 Modbus/RTU communication converter to IP protocol for network connections.
2. 4-port unmanaged ethernet switch with additional fiber port.
3. RJ45 10/100 Ethernet communication to local area network (LAN)
4. Include 120V power supply and NEMA Type 1 Enclosure.

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2.6 CURRENT TRANSFORMERS

A. Capacities and characteristics: Solid or split core current transformers, sized to accommodate the feeders being metered.

1. Solid core: 20 amperes to 400 amperes.
2. Split core: 50 amperes to 5000 amperes.

2.7 Wires and cables

A. Electrical power wiring: Comply with requirements in Section 26 0519 Wires and Cables.

B. Communications cabling:

1. Low-voltage cabling for input/output pulse communications: Multiple conductor, color-coded, No. 20 AWG copper, minimum, plenum rated.
2. RS-485 Modbus/RTU communication cabling: 3-pair twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors, plenum rated, equal to Belden 88777.
3. RJ45 10/100 Ethernet cabling: Comply with 26 0519.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting performance of the work.

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

3.2 INSTALLATION

A. Comply with NECA 1.

B. Communications cabling installation:

1. Provide communications cabling between energy metering components per manufacturer's recommendations.
2. Comply with requirements of installing cable rated below 100 volts in Part 3 of Section 26 0519 Wires and Cables.
3. Label cabling with orange label at patch panel with text “Energy Management System”.

C. Provide one current transformer per each power phase of each electrical load. Place current transformers around the feeders serving the electrical loads as indicated on the Drawings.

3.3 FIELD QUALITY CONTROL

A. Manufacturer’s field service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

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B. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

1. Visually inspect communications cable placement and terminations.
2. Test low-voltage cable used for input/output (I/O) pulse communications.

a. Test every I/O point to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
b. Test every I/O point throughout its full operating range.
c. Test every pulse loop to verify that operation is stable and accurate.
d. Adjust pulse loop proportional, integral, and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each pulse loop's precision and stability via trend logs.
e. Test and adjust every pulse loop for proper operation according to sequence of operation.
f. Operate each I/O point at the following:

(1) Upper quarter of range.
(2) Lower quarter of range.
(3) At midpoint of range.

g. Exercise each I/O point.
h. For every I/O point in the system, read and record each value at pulse data collection module, at data acquisition server, and at field instrument simultaneously. Value displayed at pulse data collection module and at field instrument shall match.
i. Prepare and submit a report documenting results for each I/O point in the system, and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3. Testing RJ45 10/100 Ethernet communications cabling: Comply with Division 27.
4. Energy Meter Components Test

a. Connect a load of known kilowatt rating, 1.5 kW minimum, to a circuit supplied by metered feeder.
b. Turn off circuits supplied by metered feeder and secure them in off condition.
c. Run test load continuously for eight hours minimum, or longer, to obtain a measurable meter indication. Use test-load placement and setting that ensures continuous, safe operation.
d. Check and record meter reading at end of test period and compare with actual electricity used, based on test-load rating, duration of test, and sample measurements of supply voltage at test-load connection. Record test results.
e. Generate test report from the meter reading tests.

C. Electricity metering will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 OPERATING INSTRUCTIONS

A. As specified in Section 26 0500, provide operating instructions.

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B. Engage a factory-authorized service representative to train Owner's personnel to use, adjust, operate, and maintain the energy metering components.

1. Provide at least one session of four consecutive hours for instruction to Owner's personnel.

END OF SECTION

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SECTION 26 2716 - CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Indoor enclosures.

B. Weatherproof enclosures.

1.2 RELATED SECTIONS

A. Equipment foundations: Section 26 0528.

1.3 SUBMITTALS

A. Product data: Each type of enclosure required for the project.

PART 2 - PRODUCTS

2.1 INDOOR ENCLOSURES

A. Type 1 in accordance with NEMA 250 and conforming to UL 57, of size required by NEC to fit equipment or as shown on the drawings.

B. Construction: Code grade galvanized steel.

2.2 WEATHERPROOF ENCLOSURES

A. Type 3R in accordance with NEMA 250 and conforming to UL 57, of size required by NEC to fit equipment or as shown on the drawings.

B. Construction: Fabricated of 14-gauge galvanized steel, with drip shield top and smooth, seam-free sides and back.

C. Doors: Double doors fabricated from 12-gauge galvanized steel, overlap type without center post.

1. Door gaskets: Neoprene, attached with oil-resistant adhesive and held in place with steel retaining strips.
2. Full-length piano hinges.
3. Locks: Keyed, with all keys alike. Provide two keys with each enclosure.

D. Provide steel channels in rear of cabinet for mounting metering equipment.

2.3 FINISHES

A. Satin gray enamel, inside and out.

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PART 3 - EXECUTION

3.1 INSTALLATION

A. Securely attach enclosure to wall on plywood backboard, set on housekeeping pad, or hang on frame, as indicated.

3.2 LOCATIONS

A. Provide indoor type inside building and weatherproof type in exterior locations.

END OF SECTION

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SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Receptacles.

B. Toggle / snap switches for power.

C. Overhead power cord reels.

D. Audible signaling equipment.

E. Relays.

F. Terminal blocks.

G. Wiring devices for floor boxes and poke-through service fittings

1.2 RELATED SECTIONS

A. Boxes: Section 26 0534.

B. Identification: Section 26 0553.

C. Toggle / snap switches for lighting: Section 26 0923.

D. Lighting contactors for lighting: Section 26 0923.

1.3 REFERENCES

A. ANSI/NEMA WD 6: Wiring Devices - Dimensional Specifications.

B. NEMA WD 1: General Color Requirements for Wiring Devices.

C. UL 20: General-Use Snap Switches.

D. UL 498: Attachment Plugs and Receptacles.

E. UL 508: Standard for Industrial Control Equipment.

1.4 SUBMITTALS

A. Product data: Each type of device used in the project.

B. Samples: One sample of each type of wiring device and device plate.

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PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Acceptable Manufacturers or approved equal:

1. Arrow Hart/Eaton Wiring Devices
2. Hubbell/Bryant Electric
3. Legrand/Pass & Seymour (P&S)
4. Leviton Manufacturing Co.

B. Receptacles: NEMA 5-20R, 20-ampere rating, 125 volts AC, 2-pole, 2-wire plus ground, conforming to NEMA WD 1 and WD 6 configuration numbers, and UL 498.

1. Specification grade:

a. General-use, duplex: Basis of design: P&S TR5362, hard-use, tamper-resistant.
b. Plug load controllable type, duplex, with "controlled" marking identification:

(1) Basis of design: P&S TR5362CH, hard-use, half-controlled, tamper-resistant.
(2) Basis of design: P&S TR5362CD, hard-use, dual-controlled, tamper-resistant.

c. Ground-fault circuit-interrupter (GFCI) type, self-test, duplex:
Basis of design: P&S 2097TR, tamper-resistant.

d. Ground-fault circuit-interrupter (GFCI) type for exterior and wet locations, duplex:
Basis of design: P&S 2097TRWR, tamper-resistant, weather-resistant.

C. Specialty receptacles: Conforming to NEMA WD 1 and WD 6 configuration numbers, and UL 498.

1. Copier type: Basis of design: P&S 5871, NEMA 6-20R, heavy-duty.
2. Dryer type: Basis of design: P&S 3864, NEMA 14-30R, 125/250 volts AC, single-phase, 3-pole, 3-wire plus ground.
3. Kiln type: Basis of design: P&S 5750, NEMA 15-50R, 250 volts AC, three-phase, 3-pole, 3-wire plus ground.

D. Device colors:

1. General-purpose receptacles: Brown.
2. Controlled General-purpose receptacles: Green.
3. Generator power receptacles: Red.

E. Device covers:

1. Wall plates: Type 302 stainless steel. Basis of design: P&S Type 302 stainless steel, SS series.
2. Wet-location, weatherproof cover, single-gang, extra-duty: Basis of design: P&S WIUC10FRED, while-in-use, polycarbonate, frosted.
3. Wall plates for plug load controllable type receptacles: Custom engraved for metal, identifying with the words "SWITCHED RECEPTACLE".

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2.2 TOGGLE / SNAP SWITCHES FOR POWER

A. Acceptable manufacturers or approved equal:

1. Arrow Hart/Eaton Wiring Devices
2. Hubbell/Bryant Electric
3. Legrand/Pass & Seymour (P&S)
4. Leviton Manufacturing Co.

B. Toggle / snap switches: Specification grade:

1. General-use: UL 20, single-pole, 20 amperes, 120/277 volts:
   Basis of design: P&S PS20AC1, industrial extra heavy-duty.
2. Manual motor rated switch: UL 508, toggle type, 30 amperes, 600 volts, no overload protection, capable of being locked in the off position: Basis of design: P&S 7802MD, double-pole, single-phase.
3. Switch with pilot light (illuminated red toggle when in ON position): Basis of design: P&S PS20AC1RPL, UL 20, single -pole, industrial extra heavy-duty.

C. Device Color: Brown

2.3 OVERHEAD POWER CORD REELS

A. Rooms with open ceilings: UL Listed, standard-duty retractable cord/cable reel, enclosed drum assembly, rigid mount unit, and power accessories as detailed on the drawings.

1. NEMA L5-20P locking plug; provide with associated NEMA L5-20R receptacle.
2. 12/3 SJTOW cord/cable, 35-foot length, with ball stop.
3. NEMA 5-20R GFCI receptacle in pendant outlet box, secured with metal screws.
4. Wire-mesh cord grip/strain reliever: High-strength, galvanized-steel wire strand, matched to cable diameter.
5. Basis of design: Molex/Woodhead, Part No. 130091-0207 (Old Part Number 998L 3070G20).

B. Rooms with drop ceilings: UL Listed, standard duty retractable cord/cable reel, cast aluminum construction with white powder-coat finish, enclosed drum assembly, rigid mount, and power accessories as detailed on the drawing.

1. Standard-duty: 12/3 SJO cord/cable, 25-foot length, with adjustable stop.
2. NEMA 5-20R GFCI quad receptacle in portable outlet box.
3. Plenum rated enclosure, UL 2416 listed, for standard-duty cord/cable reel.
4. Basis of design: Hubbell, inREACH series.

2.4 AUDIBLE SIGNALING EQUIPMENT

A. Buzzer: Vibrating type, 5-inch (128-mm), 120 volts AC, electrically operated, having a minimum sound rating of 70 db at 10 feet.

1. Basis of design: Edwards Signaling, Catalog No. 340A-N5.

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B. Pushbutton for buzzer: Waterproof, momentary double-pole, normally open contacts rated 12 amperes at 250 volts AC, complete with brushed stainless steel actuating button and wall plate to be mounted on weatherproof recessed box, engraving "DOOR BELL" on wall plate, and neoprene gasket between wall plate and recessed box.

1. Basis of design: Dortronics Systems, Model No. WR5276-HD22.

2.5 RELAYS

A. Enclosure: NEMA 250 type 1.

B. Contacts: Double-break, fine silver, convertible from normally open to normally closed contacts. Provide contact status indication.

C. Coils: Molded construction, terminals provided with pressure wire connectors.

D. Coil voltage and number of contacts as indicated on the drawings.

E. Basis of design: Schneider Electric/Square D, Class 8501 Type C.

2.6 TERMINAL BLOCKS

A. Terminal blocks: Screw-terminal type, size as required by NFPA 70, NEMA 250 Type 1 enclosure with hinged cover.

2.7 WIRING DEVICES FOR FLOOR BOXES

A. Floor boxes for power and communications: As specified in Section 26 0534, Boxes, complete with specification grade 20-ampere, 125-volt receptacles as indicated on the drawings.

2.8 CEILING BOXES

A. Ceiling boxes for power and communications: As specified in Division 27, complete with specification grade 20-ampere, 125-volt receptacles as indicated on the drawings.

2.9 AUDIBLE SIGNALING EQUIPMENT

A. Chime: 120 volts AC, electrically operated, having a minimum sound rating of 88 db at 10 feet.

1. Basis of design: Nicor, Catalog No. EDC-1-120-WH-1

B. Pushbutton for Chime: Waterproof, momentary double-pole, normally open contacts rated 12 amperes at 250 volts AC, complete with nickel stucco actuating button and wall plate to be mounted on weatherproof recessed box, and neoprene gasket between wall plate and recessed box.

2. Basis of design: Nicor, Model No. EDC1BUTTONSBNK

PART 3 - EXECUTION

3.1 INSTALLATION

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A. Install devices in complete compliance with the manufacturer's recommendations.

B. Arrangement of devices: Unless otherwise indicated, mount flush with long dimension vertical. Group adjacent devices under single multi-gang wall plates.

C. Receptacles:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
2. Verify that receptacles for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

D. Wall plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard wall plates do not fit flush or do not cover rough wall opening.

E. Cord reels:

1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
3. Coordinate installation with lighting fixtures, equipment and devices at ceiling, and other trades to avoid conflicts with architectural items, structural members, sprinklers, ducts, diffusers, and other work.

3.2 IDENTIFICATION

A. Comply with Section 26 0553 "Identification for Electrical Systems."

B. Identify receptacles and toggle / snap switches with panelboard identification and circuit number. Use self-adhesive labeling.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and inspections:

1. After installing devices and after electrical circuitry has been energized, test for compliance with requirements.
2. Receptacles:

a. Insert and remove test plug to verify that device is securely mounted.
b. Verify polarity of hot and neutral pins.
c. Measure line voltage.
d. Measure grounding circuit continuity; impedance shall be not greater than 2 ohms.

3. Cord reels: Perform test and inspections indicated in manufacturer's instructions.

C. Correct malfunctioning devices on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new devices and retest.

D. Report results of tests and inspections in writing.

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END OF SECTION

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SECTION 26 2800 - ENCLOSED CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Enclosed switches (disconnects/safety switches).

B. Enclosed circuit breakers.

C. Elevator disconnecting switch.

1.2 RELATED SECTIONS

A. Motors: Sections 23 0513.

1.3 REFERENCES

A. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

B. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. UL 98: Enclosed and Dead-Front Switches.

D. UL 489: Molded Case Circuit Breakers and Circuit Breaker Enclosures.

1.4 SUBMITTALS

A. Product data: Each type of enclosed switch, enclosed circuit breaker, and elevator disconnecting switch.

1.5 QUALITY ASSURANCE

A. Comply with the following standards:

1. NEMA KS 1 for enclosed switches.
2. UL 98.
3. UL 198E
4. UL 489 for enclosed circuit breakers.

B. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. ABB; General Electric products.

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2. Eaton Corporation.
3. Schneider Electric; Square D products.

B. Properly size switches for number of poles and provide fused or non-fused as required for project conditions and to meet NFPA 70 requirements.

1. Neutral kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
2. Auxiliary contact kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

C. Fuse contacts and quick-make/quick-break jaws shall insure positive contacts with reinforcing spring clips or other approved means.

D. Switches shall be front-operated.

E. Current-carrying parts: Silver-plated copper.

F. Hinges: Noncurrent-carrying.

G. Switches shall be lockable in either open or closed position.

H. Type:

1. Non-fused switches: Heavy-duty type.
2. Fused switches: Heavy-duty type.

I. Enclosures: Indoors NEMA 250 Type 1; outdoors Type 3R, with raintight hubs.

2.2 ENCLOSED CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. ABB; General Electric products.
2. Eaton Corporation.
3. Schneider Electric; Square D products.

B. Separately enclosed circuit breakers, as indicated, manually operated, trip-free from the handle, and provided with inverse-time, thermal-element overload protection and instantaneous magnetic short-circuit protection on all poles.

C. Breaker sizes, calibrations and interrupting capacity: Noted on the drawings. Breakers shall be calibrated for 50 degrees C ambient and shall be rated for use with minimum 75 degree C wire.

D. Type: Molded-case, NEMA AB 1.

E. Operating handles shall clearly indicate the positions On, Trip, and Off.

F. Provide shunt trip operation where indicated on the drawings.

G. Enclosures: Indoors NEMA 250 Type 1; outdoors Type 3R, with raintight hubs.

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2.3 ELEVATOR DISCONNECTING SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Eaton Corporation; Bussmann.
2. Mersen.
3. Littelfuse, Inc.

B. Separately enclosed in NEMA 250 Type 1 enclosure with externally operable lockable handle allowing switch to be locked in the OFF position ensuring load side power isolation during servicing.

1. Properly sized Class J fuses, equal to Cooper Bussmann JKS Limitron fuses, Class J fuse block, connected in series with molded case safety switch.
2. Properly sized molded case switch, with 120 VAC shunt trip operation, connected in series with fuses.
3. Control circuit: 120-Volt.

a. Control power transformer: Primary voltage as required for the motor, 120V secondary voltage; capacity to operate control devices and 100 percent spare capacity.
b. Primary and secondary fuse protection for each control power transformer: Class CC fuses, current-limiting rejection type, rated 0.1 to 30 A, 600 V, and 200 kA interrupting rating.

4. Fire safety interface isolation relay: 3PDT, 10A, 120V relay with coil voltage as required to interface with the fire alarm system.
5. Voltage monitoring relay: To monitor shunt trip voltage.
6. Auxiliary control contacts:

a. One normally open and one normally closed primary auxiliary contact.
b. One normally open and one normally closed secondary auxiliary contact.

7. Green power ON pilot light.
8. Ground lug.
9. Key-to-Test Switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches where indicated and as required for motors, transformers, and other equipment.

B. Securely attach and properly connect enclosed switches, enclosed circuit breakers, and elevator disconnecting switches.

C. Provide an enclosed switch for each motor, as required by NFPA 70, except where it is provided in a panelboard within sight and easy reach of the motor or where it is provided with a variable frequency drive, and provide wiring and connections from source. Enclosed switches shall be fused where protection is required or indicated on drawings and unfused elsewhere.

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D. Enclosed switches:

1. Provide neutral kit where required for four-wire applications.
2. Provide auxiliary contact kit where indicated on drawings.

END OF SECTION

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SECTION 26 2914 - ENCLOSED MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Alternating-current motor starters (enclosed controllers) rated 600 V and less that are supplied as enclosed units.

1. Magnetic motor starters and combination starters.
2. Manual motor starters.

1.2 RELATED SECTIONS

A. Motors: Sections 23 0513.

1.3 SUBMITTALS

A. Product data: Each type of motor starter included in the project, including dimensions, ratings, and data on features and components.

B. Shop drawings: Composite wiring diagram showing the interlocking and control wiring.

C. Operation and maintenance data: For operating and maintenance manuals, as specified in Section 26 0101.

1.4 QUALITY ASSURANCE

A. Source limitations: Obtain motor starters of a single type through one source from a single manufacturer.

B. Electrical components, devices, and accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate layout and installation of motor starters with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required clearances for work space and for access.

B. Coordinate features, accessories, and functions of each motor starter with ratings and characteristics of supply circuit, motor, control sequence, and duty cycle of motor and load.

1. Refer to wiring diagrams required in the sections specifying the equipment.

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PART 2 - PRODUCTS

2.1 MOTOR STARTERS, GENERAL

A. Basis-of-design product: Subject to compliance with requirements, provide the specified Schneider Electric; Square D products, or comparable products by one of the following or approved equal:

1. ABB; General Electric products.
2. Eaton Corporation.
3. Schneider Electric; Square D products.

2.2 MAGNETIC MOTOR STARTERS

A. Enclosure: Surface-mounted, NEMA 250 Type 1, unless otherwise indicated.

1. Outdoor locations: Type 3R.
2. Kitchen areas: Type 4X, stainless steel.

B. Motor starters and combination starters shall be across-the-line magnetic type, equal to Schneider Electric; Square D products, Class 8536, Type S, rated in accordance with NEMA Standards, sizes, and horsepower ratings.

1. Contacts: Double-break silver-alloy type, replaceable from the front without removing power wiring or removing the starter from its mounting.
2. Overload protection: Solid-state overload relay, one-piece construction, interchangeable, with reset button set in cover.

a. Sensors in each phase: Matched to nameplate full-load current of the motor to which they connect and with appropriate adjustment for duty cycle.

3. Starter shall operate only when protective relays are in place.
4. Combination starters shall be lockable in the Off position.
5. Circuit-breaker disconnect for combination starters: NEMA AB 1 thermal-magnetic type molded-case circuit breakers. Interlock with unit cover.

C. Control circuit: 120-Volt.

1. Control power transformer: Primary voltage as required for the motor, 120-V secondary voltage; capacity to operate connected indicating and control devices and 100 percent spare capacity.
2. Primary and secondary fuse protection for each control power transformer: Class CC fuses, current-limiting rejection type, rated 0.1 to 30 A, 600 V, and 200 kA interrupting rating.

D. Auxiliary control contacts:

1. One spare normally open and one spare normally closed.
2. Additional contacts required by the automatic temperature control system.

E. Selector switches, indicating lights, and identification on each motor starter cover, complete with wiring and interconnections to starter and auxiliary control contacts:

1. Selector switch: Hand-Off-Automatic (HOA), heavy-duty.

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2. Indicating lights: Push-to-test, 30.5 mm or 22 mm, transformer type, LED or neon. Indications:

   a. Red for Running and green for Stopped.

3. Identification: Printed or engraved nameplates for HOA switch and for each indicating light.
4. Manual control devices: Four-button or four-position type, with Slow, Fast, Stop, and Automatic positions indicated by LED or neon lights.

2.3 MANUAL MOTOR STARTERS

A. Enclosures: NEMA 250 Type 1 for interior use and NEMA 250 Type 3R for exterior or damp or wet locations.

1. Mounting: Flush-mounted in finished areas and where possible; surface-mounted elsewhere, with cover plates to suit the mounting.
2. Indicating lights mounted in enclosure.
3. Engraved plastic identification plates.

B. Manual motor-starting switch: Equal to Square D Class 2510, single- or two-pole as required, with or without built-in thermal overload protection as indicated on drawings.

C. Switch: Toggle, quick-make and quick-break, with self-indicating, trip-free handle, and means for locking in Off position.

D. Overload protection unit: Melting-alloy type, interchangeable; starter shall be inoperative if unit is removed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. For equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For equipment not at walls, mount on lightweight structural-steel channels bolted to floor or to structure above ceiling.

B. Provide wiring as indicated on the drawings.

C. Applications: Magnetic motor starters for all equipment unless otherwise specified or indicated on drawings.

D. Install starters, auxiliary contacts, and automatic control devices furnished with equipment, except those that are already mounted on the equipment, fully wired and connected. See coordination requirements specified in Part 1 above.

E. Check the size of the overload protection, and change or adjust it as required, after the HVAC systems have been adjusted and balanced as specified in Section 23 0593, Testing, Adjusting, and Balancing.

END OF SECTION

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SECTION 26 4313 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Surge protective devices (SPD's) for the protection of AC electrical circuits from the effects of lightning-induced currents, substation switching transients, and internally generated transients resulting from inductive or capacitive load switching.

1.2 RELATED SECTIONS

A. Service entrance: Section 26 0541.

B. Panelboards: Section 26 2416.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. MCOV: Maximum continuous operating voltage.

C. MOV: Metal-oxide varistor.

D. SPD: Surge protective device.

E. VPR: Voltage protection rating.

1.4 SUBMITTALS

A. Product data: Manufacturer’s catalog information, including unit dimensions and rated capacities for each type of unit included in the project.

B. Certifications:

1. Cover page of manufacturer’s UL test report for each type of unit, showing that the unit is UL 1449 Fourth Edition listed.
2. UL 1449 Fourth Edition listing documentation verifying the following:

    a. Voltage protection rating (VPR).
    b. Maximum continuous operating voltage (MCOV).

3. Electromagnetic interference certification in accordance with UL 1283.

1.5 QUALITY ASSURANCE

A. Each SPD shall be UL 1449 Fourth Edition listed and labeled.

B. A single manufacturer shall provide SPD’s for every location.

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1.6 WARRANTY

A. In addition to the general project warranty and correction period, provide manufacturer's special warranties providing unlimited replacements of suppressor modules if they are destroyed by transients. Length of warranties:

1. Service entrance SPD: Ten years
2. Secondary distribution SPD: Ten years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design product: Subject to compliance with requirements, provide externally mounted SPD units manufactured by one of the following or approved equal:

1. ABB; General Electric products.
2. ASCO Power Technologies.
3. Eaton Corporation.
4. Erico International Corp.; Pentair.
5. Schneider Electric; Square D products.
6. Siemens Industry, Inc.
7. Surge Suppression Inc.

2.2 SERVICE ENTRANCE SURGE PROTECTIVE DEVICE

A. Mounting: Service entrance SPD unit externally mounted and field wired to service entrance Section 26 2416, Panelboards.

B. Suppression components shall be MOV based, serviceable, and replaceable.

C. SPD shall provide surge current paths for the following modes of protection: L-N, L-G, L-L, and N-G.

D. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.

E. Provide terminals for the necessary power and ground connections. Each terminal shall accommodate wire sizes of No. 10 to No. 1 AWG.

F. SPD shall meet or exceed the following criteria:

1. Surge current capacity, single pulse rated (L-N + N-G): 150 kA per phase (8/20 µs waveform).
2. The UL 1449 Fourth Edition; voltage protection ratings (VPR) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120V	700V	800V	1200V	700V

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3. UL 1449 listed maximum continuous operating voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation	MCOV
208Y/120V	25 percent	150V

G. SPD shall be equipped with the following:

1. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
2. Audible alarm with on/off silence function and diagnostic test function.
3. One set of normally open/normally closed dry contacts.

H. Enclosure: NEMA 250 Type 1.

2.3 SURGE PROTECTIVE DEVICES FOR SECONDARY BRANCH CIRCUIT PANELBOARDS

A. Mounting: Service entrance SPD unit externally mounted and field wired to service entrance Section 26 2416, Panelboards.

B. Suppression components shall be MOV based, serviceable, and replaceable.

C. SPD shall provide surge current paths for the following modes of protection: L-N, L-G, L-L, and N-G.

D. SPD shall incorporate a UL 1283 listed EMI/RFI filter with minimum attenuation of - 50dB at 100 kHz.

E. Provide terminals for the necessary power and ground connections. Each terminal shall accommodate wire sizes of No. 10 to No. 1 AWG.

F. SPD's shall meet or exceed the following criteria:

1. Surge current capacity, single pulse rated, (L-N + N-G):

a. For power distribution panelboards: 100 kA per phase.
b. For branch-circuit panelboards: 100 kA per phase.

2. The UL 1449 Fourth Edition; voltage protection ratings (VPR) shall not exceed the following:

System Voltage	L-N	L-G	L-L	N-G
208Y/120V	700V	800V	1200V	700V

3. UL 1449 listed maximum continuous operating voltage (MCOV):

System Voltage	Allowable System Voltage Fluctuation	MCOV
208Y/120V	25 percent	150V

G. SPD shall be equipped with the following:

1. Visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.

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H. Enclosure: NEMA 250 Type 1.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install per manufacturer’s installation instructions and recommendations.

B. Install SPD's plumb, level and rigid without distortion.

3.2 ADJUSTMENTS AND CLEANING

A. Remove debris from SPD and wipe dust and dirt from all components.

B. Repaint marred and scratched surfaces with touch up paint to match original finish.

3.3 FIELD QUALITY CONTROL

A. Test and inspections:

1. Perform each visual and mechanical inspection and electrical test in accordance with NETA Acceptance Testing Specifications. Certify compliance with test parameters.
2. After installing SPD devices but before electrical circuitry has been energized, test for compliance with requirements.
3. Complete startup procedures according to manufacturer’s written instructions.

B. SPD device shall be considered defective if it does not pass tests and inspections.

END OF SECTION

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SECTION 26 5100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Lighting fixtures, including LED light engines, LED drivers, and accessories.

1.2 RELATED SECTIONS

A. Commissioning requirements: Divisions 01 and 23.

B. Lighting controls: Sections 26 0923.

1.3 SUBMITTALS

A. Product data: For each type of lighting fixture indicated, arranged in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures, photometrics and efficiency, wattage, reflectors, glassware, voltage, suspension, and appurtenances.
2. Certified results of laboratory tests for lighting fixtures for photometric performance.
3. Emergency lighting unit battery and charger.
4. LED drivers
5. Lumen output, rated color temperature, and manufacturer’s LED binning procedures.
6. Fire rated troffer cover.

B. Coordination drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.

C. Shop drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

1. Wiring diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.

D. Samples: If contractor has selected fixtures not identical to scheduled fixtures, as permitted in Part 2 below as an option, Architect may require submittal of samples.

1. One complete fixture of each approved type, except as otherwise instructed by the Architect.
2. Install approved samples as work of the project, in locations as directed, as standards for all fixtures of the same type.
3. Ascertain that the fixture will fit in the available space and is coordinated with adjacent and connected products.

E. Field test reports: Provide test results for compliance with performance requirements.

F. Maintenance data: For lighting fixtures to include in maintenance manuals specified in Division 01.

G. Warranties: Special warranties specified in this section.

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1.4 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

B. Comply with requirements for LEED certification specified in Division 01, and commissioning specified in Division 01.

C. Fixtures, emergency lighting units, and accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. Comply with NFPA 70.

E. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.5 COORDINATION

A. Fixtures, mounting hardware, and trim: Coordinate layout and installation of lighting fixtures with ceiling system and other construction.

1.6 WARRANTY

A. Special warranty for batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special warranty period for batteries: Manufacturer’s standard, but not less than 10 years from date of substantial completion. Full warranty shall apply for first year, and prorated warranty for last nine years.

B. Special warranties for LED fixtures: Written warranty, executed by manufacturer agreeing to replace LED fixture that fail in materials or workmanship within specified warranty period.

1. Special warranty period for LED fixtures: Five years from date of manufacture, but not less than four years from date of Substantial Completion.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor’s and subcontractors’ responsibilities are described in Divisions 01 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Fixtures indicated in the Fixture Schedule on the drawings are the basis of design of the project.

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1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to Bidding and Contracting requirements and Division 01 requirements for substitutions.

B. Subject to compliance with requirements, provide products by one of the following or approved equal:

1. Drivers:

a. Philips/Advance
b. Osram Sylvania
c. Universal Lighting Technologies
d. Lutron
e. EldoLED

2.2 LIGHTING FIXTURES, GENERAL

A. Lighting fixtures shall comply with UL 1598 and be complete with casings, fittings, holders, shades, and appurtenances, wired and completely assembled.

B. Metal parts: Free from burrs, sharp corners, and edges.

C. Sheet metal components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, frames, and other internal access: Smoothly operating, free from light leakage under operating conditions, and arranged to permit access without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during access and when secured in operating position.

E. Metal finishes: Painted after fixture fabrication.

F. Reflecting surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White surfaces: 85 percent.
2. Specular surfaces: 83 percent.
3. Diffusing specular surfaces: 75 percent.
4. Laminated silver metalized film: 90 percent.

G. Lenses, diffusers, covers, and globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated, exactly as scheduled or specified in optical details and lighting characteristics.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens thickness: 0.125 inch (3 mm) minimum, unless greater thickness is indicated.

H. Wire guards: 14 gauge welded wire guard, four foot length, baked white enamel, 2 inch by 2 inch grid pattern mounted with four hinge-latch clips with captive knurled thumb screws.

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2.3 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED light sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.
3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.4 LED LIGHT ENGINES

A. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.

B. LED light engines shall be integrated into an engineered package for the specific lighting fixture application, including heat dissipation components.

C. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the owner.

D. Minimum performance characteristics:

1. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
2. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
3. Color rendering index: Rated at 80 or higher.

2.5 EXIT SIGNS

A. General requirements: Exit signs shall meet the Energy Star Program requirements to operate on 5 W or less input power per face. Comply with UL 924 and the following:

1. Sign colors and lettering size: Comply with authorities having jurisdiction.

B. Internally lighted signs: As follows:

1. Light sources for ac operation: Light-emitting diodes, 70,000 hours minimum rated life.

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2.6 EMERGENCY LIGHTING UNITS

A. General requirements: Self-contained units. Comply with UL 924. Units include the following features:

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 lights on when supply circuit voltage drops to 80 percent of nominal voltage or below. Lights automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lights, and battery is automatically recharged and floated on charger.
4. Wire guard: Where indicated, heavy-chrome-plated wire guard arranged to protect lighting heads or fixtures.

2.7 EMERGENCY LIGHTING CONTROL TRANSFER RELAY DEVICE

A. Specified in Section 26 0923, Stand-Alone Lighting Control Devices.

2.8 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 26 0500, Common Work Results for Electrical, for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-stem hangers: 1/2-inch (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-stem hangers: Two, 1/2-inch (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod hangers: 3/16-inch- (5-mm-) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft cable support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.9 FINISHES

A. Fixtures: Manufacturer’s standard, unless otherwise indicated.

1. Paint finish: Applied after fabrication over corrosion-resistant treatment or primer, free of defects.
2. Metallic finish: Corrosion-resistant.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before ordering the light fixtures, consult with the installer of the ceilings to ensure that the correct fixture trim is supplied and installed. Provide the supports and accessories required for installation in each ceiling system.

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B. Before ordering the light fixtures, verify the specified voltage with the voltage shown on the drawings to ensure the correct voltage is supplied.

3.2 INSTALLATION

A. Furnish and install a complete lighting fixture for every outlet indicated on the drawings so that every outlet shall be properly provided with a suitable fixture of type specified, of wattage indicated.

B. Fixture wire shall bear UL label. Fixture wiring within fixture housing and concealed channels shall be type THHN.

C. Furnish fixtures in the quantities, sizes, and types indicated on drawings.

D. Where a letter designating fixture type is adjacent to a row of fixtures, it shall be understood that all fixtures in the row shall be of this type.

E. Provide recessed fixtures with flexible conduit connector and wire (fixture whip), or a removable wiring access plate, so that they may be wired without removing integral parts of the fixture. Plate shall be screwed to fixture housing and conduit shall be securely attached and grounded to fixture to meet NEC requirements.

3.3 LIGHTING FIXTURE SUPPORT

A. Support from building structure: Provide fasteners appropriate to the supporting substrate, and wire, jack chain, or rods as specified for particular fixture types below.

1. Provide channels bolted or welded between joists where required to obtain proper spacing for lighting supports.
2. Connections to joists or beams: Beam clamps. For wire supports, wrap wire securely around structural member.
3. Connections to concrete: Embedded, as specified in Section 26 0533, Conduits.

B. In suspended plaster and drywall ceilings, fixtures may be supported from the suspended ceiling construction. Fasten box and fixture supports securely to suspension system. Where fixtures are surface-mounted, cut neat holes in the plaster as required for supports.

C. Recessed fixtures in suspended acoustical ceilings: Coordinate fixture installation with ceiling installer. Ensure that ceiling supports are located to clear fixtures.

1. Support from building structure: Use fasteners specified in Section 26 0533, Conduits, and No. 10 wire.

2. Provide 2 supports for each individual fixture, one at each corner of fixture. In continuous rows, install additional supports at each joint.

D. Lighting fixtures mounted in gymnasium with open bar joists: Attach to a structural channel attached to the top of the joists with fixture mounted flush with the bottom of the joists. Provide lenses and electrical devices with safety chains.

E. Surface-mounted and stem-suspended fixtures on or below suspended acoustical ceilings: Supported from the building structure above with No. 10 wire.

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1. Provide four supports for each individual fixture, two at each end of fixture. In continuous rows, install an additional support at each joint.
2. Surface-mounted fixtures mounted on low-density ceilings shall be provided with spacers where required.

F. Where it is necessary for a fixture to be installed directly below an air duct, install two hanger rods, one on each side of the duct, bolted to a channel or angle suspended from the hangers under the duct, and support the fixtures from the suspended channel or angle.

3.4 IDENTIFICATION

A. Adhesive film labels: Refer to Division 26 Section “Identification for Electrical Systems” for requirements.

1. Identify interior lighting fixtures on emergency circuit.
2. Identify locations of lighting relay room controllers.
3. Identify locations of emergency lighting control transfer relay devices.

3.5 ADJUSTMENT PERIOD

A. Occupancy adjustments: When requested within 6 months of date of Substantial Completion, provide on-site assistance in adjusting fixtures to suit occupied conditions. Provide up to 2 visits to project outside of normal occupancy hours for this purpose. Some work may be required after dark.

3.6 CLEANING

A. Lighting fixtures, used for temporary lighting during construction, shall be cleaned free of construction dirt to like-new condition.

END OF SECTION

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SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Poles

B. Fixtures

1.2 RELATED SECTIONS

A. Commissioning requirements: Division 01 and 23.

B. Conduits: Section 26 0533.

C. Wires and cables: Section 26 0519.

D. Equipment foundations: Section 26 0528.

E. Excavation and fill for electrical work: Section 26 0501.

1.3 DEFINITIONS

A. Bracket: An attachment to a standard, on which a luminaire is carried.

B. Luminaire: A lighting device consisting of a light source together with its direct appurtenances, including globe, reflector, refractor, housing, and such support as is integral with the housing. The standard and the bracket are not part of the luminaire.

C. Pole: A support generally used to carry overhead lighting distribution circuits.

D. Standard (lamp post): A support used to carry a luminaire, provided with

1. Internal attachments for wiring and
2. External attachments for brackets (if any) and luminaire.

1.4 SUBMITTALS

A. Product data: Submit for each type of fixture, pole and standard.

1. Type
2. Wattage
3. Voltage
4. Efficiency
5. Suspension
6. Glassware
7. Finished diameters
8. Mounting heights
9. Lamps
10. LED drivers
11. Length and diameter of poles and standards

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12. Appurtenances

B. Shop drawings shall show complete dimensions of complete assembled unit with accessories. Include wiring diagrams, showing clearly manufacturer-installed and field-installed wiring.

C. Photometric data: Point-to-point, indicating footcandle readings minimum 10 feet on centers along the horizontal plane, for layout shown on the site plans. Provide complete data to a point where the calculations indicate zero foot candles.

D. Samples: If contractor has selected fixtures not identical to scheduled fixtures, as permitted in Part 2 below as an option, Architect may require submittal of samples.

1. One complete fixture of each approved type, except as otherwise instructed by the Architect.
2. Install approved samples as work of the project, in locations as directed, as standards for all fixtures of the same type.
3. If substitute fixtures should be requested, submit samples as required.
4. For selection, manufacturer's complete line of colors and textures.

1.5 QUALITY ASSURANCE

A. UL label and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

B. Comply with requirements for LEED certification specified in Division 01, and commissioning specified in Division 01 and Section 26 0800.

C. Comply with NFPA 70.

D. LED fixtures shall contain zero mercury content.

1.6 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Divisions 01 and 23 and Section 26 0800 for Commissioning Requirements.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-design products: Fixtures indicated in the Fixture Schedule on the drawings are the basis of design of the project.

1. Subject to compliance with requirements, provide the scheduled products. Unnamed products will only be considered and approved according to bidding and Contracting requirements and Division 01 requirements for substitutions.

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B. Subject to compliance with requirements, provide products by one of the following or approved equal:

1. LED drivers:

a. EldoLED
b. Lutron
c. Osram Sylvania
d. Philips/Advance
e. Universal Lighting Technologies

2.2 CONCRETE

A. Concrete shall be 4,500 psi strength.

2.3 ELECTRICAL POLES AND STANDARDS

A. Metal lighting poles and standards: Provide metal, raceway-type, lighting poles and standards, of sizes and types indicated, comprised of shafts and tenon joints. Equip with grounding connections readily accessible from handhole or transformer base access doors; and construct of the following materials and additional construction features:

1. Material: Spun aluminum.
2. Configuration: Anchor base type with hand hole and cover where indicated.
3. Metal lighting standard accessories: Provide accessories including anchor bolts, as recommended by lighting standard manufacturer, of sizes and materials needed to meet erection and loading application requirements.

2.4 EXTERIOR LIGHTING FIXTURES

A. Provide lighting fixtures of sizes, types, and ratings scheduled, complete with, but not limited to, housings, energy-efficient ballasts, starters, and wiring.

B. Backlight rating: B0, B1, B2, B3, B4.

C. Luminaire uplight rating: U0, U1, U2.

D. Glare rating: G0, G1, G2.

E. Mercury-containing lamps: Maximum 35 picograms per lumen hour.

2.5 LED DRIVERS

A. Driver shall operate from a 120-volt or 277-volt, 60-Hz input power source and be suitable for outputting power to 12-volt or 24-volt LED light engine sources, as required.

B. Drivers, where specified, shall be capable of being dimmed. Dimmable drivers shall be controlled by a Class 2 low-voltage 0-10VDC controller.

C. Performance criteria:

1. Driver shall have a Class A sound rating.
2. Driver shall have a power factor (PF) greater than 0.90.

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3. Driver shall have Total Harmonic Distortion (THD) of input current equal to or less than 20 percent.

D. Driver shall meet FCC and Title 47 CFR regulations for EMI/RFI.

E. Driver shall comply with ANSI C62.41 Class A requirements for transient protection.

2.6 LED LIGHT ENGINES

A. The LED manufacturer shall provide the quantity and wattage of LEDs required to achieve the defined lighting output set forth by the lighting fixture manufacturer.

B. LED light engines shall be integrated into an engineered package for the specific lighting fixture manufacturer.

C. Color temperature: As specified in lighting fixture schedule, with a tolerance of plus or minus 100K and within a range of three macadam ellipses. Noticeable color temperature variation between adjacent lighting fixtures shall be considered a failure to meet these specifications and shall be replaced at no cost to the Owner.

D. Minimum performance characteristics:

1. Life: Minimum lumen maintenance of L70 at 50,000 hours, as defined by IES LM-80.
2. Lumen output: Based on absolute photometry, lumens (total luminous flux exiting the physical luminaire), as specified on contract drawings and schedules.
3. Color rendering index: Rated at 80 or higher.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install poles, accessories, and fixtures as indicated, in accordance with manufacturer’s written instructions, applicable requirements of NFPA 70, NESC and NEMA standards, and with recognized industry practices.

3.2 INSTALLING POLES

A. Provide reinforced concrete bases as shown on the drawings Chamfer exposed edges of concrete. Grout base plates to concrete bases to provide proper leveling.

B. Base size and depth shall be as indicated on the drawings.

C. Use belt slings or rope, not chain or cable, to protect finishes when raising and setting finished poles and standards.

D. Where poles and standards are indicated to be embedded in soil, set to depth required for adequate structural support, but not less than minimum 5 foot 6 inches below finish grade.

E. Set poles and standards plumb. Support adequately during backfilling, or when anchoring them to the foundations.

F. Provide sufficient space encompassing hand-access and cable-entrance holes for installation of underground cabling where indicated.

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G. Fasten electrical lighting fixtures and brackets securely to indicated structural supports, including poles/standards; and ensure that installed fixtures are plumb and level.

H. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torqueing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B, and the National Electrical Code.

3.3 GROUNDING

A. Provide equipment grounding connections for poles and standards as indicated, and in accordance with Section 26 0526, Grounding and Bonding. Tighten connections to comply with tightening torques specified in UL 486A.

3.4 ADJUSTING AND CLEANING

A. Verify that measured illuminance values comply with approved photometric diagram.

B. Clean lighting fixtures of dirt and debris upon completion of installation.

C. Protect installed fixtures from damage during construction period.

3.5 DEMONSTRATION

A. Upon completion of installation of exterior lighting fixtures, and associated electrical supply circuitry, apply electrical energy to circuitry to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

END OF SECTION

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SECTION 27 0101 - COMMUNICATIONS GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for communications work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Green Globes certification and construction waste management: Division 01.

C. Commissioning requirements: Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 27.

B. Visit the site and study aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of labor, equipment and materials, and the performance of operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for necessary signatures and paperwork, permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Communications work of this project includes, as a brief general description, the following:

1. Intercommunications/public address system.
2. Sound reinforcement systems.
3. Conduit and box provisions for data/voice/video communications systems.
4. Conduit and box provisions for security system.
5. The project includes commissioning under the direction of a Commissioning Agent (CxA).
6. The project will be Green Globes certified.

F. See Division 01 for requirements related to Green Globes certification, commissioning, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

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1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 27 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for coordination and additional costs as specified in article "Substitutions" below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
2. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 27 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

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F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. Materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. Equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. Materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturers' instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

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B. Plan and coordinate work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate communications work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of conduit, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractors' assistants shall include a competent communications foreman, who shall be on the premises at all times to check, layout, coordinate and superintend the installation of work. The foreman shall establish basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.

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4. Exclusively communications items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

a. Contract Drawings.
b. Specifications.
c. Addenda.
d. Change Orders and other Modifications to the Contract.
e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

a. Manufacturer's name and product model and number.
b. Product options, substitutions, or alternates utilized.
c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

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a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
c. Field changes of dimension and detail.
d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
3. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," and title of project. Print on spine of binder “O & M INSTRUCTIONS.” If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
4. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
5. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
6. Part 1: Directory, listing names, addresses, and telephone numbers of communications engineers; contractor; communications subcontractors; and major communications equipment suppliers.
7. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. Significant design criteria.
b. List of equipment.
c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

8. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Photocopies of certificates.
c. Photocopies of warranties, guarantees, and bonds.
d. Test reports: Copies of the results of tests required under sections of specifications.

9. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
10. Submit final volumes revised within ten days after final inspection.

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11. Submit operation and maintenance data in electronic format using USB flash drive storage media.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The communications, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA)
4. International Building Code (IBC).
5. International Energy Conservation, Fire, and Communications Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. International Code Council (ICC)
4. Institute of Communications and Electronics Engineers (IEEE)
5. National Communications Code (NEC) (NFPA 70)
6. National Communications Manufacturer's Association (NEMA)
7. National Fire Protection Association (NFPA)
8. The Occupational Safety and Health Act (OSHA)
9. Underwriters Laboratory Inc. (UL)
10. Maryland Occupational Safety and Health Act (MOSHA)
11. Illuminating Engineering Society of North America (IESNA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for contents within these areas. Provide security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store communications construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

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1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Communications equipment such as motor controllers, panelboards and circuit breakers stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.
6. Seal off return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect communications materials and products from weather events and accidents of construction.

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F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 ENVIRONMENTAL REQUIREMENTS

A. Waste management: Recycle waste materials, including packaging materials, in accordance with Division 01 Section Construction Waste Management Requirements.

1.19 WARRANTY

A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty, which shall be 2 year/24 hour/7 day full parts and labor for electrical work and equipment. In addition, provide added special warranties as specified in individual sections.

B. During the warranty (correction) period, the Contractor shall promptly correct any work found to be defective or otherwise not in accordance with the requirements of the Contract Documents, on receipt of written notice from the Owner. Except as otherwise required in General Conditions and Division 01, the warranty (correction) period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

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F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.20 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractor's and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of conduits. Close superfluous openings and remove debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

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3.4 COMMISSIONING

A. Comply with requirements of "Commissioning" in Part 1 above.

END OF SECTION

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SECTION 27 0500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 27.

B. Basic materials and equipment required for communications work.

C. Date sensitive equipment.

D. Communications identification.

E. Operating instructions.

F. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 27 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 27 0101.

C. Painting: Division 09.

D. Green Globes certification and construction waste management: Division 01.

E. Commissioning requirements: Division 01.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A national recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.

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B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

1.5 SUBMITTALS

A. Green Globes submittal:

1. Product data for Adhesives and Sealants VOC Limits 3.7.2.1.1: For adhesives and sealants, include printed statement of VOC content.
2. Product data for Building Materials and Building Envelope 3.1.2.3: For wood products such as plywood equipment backboards, include printed statement of non-urea-formaldehyde component present in material.

B. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.

B. Communications equipment, materials and devices provided or installed as work of Division 27 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. The project shall be Green Globes certified. See requirements specified in Division 01 and individual sections for Green Globes requirements, waste and air quality control.

D. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

E. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Techniques, testing, and operating instructions specified in this section apply to products specified in other sections of Division 27.

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B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

2.2 MATERIALS

A. Telephone, data, and communications equipment backing panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 0.5 inch (13 mm) nominal.

1. One side finished.
2. No added urea formaldehyde resins.

B. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
e. Wood floor plates that are installed over concrete slabs-on-grade.

C. Nameplates: Laminated plastic, engraved, white letters on black background, except where other colors are noted or specified.

1. Size: Minimum 0.75 inch (19 mm) by 2.5 inches (64 mm).
2. Letter size: Minimum height 0.1875 inch (5 mm).
3. Fasteners: Vandalproof brass screws or rivets.

D. Aircraft cable: 0.25-inch (6-mm) steel wire rope, galvanized, construction 7 by 19 strands, minimum 7000 lbs (31138 N) breaking strength.

E. Adhesives, sealants, paints and coatings applied within building waterproofing envelope: Comply with low-emitting requirements in Division 01 Section "Indoor Air Quality Requirements."

2.3 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

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PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic, and do not indicate all fittings or offsets in conduit or all pull boxes, access panels, or other specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No conduit shall be run below the head of a window or door.

D. Equipment and conduits installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. Install plywood backing panels with finished face exposed.

3.3 IDENTIFICATION

A. Items to be identified include, but are not limited to:

1. Communications systems and devices.
2. Sound systems and devices.

B. Identify function, equipment services, and area served.

3.4 TESTS

A. During the progress of the work and after completion, test the communications cabling and wiring systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

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D. Tests shall demonstrate the following:

1. Power, control, and system circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. The resistance to ground of each non-grounded circuit is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Circuits are operable.

E. Immediately repair defects and retest until systems are operating correctly.

F. Submit test reports.

3.5 OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the communications systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, maintenance, lubrication, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

END OF SECTION

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SECTION 27 1500 - VOICE AND DATA COMMUNICATIONS CABLING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high-speed data transmission.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. LAN: Local area network.

D. PVC: Polyvinyl chloride.

E. STP: Shielded twisted pair.

F. UTP: Unshielded twisted pair.

1.3 SUBMITTALS

A. Product data: Include data on features, ratings, and performance for each component specified.

B. Shop drawings: Include dimensioned plan and elevation views of each individual component. Show equipment assemblies, method of field assembly, workspace requirements, and access for cable connections.

1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.
2. Wiring diagrams. Show typical wiring schematics including the following:

    a. Workstation outlets, jacks, and jack assemblies.
    b. Patch cords.
    c. Patch panels.

C. Cable Administration Drawings: As specified in Part 3.

D. Samples: For workstation outlets, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

E. Product certificates: For each type of cable, connector, and terminal equipment, signed by product manufacturer.

F. Qualification data: For installer.

G. Field quality-control test reports.

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H. Operation and maintenance data: For voice and data communication cabling to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer qualifications: System installer must have on staff a registered communication distribution designer certified by Building Industry Consulting Service International.

B. Source limitations: Obtain all products except twisted-pair and fiber-optic cables 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.

1.5 COORDINATION

A. Coordinate layout and installation of voice and data communication cabling with other trade contractors. Coordinate service entrance arrangement with local exchange carrier, and Owner's project manager and IT Project & Telecom Coordinator for interconnection to government systems.

1. Meet jointly with other trade contractors, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute to other participants.
3. Adjust arrangements and locations of distribution frames and cross-connect and patch panels in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of LAN equipment.

PART 2 - PRODUCTS

2.1 VENDORS

A. Subject to compliance with requirements, provide products and services by one of the following recommended Owner vendors or approved equal:

1. Department of Information Technology (DoIT) Skyline
2. Plexus Inc.
3. FiberPlus Inc.

2.2 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. Expansion capability: Provide space for future increase of connections, up to 20%.

2.3 MOUNTING ELEMENTS

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A. Raceways and boxes: Comply with Section(s) 26 0533 and 26 0534.

B. Backboards: 0.75-inch (19-mm), interior-grade, fire-retardant-treated plywood.

C. Distribution racks: Freestanding and wall-mounting, modular, steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

1. Finish: Baked-polyester powder coat.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables: Listed as complying with Category 6 of TIA/EIA-568.2-D.

B. Conductors: Solid copper.

C. UTP cable: Comply with TIA/EIA-568.2-D. Four, thermoplastic-insulated, individually twisted pairs of conductors; minimum No. 23 AWG, color-coded; enclosed in PVC jacket.

D. UTP plenum cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, except materials are modified as required for listing.

E. Armored cable: Comply with TIA/EIA-568.2-D. Four, thermoplastic-insulated, individually twisted pairs of conductors; minimum No. 23 AWG, color-coded; enclosed in PVC inner jacket; aluminum interlock armor and PVC outer jacket.

F. UTP cable connecting hardware: Comply with TIA/EIA-568.2-D. IDC type, using modules designed for punch-down caps or tools.

1. IDC terminal block modules: Integral with connector bodies, including plugs and jacks where indicated.
2. IDC connecting hardware: Consistent throughout project.

G. Jacks and jack assemblies for UTP cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service. Color as selected by Architect.

H. UTP patch cords: Four-pair cables in 48-inch (1200-mm) lengths, terminated with RJ-45 plug at each end. Use keyed plugs for data service.

I. Workstation outlets:

1. Faceplate: High-impact plastic; color as selected by Architect.
2. Mounting: Flush, unless otherwise indicated.
3. Labeling: In accordance with Department of Information Technology Services.

2.5 IDENTIFICATION PRODUCTS

A. Comply with Division 27 Section "Common Work Results for Communications" and the following:

1. Cable labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.

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PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cables. Check raceways and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION OF MEDIA

A. Horizontal cable for data service: Use UTP Category 6 cable for runs between wiring closets and workstation outlets.

3.3 INSTALLATION

A. Wiring method: Install wiring in raceway except within consoles, cabinets, desks, and counters. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings.

B. Install cables using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance of completed and linked signal paths, end to end.

C. Install cables without damaging conductors, shield, or jacket.

D. Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

E. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire or cable grips, that will not damage media or raceway.

F. Install exposed cables parallel and perpendicular to surfaces or exposed structural members and follow surface contours where possible.

G. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

H. Wiring in closets and enclosures: Provide conductors of adequate length. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

I. Separation of wires: Comply with TIA/EIA-568.2-D rules for separating unshielded copper voice and data communication cabling from potential EMI sources, including electrical power lines and equipment.

J. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels.

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K. Use splice and tap connectors compatible with media types.

3.4 GROUNDING

A. Comply with Section 26 0526, Grounding and Bonding.

B. Ground equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

C. Signal ground terminal: Locate in each equipment room and wiring closet; isolate from power system and equipment grounding.

D. Signal ground bus: Mount on wall of main equipment room with standoff insulators.

E. Signal ground backbone cable: Extend from signal ground bus to signal ground terminal in each equipment room and wiring closet.

3.5 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

A. Install plywood backboards on walls of equipment rooms and wiring closets from floor to ceiling.

B. Mount patch panels, terminal strips, and other connecting hardware on backboards, unless otherwise indicated.

C. Group connecting hardware for cables into separate logical fields.

D. Use patch panels to terminate cables entering the space, unless otherwise indicated.

3.6 INSTALLATION STANDARDS

A. Comply with requirements in TIA/EIA-568.2-D and TIA/EIA-569-E.

3.7 IDENTIFICATION

A. In addition to requirements in this Article, comply with applicable requirements in Section 27 0500, Common Work Results for Communications, and TIA/EIA-606.

B. System: In accordance with Department of Information Technology Services.

C. Workstation: Label cables within outlet boxes.

D. Distribution racks and frames: Label each unit and field within that unit.

E. Within connector fields in equipment rooms and wiring closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Cables, general: Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

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G. Cable schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.

H. Cable administration drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, entrance pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606. Furnish electronic record of all drawings, in software and format selected by Owner.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational test: After installation of cables and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.
2. Copper cable procedures: Inspect for physical damage and test each conductor signal path for continuity and shorts. Use Class 2, bidirectional, Category 6 tester. Test for faulty connectors, splices, and terminations. Test according to TIA/EIA-TSB67, "Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems." Link performance for UTP cables must meet minimum criteria of TIA/EIA-568.2-D.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

3.9 DEMONSTRATION

A. As required in Section 27 0500, provide operating instructions.

B. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and extending wiring to establish new workstation outlets.

END OF SECTION

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SECTION 28 0101 - ELECTRONIC SAFETY AND SECURITY GENERAL PROVISIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General provisions and requirements for electronic safety and security work.

1.2 RELATED SECTIONS

A. Requirements of this section generally supplement requirements of Division 01.

B. Green Globes certification and construction waste management: Division 01.

C. Commissioning requirements: Division 01.

1.3 REFERENCES

A. NFPA 10: Portable Fire Extinguishers.

B. NFPA 241: Safeguarding Construction, Alteration, and Demolition Operations.

1.4 SYSTEM DESCRIPTION

A. The full set of Contract Documents applies to work of Division 28.

B. Visit the site and study all aspects of the project and working conditions, as required by General and Supplementary Conditions, Bidding and Contracting Requirements, Drawings, and Specifications. Verify field dimensions.

C. The work covered in technical sections includes the furnishing of all labor, equipment and materials, and the performance of all operations pertinent to the work described.

D. Except as required otherwise in Division 01, promptly obtain and pay for, all necessary signatures and paperwork, all permits, fees and inspections required for work of this division by authorities having jurisdiction, including any utility connection or extension charge. No payment will be made until a copy of the permit is forwarded to the Owner.

E. Electronic safety and security work of this project includes, as a brief general description, the following:

1. Fire detection and alarm system
2. The project includes commissioning under the direction of a Commissioning Agent (CxA).
3. The project will be Green Globes certified.

F. See Division 01 for requirements related to Green Globes certification, commissioning, limits on use of site, time restrictions on work, limits on utility outages or shutdowns, and phasing (sequencing) and scheduling.

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1.5 PRODUCT OPTIONS

A. Except as modified by provisions of Bidding and Contracting Requirements and Division 01, these options apply to Division 28 specifications.

B. General: Where Contractor is permitted to use a product other than the specified item and model named as the basis of design, Contractor is responsible for all coordination and additional costs as specified in article "Substitutions" below for substitutions.

C. Products specified by reference standards or by description only: Any product meeting those standards or description.

D. Products specified by naming one or more manufacturers, or model name or catalog reference number: Products specified establish a standard of quality, options to be included, and performance.

1. Where other acceptable manufacturers are named, Contractor may provide products of those named manufacturers only, which meet the specifications.
2. Where specification permits "equal" products, without naming other acceptable manufacturers, Contractor may use products of any manufacturer, which meet the specifications.

E. Products specified by naming one manufacturer and particular product, with no provision for other options: No options or substitutions allowed.

1.6 SUBSTITUTIONS

A. Substitutions will be considered only as permitted or required by the Bidding and Contracting Requirements and Division 01. Except as modified by those requirements, the requirements below apply to Division 28 specifications.

B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor.

C. Document each request with complete data substantiating compliance of proposed substitution with contract documents.

D. A request constitutes a representation that the Bidder or Contractor:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.

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F. Substitution submittal procedure is specified in Bidding and Contracting Requirements and Division 01.

1.7 MATERIALS AND EQUIPMENT

A. All materials and equipment shall be new and the best of their respective kinds, suitable for the conditions and duties imposed on them by the project and of representative manufacturer. The description, characteristics and requirements of the materials to be used shall be in accordance with the specifications.

B. All equipment, construction and installation must meet requirements of local, state and federal governing codes.

C. Singular number: In cases where material, a device, or part of the equipment is referred to in the singular number in the specifications, it is intended that such reference shall apply to as many items of material, devices, or parts of the equipment as are required to complete the installation as shown on the drawings or required for proper operation of the system.

D. Terms have the following meanings:

1. Furnish: Supply item
2. Install: Mount and connect item
3. Provide: Furnish and install

E. All materials and equipment shall be installed and completed in a first class and workmanlike manner and in accordance with the best modern methods, practice and manufacturer's instructions. Any work which shall not present an orderly and neat or workmanlike appearance shall be removed and replaced with satisfactory work when so directed in writing by the Architect.

F. The specifications and drawings are intended to define the minimum requirements, as to quality of materials, construction, finish and overall workmanship.

G. General Conditions describe the correlation and intent of the Contract Documents. In case of discrepancies between the specifications and drawings, the specifications should be followed as to the general methods and principles and the drawings followed as to sizes, capacities and specifics for corresponding parts. If sizes are omitted, the Architect will determine sizes to be utilized.

H. In all cases of doubt, uncertainty, or conflict as to the true meaning of the specifications or drawings, it is the responsibility of the Contractor to notify the Architect of said uncertainty, doubt, or conflict and obtain a decision as to the intent prior to initiating any work which may be affected by this decision.

1.8 COORDINATION

A. Should a situation develop during construction to prevent the proper installation of any equipment or item where shown on the drawings, call the situation to the attention of the Architect and await a written decision.

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B. Plan and coordinate all work to proceed in an orderly and continuous manner without undue delay, and in conformance with the project schedule. Submit samples, shop drawings, schedules, insurance policies and certificates, and the like in time to avoid delays in actual construction. Coordinate electronic safety and security work so that work of each trade is completed before other construction begins which would obstruct it.

C. Coordinate trades to ensure that proper clearances between work of the various trades allow access to items which require operation and maintenance.

D. Coordinate location and elevation of all conduit, light fixtures, equipment, and appurtenances in such a manner that the finished installation is as indicated on drawings. In the event difficulties are encountered which prevent this, it is the Contractor's responsibility to bring this to the attention of the Architect prior to initiation of work. Correct improperly coordinated installation at no additional cost.

E. The Contractor's assistants shall include a competent electronic safety and security foreman, who shall be on the premises at all times to check, lay out, coordinate and superintend the installation of work. The foreman shall establish all basic requirements relative to the work before starting, and be responsible for the accuracy thereof.

1.9 SUBMITTALS

A. Manufacturers' and subcontractors' lists:

1. As specified in Division 01, submit a complete list of proposed manufacturers for all equipment, materials and subcontractors used for the work of this division. Lists shall follow the sequence of the specifications. No considerations will be given for partial or incomplete lists. After review of lists, submit shop drawings and product data.

B. Shop drawings and product data:

1. Submit in accordance with the requirements of Division 01 or as established at the preconstruction conference, the required number of copies of Shop Drawings and Product Data for every item of equipment. Shop drawings or product data will not be considered until Manufacturers' Lists have been approved. Shop drawings and product data shall be submitted, as required by the General Conditions, with sufficient time for checking, return to Contractor, and resubmission as required before Contractor shall install any item.
2. Each item submitted shall be properly labeled, indicating the specific service for which the equipment or material is to be used, section and paragraph number of specification or drawing number to which it applies, Contractor's name and project name and number. Data submitted shall be specific and shall include product data and printed information in sufficient detail and scope to verify compliance with requirements of the contract documents. Clearly identify each item within the data. Data of a general nature will not be accepted. Each sheet must clearly show the project name and number.
3. The review of a shop drawing or product data shall not be considered as a guarantee of the measurements or building conditions or that the shop drawings or product data have been checked to see that item submitted properly fits the building conditions. This review shall not relieve the Contractor of the responsibility for furnishing material or performing work as required by the contract documents, for correctness of dimensions and quantities, or for proper coordination of details and interfaces among trades.

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4. All exclusively electronic safety and security items furnished as items associated with mechanical items but not specifically described in the mechanical item submission, shall be submitted as a separate submittal but shall be clearly marked as associated with the mechanical item by identified specification paragraph.

C. Submit at least three copies of the results of every test required under any section in this division.

D. Specialist shall submit a list of at least three projects similar to this project in type, size, and quality, which have been in place and operating satisfactorily for at least five years.

1. Include project name, address, name and phone number of owner's representative, and project type and size.

E. After the work is completed, submit all required certificates of approval from approved inspection agencies and authorities having jurisdiction over work of this division. Certificates of approval must be received by the Architect prior to final acceptance of the work.

1.10 SPECIALIST

A. The term "Specialist" as used in the specification shall mean an individual or firm of established reputation (or, if newly organized, whose personnel have previously established a reputation in the same field,) which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the contract, installing items required by the contract, or otherwise performing work required by the contract. Where the specification requires installation by a specialist, the term shall also be deemed to mean the manufacturer of the item, an individual or firm licensed by the manufacturer, or an individual or firm who will perform the work under the manufacturer's direct supervision.

1.11 CONTRACT CLOSEOUT SUBMITTALS

A. Project record documents:

1. Maintain on site one set of the following record documents; record actual revisions to the work of this division:

a. Contract drawings.
b. Specifications.
c. Addenda.
d. Change orders and other modifications to the Contract.
e. Reviewed shop drawings, product data, and samples.

2. Maintain record documents separate from documents used for construction.
3. Record information concurrent with construction progress.
4. Specifications: Legibly mark and record in each section a description of actual products installed, including the following:

a. Manufacturer's name and product model and number.
b. Product options, substitutions, or alternates utilized.
c. Changes made by addenda and modifications.

5. Record documents and shop drawings: Legibly mark each item to record actual construction, including:

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a. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
b. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the work.
c. Field changes of dimension and detail.
d. Details not on original Contract Drawings.

6. Submit documents as specified in Division 01.

B. Operation and maintenance data:

1. Submit sets prior to final inspection as specified in Division 01. Unless otherwise specified in Division 01, submit no fewer than three sets. In addition to requirements specified in Division 01, submit operating and maintenance manuals for the work of this division as specified below.
2. Binders: Three-ring binders with vinyl-covered hard covers. Provide large enough binders, and sufficient quantity, that the required contents can be easily turned, removed, and reinserted.
3. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", and title of project. Print on spine of binder "O & M INSTRUCTIONS." If more than one binder is required, print covers and spines with volume numbers. Include in the front of every binder an index to all binders.
4. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
5. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on white paper.
6. Part 1: Directory, listing names, addresses, and telephone numbers of engineers; contractor; electronic safety and security subcontractors; and major electronic safety and security equipment suppliers.
7. Part 2: Operation and maintenance instructions, arranged by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

a. Significant design criteria.
b. List of equipment.
c. Parts list for each component, including recommended spare parts list.
d. Operating instructions.
e. Maintenance instructions for equipment and systems.
f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

8. Part 3: Project documents and certificates, including the following:

a. Shop drawings and product data.
b. Photocopies of certificates.
c. Photocopies of warranties, guarantees, and bonds.
d. Test reports: Copies of the results of all tests required under all sections of specifications.

9. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with Engineer comments. Revise content of documents as required prior to final submittal.
10. Submit final volumes revised, within ten days after final inspection.

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11. Submit operation and maintenance data in electronic format using USB flash drive storage media.

1.12 REGULATORY REQUIREMENTS

A. When these specifications call for materials or construction of a better quality or larger sizes than required by the following codes and standards, the provisions of the specifications shall take precedence.

B. Provide, without extra charge, any additional materials and labor which may be required for compliance with these codes and standards even though the work is not mentioned in these specifications or shown on the contract drawings.

C. Perform the work of this division in strict accordance with the following authorities. The latest revision of these codes accepted by the authority having jurisdiction as of the date of the contract documents shall apply.

1. The electrical, building, fire, and safety codes of the state and county or city in which the work is being performed.
2. The National Electric Code, NFPA 70 (NEC).
3. The National Fire Protection Association Code. (NFPA)
4. International Building Code (IBC).
5. International Energy Conservation, Fire, and Electrical Codes (ICC).

1.13 REFERENCE STANDARDS

A. Perform the work of this division using the standards of the following organizations, as referred to in technical sections, as a minimum requirement for construction and testing. Unless specified otherwise in Bidding and Contract Documents or Division 01, the latest revision current as of the date of the contract documents shall apply.

1. American National Standards Institute (ANSI)
2. American Society for Testing and Materials (ASTM)
3. International Code Council (ICC)
4. Institute of Electrical and Electronics Engineers (IEEE)
5. National Electrical Code (NEC) (NFPA 70)
6. National Electrical Manufacturer's Association (NEMA)
7. National Fire Protection Association (NFPA)
8. The Occupational Safety and Health Act (OSHA)
9. Underwriters Laboratory Inc. (UL)
10. Maryland Occupational Safety and Health Act (MOSHA)
11. Illuminating Engineering Society of North America (IESNA)

1.14 TEMPORARY STORAGE

A. Maintain upon premises, where directed, a storage area, and be responsible for all contents within these areas. Provide all security measures necessary for this area.

B. Area shall be maintained and shall be returned to original condition at the completion of the project.

C. Store electronic safety and security construction materials such as wire, raceways and boxes, devices, and equipment in buildings, enclosed trailers, or portable enclosed warehouses.

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1. Materials and products subject to damage from moisture: Store in dry locations. If necessary, protect with protective wraps or covers.
2. Plastics and other materials and products subject to damage from heat or cold: Store at manufacturer's recommended temperatures.
3. Plastics and other materials and products subject to damage from sunlight: Protect from sunlight.

D. Electronic safety and security equipment stored before installation and installed during construction: Provide clean, dry locations at manufacturer's recommended temperatures, and cover or wrap if required to protect from incidental damage.

1.15 PROTECTION

A. Control dust resulting from construction work to prevent its spread beyond the immediate work area, and to avoid creation of a nuisance.

1. Do not use water to control dust. Use drop cloths or other suitable barriers.
2. In areas where dirt or dust is produced as a result of the work, sweep daily, or more often as required.
3. Provide walk-off mats at entries and replace them at regular intervals.
4. Construct dust partitions, where indicated on the drawings or as required.
5. Protect areas occupied by Owner's personnel or equipment.
6. Seal off all return air registers and other mechanical systems to prevent dust from entering.

B. Each trade and subcontractor is responsible for preventing damage and soiling of work performed by other trades or subcontractors. Each trade and subcontractor is responsible for providing temporary protection of its own work.

1. Protect work from spills, splatters, drippings, adhesives, bitumens, mortars, paints, plasters, and damage from welding or burning.
2. Protect finished work from damage, defacement, staining, or scratching.
3. Protect finishes from cleaning agents, or grinding and finishing equipment.
4. Protect adjacent and finished work from damage, using tape, masking, covers or coatings and protective enclosures.
5. Coordinate installations and temporarily remove items to avoid damage from finishing work.

C. Repair all damage or soiling to the complete satisfaction of the Architect; replace any materials or work damaged to such an extent that they cannot be restored to their original condition, all at no addition to the Contract sum.

D. Protect work stored in place and supplies stored in the building.

1. Store materials and products, subject to damage from moisture, in dry locations. If necessary, protect in wraps or covers.
2. Store plastics, other materials, and products subject to damage from heat or cold at manufacturer's recommended temperatures.

E. Protect electronic safety and security materials and products from weather events and accidents of construction.

F. Use of sidewalk or roadway areas outside of the property lines shall be with permission and approval of the local authorities having jurisdiction.

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1.16 FIRE PROTECTION

A. As a minimum, provide hand-carried, portable, UL-rated extinguishers with each work crew working inside the building.

B. Select extinguishers in accordance with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.

1.17 PROJECT CONDITIONS

A. Drawings showing utilities in concealed locations are based on the best information available but are not represented as being precisely correct. Work of the contract includes digging, cutting, drilling, using nondestructive methods, and other methods of locating concealed utilities in the field, as well as patching and repairing as specified in "Cutting and Patching" below.

B. If, in the course of the work, workers encounter a material they suspect to present some hazard:

1. Promptly notify the Owner and Architect in writing.
2. Do not perform any work which would disturb the suspected material until written instructions have been received.

1.18 ENVIRONMENTAL REQUIREMENTS

A. Waste management: Recycle waste materials, including packaging materials, in accordance with Division 01 Section Construction Waste Management Requirements.

1.19 WARRANTY

A. Work and equipment provided as work of this division shall be fully warranted under the general project warranty, which shall be 2 year/24 hour/7 day full parts and labor for electrical work and equipment. In addition, provide added special warranties as specified in individual sections.

B. During the warranty (correction) period, the Contractor shall promptly correct any work found to be defective or otherwise not in accordance with the requirements of the Contract Documents, on receipt of written notice from the Owner. Except as otherwise required in General Conditions and Division 01, the warranty (correction) period is two years after the date of substantial completion of the work. Work requiring correction shall promptly be repaired or completely replaced at no addition to the Contract Sum.

1. Service reports for warranty work shall be provided to the Owner

C. When use of the permanent equipment has been permitted for temporary services during construction of the building, the warranty and correction periods shall nevertheless begin at the time of substantial completion, unless another date of acceptance has been agreed to by the Owner.

D. Special warranties are warranties required by individual specification sections, incidental product warranties, manufacturers' standard warranties, installer or subcontractor service agreements, and other individual warranties in addition to the general project warranty.

E. Provide copies of warranties as required for Operation and Maintenance Manual specified above, and by Division 01.

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F. For items of work delayed beyond date of substantial completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

1.20 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

B. Cooperate with the CxA to accomplish the requirements of the Commissioning Plan during the construction and correction periods.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Cut walls, floors, partitions, roofs, and other appurtenances for the passage or accommodation of raceways. Close superfluous openings and remove all debris caused by work of this division.

C. No cutting of any structure or finish shall be done until the condition requiring such cutting has been examined and approved by the Architect.

D. New or existing surfaces disturbed as a result of such cutting or otherwise damaged shall be restored to match original work and all materials used for any patching or mending shall conform to the class of materials originally installed.

E. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.2 TEMPORARY FACILITIES

A. Temporary water facilities, electricity, telephone, toilet facilities, and temporary heat, shall be provided as specified in Division 01.

3.3 PROGRESS MEETINGS

A. Progress meetings shall be held as specified in Division 01, and also when and if the Contractor or Architect finds them necessary or advantageous to progress of work.

B. Contractor, those subcontractors and those material suppliers concerned with current progress or with the scheduling of future progress, Architect and Owner shall each be represented at these meetings by persons familiar with the details of work and authorized to conclude matters relating to work progress.

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3.4 COMMISSIONING

A. Comply with requirements of "Commissioning" in Part 1 above.

END OF SECTION

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SECTION 28 0500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements applicable to work of more than one section of Division 28.

B. Basic materials and equipment required for electronic safety and security work.

C. Date sensitive equipment.

D. Electronic safety and security identification.

E. Operating instructions.

F. Testing wiring systems.

1.2 RELATED SECTIONS

A. Project and special warranties: Division 01 and Section 27 0101.

B. Operation and Maintenance Manuals: Division 01 and Section 27 0101.

C. Painting: Division 09.

D. Green Globes certification and construction waste management: Division 01.

E. Commissioning requirements: Division 01.

1.3 DEFINITIONS

A. Project correction period: A period after Substantial Completion of the work during which the Contractor shall correct every part of the work found to be not in accordance with the requirements of the contract documents, promptly after receipt of written notice.

B. Qualified testing agency: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

1.4 DESIGN REQUIREMENTS

A. The drawings and system performances have been designed on the basis of using the particular manufacturers' products specified and scheduled on the drawings.

B. Products of other manufacturers that are listed under the article "Acceptable Manufacturers," or permitted as "equal," are permitted provided:

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1. Product shall meet the specifications.
2. Contractor shall make, without addition to the contract sum, all adjustments for deviations so that the final installation is complete and functions as the design basis product is intended.

C. Do not propose products with dimensions or other characteristics different from the design basis product that make their use impractical or cause functional fit, access, or connection problems.

1.5 SUBMITTALS

A. Green Globes submittal:

1. Product data for Adhesives and Sealants VOC Limits 3.7.2.1.1: For adhesives and sealants, include printed statement of VOC content.
2. Product data for Building Materials and Building Envelope 3.1.2.3: For wood products such as plywood equipment backboards, include printed statement of non-urea-formaldehyde component present in material.

B. Test reports: Show that tests specified in Part 3 below demonstrate the specified results.

1.6 QUALITY ASSURANCE

A. Provide materials and perform work in accordance with the electrical, building, fire, and safety codes and regulations of the state, county, or city in which the work is performed.

B. Electronic safety and security equipment, materials and devices provided or installed as work of Division 28 shall bear UL label, or, if UL label is not available, the item shall be tested and labeled by a qualified testing agency, acceptable to authorities having jurisdiction, and in accordance with NFPA 70. Provide testing, if required, without addition to the contract sum.

C. The project shall be Green Globes certified. See requirements specified in Division 01 and individual sections for Green Globes requirements, waste and air quality control.

D. VOC content: Field-applied adhesives and sealants, limits per South Coast Air Quality Management District (SCAQMD), Rule No. 1168.

E. Products shall contain no urea-formaldehyde content.

1.7 COMMISSIONING

A. This project includes commissioning under the direction of a Commissioning Agent (CxA). Contractors' and subcontractors' responsibilities are described in Division 01.

PART 2 - PRODUCTS

2.1 GENERAL

A. Techniques, testing, and operating instructions specified in this section apply to products specified in other sections of Division 27.

B. Equipment that uses or processes date and time data in order to perform its function shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

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2.2 MATERIALS

A. Electronic safety and security equipment backing panels: Plywood, DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated in accordance with AWPA C27, in thickness indicated, not less than 0.5 inch (13 mm) nominal.

1. One side finished.
2. No added urea formaldehyde resins.

B. Wood-preservative-treated lumber: Treated by pressure process, AWPA C2, with chemicals acceptable to authorities having jurisdiction, and marked with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. Application: Treat items indicated on the drawings, and the following:

a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, or waterproofing.
b. Wood sills, sleepers, blocking, and similar concealed members in contact with masonry or concrete.
c. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
d. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
e. Wood floor plates that are installed over concrete slabs-on-grade.

C. Nameplates: Laminated plastic, engraved, white letters on black background, except where other colors are noted or specified.

1. Size: Minimum 0.75 inch (19 mm) by 2.5 inches (64 mm).
2. Letter size: Minimum height 0.1875 inch (5 mm).
3. Fasteners: Vandalproof brass screws or rivets.

D. Aircraft cable: 0.25-inch (6-mm) steel wire rope, galvanized, construction 7 by 19 strands, minimum 7000 lbs (31138 N) breaking strength.

E. Adhesives, sealants, paints and coatings applied within building waterproofing envelope: Comply with low-emitting requirements in Division 01 Section "Indoor Air Quality Requirements."

2.3 DATE-SENSITIVE EQUIPMENT

A. Date-sensitive equipment: Systems, equipment, or components which use or process date and time data in order to perform their functions.

B. Each item of date-sensitive equipment used in the project shall be warranted by the manufacturer to properly function and correctly use or process all time-related data for all dates and times which occur during a reasonable life expectancy of the equipment.

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PART 3 - EXECUTION

3.1 GENERAL

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. The contract drawings are diagrammatic, and do not indicate all fittings or offsets in conduit or all pull boxes, access panels, or other specialties required. Provide required fittings, offsets, access panels, and specialties to coordinate the work.

C. No conduit shall be run below the head of a window or door.

D. Equipment and conduits installed in areas without a suspended ceiling shall be as tight to structure as possible, but at least above a height of 6'-8", unless otherwise noted.

E. Items which require access for operation or maintenance shall be easily accessible. Do not cut or form hand holes for operation or maintenance of appliances through walls or ceilings.

3.2 INSTALLATION OF PRODUCTS AND EQUIPMENT

A. Manufacturers' instructions: Except as modified by drawings or specifications, install products and equipment in accordance with manufacturers' instructions and recommendations applicable to the project conditions.

1. Immediately notify Architect if a difference or discrepancy is found between manufacturers' instructions and the drawings or specifications.

B. Install plywood backing panels with finished face exposed.

3.3 IDENTIFICATION

A. Items to be identified include, but are not limited to:

1. Electronic safety and security systems and devices.
2. Fire detection and alarm system and devices.

B. Identify function, equipment served, and area served.

3.4 TESTS

A. During the progress of the work and after completion, test the circuits, and electronic safety and security system, and the low-voltage alarm and signal systems.

B. Results of the tests shall show that the wiring meets the requirements of this specification. Should any test indicate defect in materials or workmanship, immediately repair, or replace with new, the faulty installation, and retest the affected portions of the work.

C. Furnish equipment and instruments necessary for testing.

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D. Tests shall demonstrate the following:

1. Power, control, and system circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. The resistance to ground of each non-grounded circuit is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Circuits are operable.

E. Immediately repair defects and retest until systems are operating correctly.

F. Submit test reports.

3.5 OPERATING INSTRUCTIONS

A. Furnish the necessary technicians, skilled workers, and helpers to operate the electronic safety and security systems and equipment of the entire project for one 8-hour day.

B. Where specified in technical sections, provide longer periods required for specialized equipment.

C. Instruct the Owner or designated personnel in operation, and adjustment of systems and equipment.

D. The Operating and Maintenance Manual shall be available at the time of the instructions for use by instructors and Owner personnel.

E. Schedule the general and specialized instruction periods for a time agreed upon by the Owner and Architect.

END OF SECTION

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SECTION 28 3100 - FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Provide a complete fire detection and alarm system of the noncoded, addressable, analog type, with manual stations, detectors, notification appliances, controls, and devices.

B. Costs of certification and testing, including tests required by NFPA 72, shall be included in the contract sum.

1.3 RELATED SECTIONS

A. Division 08 section specifying door hardware for coordinating electrical hardware operators.

B. Section 21 1000 for fire suppression system, for coordinating flow, pressure, and valve tamper switch requirements.

C. Electrical general provisions: Section 26 0101.

D. Common work results for electrical: Section 26 0500.

1.4 DEFINITIONS

A. FACP: Fire alarm control panel.

B. HVAC: Heating, ventilation, and air-conditioning.

C. LED: Light-emitting diode.

D. SPDT: Single pole, double throw.

E. Definitions in NFPA 72 apply to fire alarm terms used in this section.

1.5 SYSTEM DESCRIPTION

A. Control of system: By the FACP.

B. System supervision: Automatically detect and report open circuits, shorts, and grounds of wiring for initiating device, signaling line, and notification-appliance circuits.

C. Priority of signals: Automatic alarm response functions resulting from an alarm signal from one zone or device are not altered by subsequent alarm, supervisory, or trouble signals. An alarm signal is the highest priority. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even when the lower-priority condition occurs first. Annunciate and display all alarm, supervisory, and trouble signals regardless of priority or order received.

D. Noninterference: A signal on one zone shall not prevent the receipt of signals from other zones.

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E. System reset: All zones are manually resettable from the FACP after initiating devices are restored to normal.

F. Transmission to remote alarm receiving station.

G. System alarm capability during circuit fault conditions: System wiring and circuit arrangement prevent alarm capability reduction when a single ground occurs in an initiating device circuit, signal line circuit, or notification-appliance circuit.

H. Loss of primary power at the FACP initiates a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on the secondary power supply.

I. Basic alarm performance requirements: Unless otherwise indicated, operation of a manual station, automatic alarm operation of a smoke or heat detector, or operation of sprinkler flow switch, initiates the following:

1. Notification-appliance operation.
2. Identification at the FACP and the remote annunciator of the zone and device originating the alarm.
3. Release of fire and smoke doors held open by magnetic door holders.
4. Operation of duct smoke detector shall initiate a supervisory signal and shutdown of fans and other air-handling equipment serving zone where alarm was initiated.
5. Recording of the event in the system memory.
6. Initiate the transmission of alarm to the Owner's remote alarm receiving station.

J. In addition to functions mentioned above, elevator smoke detectors shall perform elevator recall functions in accordance with ANSI requirements. Elevator heat detectors shall activate the shunt trip breakers.

K. Alarm silencing, system reset and indication: Controlled by switches in the FACP and the remote annunciator.

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. System reset shall be controlled only at the FACP.

L. Remote detector sensitivity adjustment: Manipulation of controls at the FACP causes the selection of specific addressable, analog smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. Same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity-adjustment schedule changes are recorded in system memory.

M. Removal of an alarm-initiating device or a notification appliance initiates the following:

1. Transmission of trouble signal to remote alarm receiving station.

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N. FACP alphanumeric display: Plain-English-language descriptions of alarm, supervisory, and trouble events; and addresses and locations of alarm-initiating or supervisory devices originating the report. Display monitoring actions, system and component status, system commands, programming information, and data from the system's historical memory.

1.6 SUBMITTALS

A. General:

1. Comply with Division 01 and Section 26 0101. When approved, no variation will be permitted except with the approval of the Architect.
2. Submit to the authority having jurisdiction and to the Architect for review and approval.

B. Shop drawings:

1. Floor plans indicating final equipment and device locations and raceway routes.
2. System operation description: Detailed description for this project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer’s standard descriptions for generic systems are not acceptable.
3. Details of graphic display.
4. Wiring diagrams and riser diagrams.

C. Product data: Schedule and each type of system component, including dimensioned plans and elevations showing minimum clearances and installed features and devices. Include UL listings.

D. Battery calculations.

E. Provide a complete project record drawing as specified in Division 01 and Section 26 0101 showing the location of all the outlets, cable taps, cable routes, and other components installed. Drawings shall be made part of Operating and Maintenance Manuals.

F. Certifications:

1. UL Certificate of Compliance of system supplier as specified in "Quality Assurance" below.
2. Fire and smoke detection system inspection and test report, completed by the factory representative, endorsed by the Owner and the factory representative, including test data, detector locations and serial numbers, a summary of maintenance performed, recommendations for relocation or addition of detectors and final action regarding these recommendations, and system certification.

1.7 QUALITY ASSURANCE

A. System and equipment shall be UL listed. Each major component shall bear the manufacturer's name and catalog number.

B. UL labels and local testing (if required): As specified in Section 26 0500, Common Work Results for Electrical.

C. Single-source responsibility: Obtain system components from a single source who assumes responsibility for their compatibility.

D. Qualifications of system supplier and installer:

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1. Staff shall consist of at least one NICET Level IV Technician or a professional engineer registered in Maryland.
2. Has installed at least ten systems of the type specified which have performed satisfactorily for not less than two years.
3. Maintains a facility with a sufficient stock of spare parts.
4. Shall respond within 24 hours of notification to correct system failure or malfunction. During the project correction period defined in General Conditions and in Section 26 0500, perform such corrections at no addition to the Contract Sum.

E. Factory-authorized service representative: Trained and certified by the manufacturer of the system, and experienced in the installation and operation of the type of system included in the work.

F. Comply with NFPA 72, applicable local codes, and regulations and requirements of the authorities having jurisdiction. Baltimore County is the local code authority.

1.8 SEQUENCING AND SCHEDULING

A. Existing fire alarm equipment: Maintain fully operational until new equipment has been tested and accepted.

1. Field verify existing system is fully operational before beginning work on the existing components. If existing system is not fully operational immediately notify the Owner and Architect in writing, and do not perform any work on the existing system until directed by the Architect.
2. As new equipment is installed, label it NOT IN SERVICE until new equipment is accepted. As equipment is put in service, remove label and label existing equipment NOT IN SERVICE until it is physically removed.

B. Disconnected equipment: Remove equipment and restore damaged surfaces.

1. Operational disconnected equipment: Package, label, and deliver to Owner.

1.9 INSPECTIONS AND SERVICE CONTRACT

A. During the general project correction period, every six months starting six months after Substantial Completion, the supplier shall inspect and test the system.

1. Submit written reports to the Owner and Architect, describing test results, including defects found and how they have been corrected, and listing components replaced.

B. At the end of the correction period, offer the Owner a service contract for the complete system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Basis-of-design system: Subject to compliance with requirements, provide system by Fire-Lite Alarms; Honeywell or comparable system by one of the following or approved equal:

1. Edwards (EST); Carrier
2. Fire-Lite Alarms; Honeywell

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3. Notifier; Honeywell
4. Silent Knight; Honeywell

B. Wire and Cable or approved equal:

1. Comtran Corporation.
2. Helix/HiTemp Cables, Inc.; a Draka USA Company.
3. Rockbestos-Suprenant Cable Corporation; a Marmon Group Company.
4. West Penn Wire/CDT; a division of Cable Design Technologies.

2.2 FIRE ALARM CONTROL PANEL

A. Cabinet: Lockable steel enclosure. Arrange interior components so operations required for testing or for normal maintenance of the system are performed from the front of the enclosure. If more than one unit is required to form a complete control panel, fabricate with matching modular unit enclosure to accommodate components and to allow ample gutter space for field wiring and interconnecting panels.

1. Mounting: Surface.

B. Alarm and supervisory systems: Separate and independent in the FACP. Alarm-initiating zone boards consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.

C. Control modules: Include types and capacities required to perform all functions of fire alarm systems.

D. Indications: Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm has a different sound.

E. Resetting controls: Prevent the resetting of alarm, supervisory, or trouble signals while the alarm or trouble condition still exists.

F. Alphanumeric display and system controls: Arranged for interface between human operator at the FACP and addressable system components, including annunciation, supervision, and control.

1. Display: A minimum of 80 characters; alarm, supervisory, and component status messages; and indicate control commands to be entered into the system for control of smoke detector sensitivity and other parameters.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.

2.3 EMERGENCY POWER SUPPLY

A. General: Components include nickel-cadmium battery, charger, and an automatic transfer switch.

1. Battery nominal life expectancy: 20 years, minimum.

B. Battery capacity: 24 hours of supervisory power with 15 minutes of general alarm capability at end of 24 hours.

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C. Battery charger: Solid-state, fully automatic, variable-charging-rate type. Provide capacity for 150 percent of the connected system load while maintaining batteries at full charge. If batteries are fully discharged, the charger recharges them completely within four hours. Charger output is supervised as part of system power supply supervision.

D. Integral automatic transfer switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.4 ONE-WAY VOICE COMMUNICATION

A. The system shall have one-way voice communication and tone-generating capabilities. The voice messaging system shall be of the same manufacturer as the control panel.

B. Central audio control module: Alarm message or tone generation and microphone connections with continuous supervision and identification of the type of failure should a problem occur (e.g. main microphone trouble, tone trouble). Audio outputs shall have individual gain control.

C. Hand-held, push-to-talk microphone: Recessed within a protective panel-mounted enclosure, noise-canceling communication type with a frequency range of 200 Hz to 4000 Hz, equipped with a self-winding five-foot coiled cable. An LED indicator shall indicate the microphone push-to-talk button has been pressed and speaker circuits are ready for transmission. The microphone shall be supervised for disconnection.

D. Audio control switch and indication module: To provide manual access to audio operations for authorized personnel. Include a phone page select switch, tone select switch, tape select switch, and “Audio trouble Reset switch”. These switches and associated LED indicators shall be supervised for disarrangement or failure.

E. Audio power amplifiers: Furnished with a self-contained filtered 24 Vdc power supply, transformer, and amplifier monitor circuits. The amplifiers shall provide a 25-V rms output with a frequency response of 120 Hz to 12,000 Hz. Provide sufficient amplification to operate all system speakers simultaneously plus 25 percent spare capacity.

F. Backup amplifier: Capable of automatically replacing any failed amplifier.

G. Speaker circuits: Capable of supplying 25-V rms audio power from the system amplifiers. Provide supervision for open, short, or ground fault conditions; individual and distinct trouble indications for each fault; and one circuit for each zone or area of distinct communication.

H. Digitized tones: For alarm (slow whoop) and auxiliary requirements (wail, horn, chime, and others).

I. Pre-recorded digitized voice message capability: Automatically transmitted to occupants during alarm conditions.

1. The automatic message player shall not rely on a tape or other mechanical means of transmitting the evacuation message.
2. Provide a standard evacuation message, and message transmitter capable of transmitting a custom message up to 30 seconds long. A self-contained speaker shall provide testing of the message(s) without disturbing the occupants of the facility.

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J. Automatic voice evacuation sequence:

1. Alarm tone shall sound for a maximum of 15 seconds, followed by automatic preselected voice evacuation messages. At the end of each voice evacuation message, the alarm tone shall resume. The alarm tones shall sound alternately until the Alarm Silence Switch at the FACP has been operated.
2. Audible alarm operations (speaker circuit selection and alarm tone and voice message timing variations) shall be activated by the system software so that changes to the evacuation sequence can be made by authorized personnel without any component rewiring.

K. Manual voice paging sequence:

1. The system shall allow voice paging. Upon activation of speaker manual control switch, attention-getting beeps shall sound over the speakers indicating an impending voice message.
2. Voice message: Operator shall be able to make announcements via the push-to-talk paging microphone.

2.6 MANUAL PULL STATIONS

A. Description: Fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.

1. Single-action mechanism initiates an alarm.
2. Station reset: Key or wrench operated; double pole, double throw; switch rated for the voltage and current at which it operates.
3. Integral addressable module: Arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP.
4. False alarm protector: Tamperproof clear polycarbonate shield in a frame that fits over the pull station. When the shield is lifted to gain access to the pull station, a warning horn shall sound. Include 9-V dc alkaline battery.

2.7 SMOKE DETECTORS

A. General: UL 268A listed. Include the following features:

1. Operating voltage: 24 volts DC, nominal.
2. Self-restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
3. Plug-in arrangement: Detector and associated electronic components are mounted in a module that connects in a tamper-resistant manner to a fixed base with a twist-locking plug connection. Terminals in the fixed base accept building wiring.
4. Integral visual-indicating light: LED type. Indicates detector has operated.
5. Sensitivity: Can be tested and adjusted in-place after installation.
6. Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
7. Remote controllability: Unless otherwise indicated, detectors are analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

    a. Detectors which will be installed in ducts or other concealed locations shall be capable of being tested from an indicating and test station specified below.

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B. Photoelectric smoke detectors: Include the following features:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.
2. Detector sensitivity: Between 2.5 and 3.5 percent/foot (0.008 and 0.011 percent/mm) smoke obscuration when tested according to UL 268A.
3. Integral thermal detector: Fixed-temperature type with 135 deg F (57 deg C) setting.

C. Duct smoke detector: Photoelectric type.

1. Sampling tube: Design and dimensions as recommended by the manufacturer for the specific duct size, air velocity, and installation conditions where applied.
2. Relay fan shutdown: Contacts rated to interrupt fan motor-control circuit.

2.8 OTHER DETECTORS

A. Heat detector, fixed-temperature type:

1. Actuated by temperature that exceeds a fixed temperature of the following:

a. Elevator shaft and elevator machine room: 135 degrees F (57 degrees C).
b. Other locations or where indicated on drawings: 190 degrees F (88 degrees C).

2. Mounting:

a. Adapter plate for outlet box mounting.
b. Plug-in or twist-lock base, interchangeable with smoke detector bases.

3 Integral addressable module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.10 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and have screw terminals for system connections.

1. Combination devices: Factory-integrated audible and visible devices in a single-mounting assembly.

B. Visible alarm devices: Synchronized xenon strobe lights listed under UL 1971 with clear or nominal white polycarbonate lens. Mount lens on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on a removable sleeve on the lens.

1. Rated light output: Indicated on drawings for each location.
2. Strobe leads: Factory connected to screw terminals.

C. Speakers:

1. UL 1480 listed.
2. Sound output: Minimum of 84 dBA at 10 feet when tapped at 0.5 watt, and maximum of 87 dBA at 10 feet. Taps shall be available at 0.25, 0.5, 1, and 2 watts.
3. 25 or 70.7 V rms.
4. Mounting: Flush or surface-mountable; bidirectional as indicated, with sealed back.

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5. Operation: From standard signaling circuits or addressable single- or multizone I/O modules.
6. Color: White.

D. Combination speaker/strobe units: Speaker and visible alarm device as specified above, mounted in a fire-retardant, high-impact, white polycarbonate housing suitable for flush or surface mounting.

1. Speaker: Tapped at 0.5 watts; 25 V rms.
2. Color: White.

2.11 FIRE ALARM NOTIFICATION BOOSTER

A. Power supply booster designed to extend power available to notification appliance circuits.

B. Enclosure: Steel, with lockable front panel allowing access to all interior components, surface-mounted.

C. Functions: Contains circuits to monitor and charge batteries, control and supervise 4 Class B appliance circuits, and monitor two controlling inputs from external sources.

1. Configurable to operate at any one of three signaling rates, or to follow the main panel's notification appliance circuit.
2. Trouble contact with 16-second delay.

D. Batteries: Two, sized for 24 hours of standby followed by 15 minutes of alarm.

E. Indicators: LEDs, one for each circuit, one for battery supervision, one for ground fault, and one for power.

2.13 ADDRESSABLE INTERFACE DEVICE

A. Monitor module: Microelectronic monitor module listed for use in providing a system address for external alarm-initiating devices with normally open contacts.

1. Dual circuit, intelligent, signaling circuit interface module.

B. Control module: Microelectronic control relay module listed for use in providing control to external appliances or equipment shutdown, to elevator controller to initiate elevator recall and to circuit-breaker shunt trip for power shutdown.

1. One Form C (SPDT) dry relay contact rated at 2 amps and 24 volts DC.

C. Isolator module: Microelectronic fault isolator module listed for isolating and removing a fault from a data circuit while allowing the remaining data loop to continue operating.

1. Protect loop system against wire-to-wire short circuits by isolating section of loop and permitting other loop sections to continue to operate.

D. Non-addressable control relay: Isolation relay for the control of HVAC unit contactors, magnetic door holders, and elevator recall circuits, UL 864 Listed.

1. Construction: Sealed, non-removable, with terminations to pressure-type screw terminals.

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2. Rating: Use with circuits up to 240 volts AC at 7amperes inductive.

2.14 WIRE AND WIRING SYSTEM

A. Non-power-limited circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.

1. Low-voltage circuits: No. 16 AWG, minimum.
2. Line-voltage circuits: No. 12 AWG, minimum.

B. Power-limited circuits: NFPA 70, Types FPL, FPLR, or FPLP, as recommended by manufacturer.

C. Wiring system: Class B in accordance with NFPA 72.

D. Type MC fire alarm cable: Equal to AFC Cable Systems FPLP metal-clad, multi-conductor, fire alarm and control cable.

1. Ratings:

a. Plenum rated.
b. Approved for use as fixed wiring concealed in building.
c. Maximum operating temperatures:

(1) 105 degrees C dry for FPLP applications at nominal voltage ratings 300 V and less.
(2) 90 degrees C dry for MC cable installations at nominal voltage ratings of 600 V and less.

d. UL listed for penetrations of wall and floor assemblies of gypsum wallboard, concrete, and concrete masonry with one-, 2-, and 3-hour fire ratings.

2. Shield over conductor assembly: Laminated aluminum and mylar tape and tinned copper drain wire.

a. Drain wire: Minimum No. 18 AWG, in contact with aluminum shield.

3. Listed in accordance with UL 1596:

a. Insulated or bare grounding conductor in accordance with Table 6.3, cabled with the circuit conductors and identified in compliance with Section 35.
b. Galvanized steel armor, red, applied over inner cable assembly with positive interlock conforming to the requirements of Section 12.
c. Tested in accordance with applicable requirements.

E. Survivability: Circuits necessary for the operation of notification appliances shall be protected by a 2-hour fire-rated cable, a 2-hour fire-rated cable system, or a 2-hour fire-rated enclosure.

2.15 PERIPHERAL EQUIPMENT

A. Alarm reporting device: A digital communicator shall report an alarm or trouble condition. It shall notify Owner's fire alarm monitoring service and one or more facilities personnel. Provide unit compatible with the Owner's monitoring service.

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B. Sprinkler flow and tamper switches: Specified in fire suppression sprinkler system specifications. Provide a monitor module for addressing each device. Unit shall mount on 4-inch-square, 2.5-inch-deep back box.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Factory-authorized service representative, as required in "Quality Assurance" in Part 1 above, shall supervise installation, software documentation, adjustment, preliminary testing, final testing, and certification of the system, and provide the operating instructions.

B. Provide wiring, conduit, and outlet boxes required for the complete system, in accordance with system manufacturer's instructions and with requirements specified in Division 26 for wiring, conduit, and boxes. Provide 12 inches of slack at each outlet.

1. Install wiring in conduit, except where noted on drawings to provide Type MC fire alarm cable.
2. Install Type MC fire alarm cable in accordance with Article 330 of the National Electric Code (NFPA 70).
3. Identification: Paint fire alarm junction box covers red.

C. Wires, cables, conduits, and wiring connections are specified in Division 26, Electrical. Include in the work of this section, wiring, conduits, and equipment connections complying with the requirements of Division 26, so that the fire alarm system will function as specified and indicated on the drawings.

D. Wiring: Free from grounds or crosses between conductors.

1. Identification: Color code wiring, not duplicating building wiring colors. Tag each wire at each junction point.

E. Final connections between equipment and the wiring system shall be made under the direction and supervision of the qualified supplier.

F. Provide 20 percent spare capacity for each notification appliance circuit.

G. Locate 135 degree F (57 degree C) rated heat detectors in elevator shafts and elevator machine rooms within 18 inches (457 mm) of sprinklers.

3.2 INSTALLATION, FIRE ALARM NOTIFICATION BOOSTER

A. Provide number of notification power supply boosters required for a complete fire alarm system.

B. Utilize spare single-pole, 20-ampere circuit breaker in a 120-volt emergency electrical panelboard to make electrical connection to each power supply booster.

1. Circuit breakers shall match and shall be compatible with the other breakers in the panelboard.

C. Branch circuits from panelboards to each notification power supply booster: Two No. 10 wires and one No. 10 ground in conduit no less than 0.75 inch (21-mm) trade size.

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D. Install conduits and wiring as specified in Sections 26 0519 and 26 0533.

E. Provide smoke detector above each power supply booster.

3.3 INTERFACE WITH OTHER WORK

A. Furnish duct smoke detectors to be installed as part of ductwork specified in Division 23.

B. Coordinate with installation of flow and tamper switches in fire suppression sprinkler system.

C. Coordinate with sprinkler contractor for number and locations of sprinklers in elevator shaft and elevator machine room.

3.4 LOCATIONS OF FIRE ALARM EQUIPMENT

A. Locate the control panel, annunciator, and other associated equipment as shown on the drawings.

B. Visual indicating appliances: Install where shown on the drawings. If field conditions require variation from drawings, do not violate ADA requirements, including, but not limited to, the following:

1. Any room or space required to have a visual appliance, including corridors or hallways: No place shall be more than 50 feet from the indicating appliance in the horizontal plane.
2. Rooms and spaces exceeding 100 feet in one dimension, without obstructions 6 feet above the finished floor: Indicating appliances may be placed around the perimeter, spaced approximately 100 feet apart.

C. Mount indicating and test station for concealed smoke detectors near ceiling under detector. Text engraved on plate shall be descriptive of the device identified.

D. Provide a smoke detector at each fire alarm panel location, including but not limited to main control, auxiliary control, and power panels.

3.5 INSPECTION, TEST, ADJUSTMENT AND REPORT

A. Furnish equipment and appliances for testing the complete system during progress of the work and after completion of the installation, including a megger test of wiring. The tests generally shall demonstrate the following:

1. Circuits are continuous and free from short circuits.
2. Circuits are free from unspecified grounds.
3. Resistance to ground of non-grounded circuits is not less than one megohm.
4. Circuits are properly connected in accordance with the applicable wiring diagrams.
5. Each detector operates correctly.
6. Detectors are correctly located and sufficient in number.

B. Defects or omissions observed during general and system tests shall be repaired as quickly as possible and the tests reconducted.

C. Submit report as required in Part 1 above.

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3.6 OPERATING INSTRUCTIONS

A. As specified in Section 26 0500, provide operating instructions.

B. Provide at least 8 hours of additional instruction time for the systems and equipment specified in this section, consisting of 2 periods of 4 consecutive hours, during a period of not more than 60 days.

END OF SECTION

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SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and abandoning site utilities in place.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

C. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

1.3 DEFINITIONS

A. 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.

B. 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.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

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

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings and indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection."

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

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 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.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

1.7 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. Utility Locator Service: Contractor to engage a private utility locator service for area where Project is located before site clearing.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

D. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."

E. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

PART 3 - EXECUTION

3.1 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 015639 "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.

3.2 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.3 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
1. Coordinate with owner to arrange to shut off indicated utilities when requested by Contractor.

B. Locate, identify, and disconnect utilities indicated to be abandoned in place.

C. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than seven days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

D. Excavate for and remove underground utilities indicated to be removed.

3.4 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
3. Use only hand methods or air spade for grubbing within protection zones.
4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and 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.

1. Limit height of topsoil stockpiles to 72 inches.
2. Do not stockpile topsoil within protection zones.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.6 STOCKPILING ROCK

A. Remove from construction area naturally formed rocks that measure more than 1 foot across in least dimension. Do not include excavated or crushed rock.

1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

3.8 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.

END OF SECTION 311000

SECTION 312000 - EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for walks and pavements.
3. Subbase course for concrete walks and pavements.

B. Related Requirements:
1. Section 311000 "Site Clearing" for site stripping, grubbing, stripping topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.2 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. 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, will be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Rock:

1. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. or more in volume that exceed a standard penetration resistance

of 100 blows/2 inches when tested by a geotechnical testing agency, according to ASTM D1586.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.

H. 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.

I. 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.

J. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D2487.
2. Laboratory compaction curve according to ASTM D698.

1.6 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E329 and ASTM D3740 for testing indicated.

1.7 FIELD 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: Contractor to notify and engage a private utility locator service for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

D. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "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

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D2487, 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 D2487, 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. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D2940/D2940M; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and zero to 5 percent passing a No. 4 sieve.

H. Sand: ASTM C33/C33M; fine aggregate.

2.2 GEOTEXTILES

A. 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:

a. Class 2; AASHTO M 288.
b. As follows:

1) Grab Tensile Strength: 250 lbf; ASTM D4632.
2) Sewn Seam Strength: 220 lbf; ASTM D4632.
3) Tear Strength: 90 lbf; ASTM D4533.
4) Puncture Strength: 90 lbf; ASTM D4833.

c. Apparent Opening Size: No. 60 sieve, maximum; ASTM D4751.
d. Permittivity: 0.02 per second, minimum; ASTM D4491.
e. UV Stability: 50 percent after 500 hours' exposure; ASTM D4355.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

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.

3.2 DEWATERING

A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

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.

D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

3.3 EXPLOSIVES

A. Explosives:

1. Do not use explosives.

3.4 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 without exceeding the following dimensions:

a. 24 inches outside of concrete forms other than at footings.
b. 6 inches outside of minimum required dimensions of concrete cast against grade.
c. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
d. 6 inches beneath bottom of concrete slabs-on-grade.

3.5 EXCAVATION FOR STRUCTURES

A. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose

roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below pavements to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. 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.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.8 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.9 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.10 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.11 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.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D698:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95> percent.
2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.
3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 85 percent.

3.13 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.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
1. Walks: Plus or minus 1 inch.
2. Pavements: Plus or minus 1/4 inch.

3.14 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:
1. Place subbase course and base course 6 inches or less in compacted thickness in a single layer.
2. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.
3. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D698.

3.15 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Testing agency will test compaction of soils in place according to ASTM D1556, ASTM D2167, ASTM D2937, and ASTM D6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab but in no case fewer than three tests.

D. 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.

3.16 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.

3.17 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes concrete paving**.**

B. Related Requirements:

1. Section 321373 "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.
2. Section 321713 "Parking Bumpers."
3. Section 321723 "Pavement Markings."

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to concrete paving, including but not limited to, the following:

a. Concrete mixture design.
b. Quality control of concrete materials and concrete paving construction practices.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

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. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M 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. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.7 PRECONSTRUCTION TESTING

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

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete 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 F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at 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, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 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.

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.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from galvanized-steel wire into flat sheets.

B. 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.

C. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150/C150M, white portland cement Type I/II.

B. Normal-Weight Aggregates: ASTM C33/C33M, Class 4S, 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: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Air-Entraining Admixture: ASTM C260/C260M.

D. 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 C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/C494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Water: Potable and complying with ASTM C94/C94M.

2.5 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating.

2.6 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber, ASTM D1752, cork or self-expanding cork, or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.

2.7 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 comply with or exceed requirements.

B. Concrete Mixtures: Normal-weight concrete.

1. Compressive Strength (28 Days): 4500 psi and 3500 psi.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. 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.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 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.

3.4 INSTALLATION OF 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. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
2. Provide tie bars at sides of paving strips where indicated.
3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

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. Extend joint fillers full width and depth of joint.
2. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
3. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
4. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

5. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. 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.

F. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement and joint devices.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

Initial floating operation is included in "Concrete Placement" Article.

B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.

3.8 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. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing, moisture-retaining-cover curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.9 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:

1. Elevation: 1/4 inch.
2. Thickness: Plus 3/8 inch, minus 1/4 inch.
3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/4 inch.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
5. Joint Spacing: 3 inches.
6. Contraction Joint Depth: Plus 1/4 inch, no minus.
7. Joint Width: Plus 1/8 inch, no minus.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Contractor shall Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or 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 to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M; 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 C231/C231M, 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 C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.

    a. A compressive-strength test to 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 to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to 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 will 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 REPAIR 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.

END OF SECTION 321313

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Concrete pavement joint sealants.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer.

2.2 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer 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.

2.3 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

2.4 JOINT-SEALANT BACKER MATERIALS

A. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers 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 backer materials.
2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact 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.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with 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.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and

replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

END OF SECTION 321373

SECTION 321400 - UNIT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brick pavers.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for concrete base under unit pavers.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. For materials other than water and aggregates.
2. For the following:

a. Pavers.
b. Mortar and grout materials.

B. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.

C. Samples for Verification: For full-size units of each type of unit paver indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.

C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.

1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C67.

1.5 QUALITY ASSURANCE

A. : A qualified unit paving installer. Installer's field supervisor must have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with one of the following designations:

1. Residential Paver Technician Designation.
2. Commercial Paver Technician Designation.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

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

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Store liquids in tightly closed containers protected from freezing.

1.7 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 BRICK PAVERS

A. Brick Pavers, Light-Traffic Paving Brick: ASTM C902, Class SX, Type I, Application PS. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.
1. Color: Medium red to Match Architect's sample.

B. Effloresence: Brick to be rated "not effloresced" when tested according to ASTM C67.

2.3 CURBS AND EDGE RESTRAINTS

A. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of 3000 psi.

2.4 AGGREGATE SETTING-BED MATERIALS

A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with requirements in Section 312000 "Earth Moving" for subbase material.

B. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C33/C33M for fine aggregate.

C. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing No. 16 sieve and no more than 10 percent passing No. 200 sieve.

2.5 MORTAR SETTING-BED MATERIALS

A. Portland Cement: ASTM C150/C150M, Type I or Type II.

B. Hydrated Lime: ASTM C207, Type S.

C. Sand: ASTM C144.

D. Latex Additive: Manufacturer's standard water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.

E. Water: Potable.

2.6 MORTAR AND GROUT MIXES

A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

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

3.2 PREPARATION

A. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.

B. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after deficient subgrades have been corrected and are ready to receive base course for unit pavers.

3.3 INSTALLATION, GENERAL

A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.

B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.

C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.

D. Joint Pattern: As indicated.

E. Tolerances:

1. Do not exceed 1/4 inch in 10 feet from level, or indicated slope, for finished surface of paving.

F. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

1. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."

3.4 AGGREGATE SETTING-BED APPLICATIONS

A. Compact soil subgrade uniformly to at least 95 percent of ASTM D698 laboratory density.

B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. 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.

C. Place aggregate base, compact by tamping with plate vibrator, and screed to depth indicated.

D. Place leveling course and screed to a thickness of 1 to 1-1/2 inches, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.

E. Set pavers with a minimum joint width of 1/16 inch and a maximum of 1/8 inch, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed 3/8 inch with pieces cut to fit from full-size unit pavers.

F. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a 3500- to 5000-lbf compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.

1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least 36 inches of uncompacted pavers adjacent to temporary edges.
2. Before ending each day's work, compact installed concrete pavers except for 36-inch width of uncompacted pavers adjacent to temporary edges (laying faces).
3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within 36 inches of laying face.
4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.

G. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.

H. Do not allow traffic on installed pavers until sand has been vibrated into joints.

I. Repeat joint-filling process 30 days later.

J. condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

3.5 REPAIRING, POINTING, AND CLEANING

A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.

END OF SECTION 321400

SECTION 321713 - PARKING BUMPERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Precast concrete wheel stops.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Precast concrete wheel stops.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Precast Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete; 4000-psi minimum compressive strength; manufacturer's standard height and width high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Source Limitations: Obtain wheel stops from single source from single manufacturer.
2. Surface Appearance: Smooth, free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
3. Mounting Hardware: Galvanized-steel hardware as standard with wheel-stop manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation in accordance with manufacturer's written instructions.

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

3.2 INSTALLATION

A. Install wheel stops in accordance with manufacturer's written instructions unless otherwise indicated.

B. Securely anchor wheel stops to substrate with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 321713

SECTION 321723 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Painted markings applied to concrete surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.

   1. Pavement-marking paint, acrylic.

B. Shop Drawings:

   1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
   2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Standards and Specifications of Maryland State Highway Administration for pavement-marking work.

   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design".

2.3 PAVEMENT-MARKING PAINT

A. Pavement-Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II, with drying time of less than 45 minutes.

1. Color: White.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.

B. Allow asphalt paving or concrete surfaces to age for a minimum of 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.

1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to asphalt paving or concrete surface. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

SECTION 329113 - SOIL PREPARATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes planting soils specified by composition of the mixes.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. 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.

O. 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.

P. 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.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of soil amendment and fertilizer before delivery to the site, according to the following:

    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Samples: For each bulk-supplied material, 1-quart volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.

B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

C. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1. Laboratories: Select from suggested list recommended by the University of Maryland Extension.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.9 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.10 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
   b. Hydrometer Method: Report percentages of sand, silt, and clay.

2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D698 (Standard Proctor).

C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
5. Nitrogen ppm.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
9. Manganese-availability ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm.
14. Soluble-salts ppm.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Planting-Soil Type: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

2.2 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C602, 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 No. 8 sieve and a minimum of 75 percent passing through a No. 60 sieve.
2. 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 No. 6 sieve and a maximum of 10 percent passing through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 sieve.

F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C33/C33M.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: Limited to leaves.
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 30 to 40percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a 1-inch sieve.

2.4 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. 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 planting soil.

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

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 6 inches and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

3.3 BLENDING PLANTING SOIL IN PLACE

A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of 6 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

C. Mixing: Apply soil amendments, compost, and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.

1. Mix lime and sulfur with dry soil before mixing fertilizer.
2. Mix fertilizer with planting soil no more than seven days before planting.

D. Compaction: Compact blended planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D698.

E. 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.

3.4 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting 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.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.5 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 329113

SECTION 329200 - TURF AND GRASSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Turf renovation.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 329113 "Soil Preparation" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

1. Certification of each seed mixture for turfgrass sod. Include identification of source and name and telephone number of supplier.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the National Association of Landscape Professionals or AmericanHort.
2. Experience: Five years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the National Association of Landscape Professionals:

    a. Landscape Industry Certified Technician - Exterior.
    b. Landscape Industry Certified Lawn Care Manager.
    c. Landscape Industry Certified Lawn Care Technician.
    d. State Certified Professional Horticulturist

5. Pesticide Applicator: State licensed, commercial.

1.8 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.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

1.9 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of planting completion.

1. Seed
   a. Spring: March 01 to May 15
   b. Fall: August 15 to October 15
2. Sod
   a. Spring: March 01 to June 15
   b. Fall: August 15 to October 15

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.10 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.

2. Warranty Periods: From date of planting completion.

   a. Sodded and seeded turf: 12 months or completion of a single complete growing season, whichever is greater.

3. Include the following remedial actions as a minimum:

   a. Immediately remove dead turf and replace unless required to plant in the succeeding planting season.
   b. Replace sod pieces that are more than 25 percent dead or in an unhealthy condition at end of warranty period. Reseed areas of seeded turf that do not meet the minimum coverage of 94 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

c. A limit of one replacement is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 SEED

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances. It shall be mixed in the proportion shown and test results certifying 98% minimum purity, with no more than .01% weed seed (must be free of ryegrass, timothy, orchardgrass, bentgrass, Canada bluegrass, clover, or any other contaminant which will be unsightly or hard to control), no more than .01% other crops (must be free of dock, chess, chickweed, crabgrass, plantain, and black medic), free of noxious weed seed, and 85% minimum germination. Approved varieties shall be selected from “Recommended Turfgrass cultivars for Professional Seed Mixtures,” University of Maryland Turfgrass Technical Update TT-77, most recent edition.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.
2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
3. Sun and Partial Shade: Proportioned by weight as follows:

    a. 80-95% Certified Tall Fescue
    b. 5-10% Certified Kentucky Bluegrass
    c. 0-10% Certified Perennial Ryegrass*
    *Note: The routine inclusion of perennial ryegrass is not recommended, but may be added to the mixture when the seeding site is at high risk for soil erosion or when cool temperatures may hinder establishment of tall fescue and Kentucky bluegrass. Two cultivars of tall fescue and one cultivar of Kentucky bluegrass may be used, but the inclusion of three or more tall fescue cultivars is recommended. The seeding rate of this mixture shall be 7.0 to 8.0 lbs. P.L.S. per 1000 ft2.All seed and labeling must fully comply with the Maryland Seed Law and these specifications.

C. All seed must be state certified and blended under the supervision of the Maryland Department of Agriculture (MDA), Turf and Seed Section.

D. All seed and labeling must fully comply with the Maryland State Department of Agriculture (MDA) Turf & Seed Section.

E. Each bag shall contain proper label and certification tag.

2.2 FERTILIZERS

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition:

a. 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition:

a. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of less than 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60 percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

C. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

D. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. 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 soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 TURF AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 329113 "Soil Preparation."

B. Placing Planting Soil: Blend planting soil in place.

1. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

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 against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate of 7 to 8 lb/1000 sq. ft.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas from hot, dry weather or drying winds by applying straw or compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch, and roll surface smooth.

3.5 HYDROSEEDING

A. Hydroseeding: Mix specified seed, commercial fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic, fiber-mulch manufacturer's recommended tackifier.
2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.6 TURF RENOVATION

A. Renovate existing turf where indicated.

B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing turf.

F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizer required for establishing new turf and mix thoroughly into top 4 inches of existing soil. Install new planting soil to fill low spots and meet finish grades.

1. Soil Amendment(s): According to requirements of Section 329113 "Soil Preparation."
2. Initial Fertilizer: Slow-release fertilizer applied according to manufacturer's recommendations.

J. Apply seed and protect with straw or compost mulch as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

3.7 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.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. 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. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow turf-type tall fescue to a height of 2 to 3 inches.

D. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.

3.8 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by 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.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.9 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.11 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: From date of installation to end of warranty period.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION 329200

APPENDIX A

DGS FORMS

ATTACHMENT 4

SUMMARY - AREAS, VOLUME & EFFICIENCY

PROJECT: SMALLWOOD STATE PARK PROJECT NO: P-030-221-010

FACILITY: GRINDER HOUSE DATE: 28 MARCH 2025

ARCHITECT/ENGINEER: ZIGER|SNEAD ARCHITECTS

ITEM	AREA (SF)			
	PROGRAM	SCHEMATIC	DD	CD
GROSS AREA (Notes 1 & 2)			1747	1747
NET ASSIGNABLE AREA (Notes 1 & 2) (Sh. 3 to __ incl.)			1064	1064
GROSS VOLUME (Note 1)			15,218	15,218
EFFICIENCY FACTOR (Note 3) % EFFICIENCY (Note 4)			1.64	1.64
SUBMISSION DATE (Note 5)			02/09/2024	09/27/2024

NOTES:

1. Gross Areas, Net Assignable Areas and Volumes shall be calculated in strict accordance with DGS Procedure Manual Appendix D.

2. Attach additional sheets as follows: Sheet 2 - Tabulation of Gross Areas; Sheet 3 (repeated as needed) - Tabulation of Net Assignable Areas (Room by Room).

3. To obtain Efficiency Factor: Divide Gross Area by Net Assignable Area (e.g. 49,209 SF Gross Area divided by 33,705 SF Net Assignable Area = 1.46).

4. To obtain % Efficiency: Divide Net Assignable Area by Gross Area and multiply by 100 (e.g. 33,705 SF Net Assignable Area divided by 49,209 SF Gross Area multiplied by 100 = 68.5% Efficiency).

5. Submit in triplicate to the DGS Project Manager with each phase submission of review documents. Figures shall be shown for all previous phases as well as the current phase submitted.

TABULATION OF GROSS AREA

PROJECT: SMALLWOOD STATE PARK PROJECT NO: P-030-221-010

FACILITY: GRINDER HOUSE DATE: 9 MAY 2025

ARCHITECT/ENGINEER: ZIGER|SNEAD ARCHITECTS

DESCRIPTION	GROSS AREA (SF)			
	PROGRAM	SCHEMATIC	DD	CD
Utility Tunnels (Within 10 feet)			0	0
Crawl Space (6 feet or more high)			0	0
Sub-Basement			0	0
Basement			0	0
Ground Floor			0	0
Mezzanine			0	0
Balcony			0	0
Fixed Bleachers (w/rooms below)			0	0
1st Floor			908	908
2nd Floor			750	750
3rd Floor			0	0
4th Floor			0	0
Other			0	0
Other			0	0
Mezzanine (Boiler or Equip. Room)			0	0
Penthouses (Stairs, Elev., Mech.)			0	0
Areaways (1/2)			0	0
Canopies (1/2)			0	0
Roof or Floor			0	0
Overhangs (1/2) PORCHES			89	89
Open piazza under bldg. (1/2)			0	0
Covered Balcony (1/2)			0	0
Loading Dock (1/2)			0	0
TOTALS			1747	1747

SUMMARY - AREAS, VOLUME & EFFICIENCY

PROJECT: SMALLWOOD STATE PARK PROJECT NO: P-030-221-010

FACILITY: GRINDER HOUSE DATE: 28 MARCH 2025

ARCHITECT/ENGINEER: ZIGER|SNEAD ARCHITECTS

Room No.	DESCRIPTION	NET ASSIGNABLE AREAS (SF)			
		PROGRAM	SCHEMATICS	DD'S	CD'S
101	RECEPTION			133	133
102	OFFICE			166	166
101A	CLOSET			16	16
103	BREAKROOM			177	177
103A	BATHROOM			50	50
103B	MECHANICAL/ELECTRICAL				
201	MEETING ROOM			290	290
201A	CLOSET			24	24
201B	CLOSET			33	33
202	OFFICE 2			175	175
Total (This Sheet)				1064	
GRAND TOTAL (Sheet 3 to 3)				1064	

APPENDIX B

TEST REPORTS

GREEN STREET ENVIRONMENTAL
6304 BLAIR HILL LANE
SUITE 2
BALTIMORE, MD 21209
PHONE 410.296.8800
FAX 410.296.8801
WWW.GREENSTREET-ENVIRONMENTAL.COM

November 15, 2016

Brian Degenhard
MD DNR
590 Taylor Avenue, D-3
Annapolis, MD 21401

Letter Report: **Lead-Specific Pre-Demolition Composite TCLP Sampling Smallwood State Park; Project No. 161031-4**

Dear Brian,

Green Street Environmental (GSE) was retained by MD DNR to perform lead-specific Toxicity Characteristic Leaching Procedure (TCLP) sampling and analysis of the burned park house on Lucille Thornton Place in Smallwood State Park.

GSE is a Maryland Licensed Lead Inspection Contractor # 12857. The inspection was conducted on November 2, 2016 by Robert Jacque (Maryland Licensed Lead Inspector No. 15938).

The lead-specific TCLP test simulates landfill-leaching conditions; specifically how much lead will leach out of the waste when exposed to typical landfill conditions. If the leachable amount of lead is equal to or greater than 5.0 mg/l, the waste is classified as hazardous waste. If the leachable amount of lead is less than 5.0 mg/l, the waste is classified as non-hazardous waste (e.g. regular construction debris). Maryland and EPA require that samples be truly "representative" of the building waste intended for disposal; samples must contain a minimum of 100 grams of material; and laboratories conducting the TCLP test must comply with EPA guidance SW-846. To ensure that composite samples are "representative" of the entire quantity of debris removed, GSE collects one composite sample per structure or one per 2,500 square feet of floor space, whichever results in the greater number of samples. GSE collected one TCLP sample.

Samples were shipped to SanAir Technologies Laboratory for analysis. Results are attached to this letter.

The results of the lead-specific TCLP testing indicate leachable lead levels for each of the properties tested are less than 5.0 mg/l. As a result, construction waste

associated with the burned park house is non-hazardous for lead.

Please visit our website at www.greenstreet-environmental.com for additional information about our inspection protocols or qualifications.

Sincerely,
GREEN STREET ENVIRONMENTAL



Robert Jacque
Industrial Hygienist

Reviewed By:



John Conaway, CHMM
Principal/VP Operations

Attachments

- Laboratory Analyses Results

SanAir Technologies Laboratory

Analysis Report

prepared for

Green Street Environmental

Report Date: 11/9/2016
Project Name: Smallwood State Park
Project #: 161031-4
SanAir ID#: 16040166

NVLAP LAB CODE 200870-0

AIHA LAP, LLC ACCREDITED LABORATORY ENVIRONMENTAL LEAD ENVIRONMENTAL MICROBIOLOGY ISO/IEC 17025:2005 LAB # 162952

Virginia SBE Certification # 652931

Texas Licensed Mold Analysis Laboratory License # LAB0166

SanAir Technologies Laboratory

804.897.1177 www.sanair.com

SanAir Technologies Laboratory, Inc.

1551 Oakbridge Drive, Suite B, Powhatan, VA 23139
804.897.1177 Toll Free: 888.895.1177 Fax: 804.897.0070
Web: http://www.sanair.com E-mail: iaq@sanair.com

Green Street Environmental
6304 Blair Hill Lane
Ste 2
Baltimore, MD 21209

November 9, 2016

SanAir ID # 16040166
Project Name: Smallwood State Park
Project Number: 161031-4

Dear Robert Jacque,

We at SanAir would like to thank you for the work you recently submitted. The 1 sample(s) were received on Thursday, November 03, 2016 via FedEx. The final report(s) is enclosed for the following sample(s): M1.

These results only pertain to this job and should not be used in the interpretation of any other job. This report is only complete in its entirety. Refer to the listing below of the pages included in a complete final report.

Sincerely,

L. Claire Macdonald
Microbiology Laboratory Manager
SanAir Technologies Laboratory

Final Report Includes:
- Cover Letter
- Analysis Pages
- Disclaimers and Additional Information

sample conditions:
1 sample(s) in Good condition

SanAir Technologies Laboratory
1551 Oakbridge Dr STE B
Powhatan, VA 23139
804.897.1177 / 888.895.1177
Fax 804.897.0070
sanair.com

Green Street Environmental

Metals & Lead Chain of Custody

SanAir ID Number: 16040166

Company: Green Street Environmental	Project #: 161031-4	Phone #:
Address: 6304 Blair Hill Lane	Project Name: Smallwood State Park	Phone #: 410-296-8800
City, St., Zip: Baltimore, MD 21209	Date Collected: 11-2-16	Fax #:
Samples Collected By: Robert Jacque	P.O. Number:	Email: rjacque@greenstreet-environmental.com
Account #: 2555	U.S. State Collected in: MD	Email:

Matrix Types

☐ **Air** (ug/m^3)	
☐ **Wipe** (ug/ft^2)	
☐ **Paint** ☐ **Soil** ■ **Bulk** (ug/g or ppm)	
☐ **Other:**	

Metals Analysis Types

Total Concentration of Lead ☐	☐ ICP-total concentration of metals (please list metals):
Total Concentration of RCRA 8 Metals ☐	
TCLP for Lead ☐	
TCLP for RCRA 8 Metals ☐	

Turn Around Time	Same Day ☐	1 Day ☐	2 days ☐	3 Days ☐
	■ Standard (5 day)	☐ Full TCLP (10d)		

Sample #	Collection Date & Time	Sample Identification/Location	Flow Rate	Start Time	Stop Time	Volume (L) Area (Sq ft)
M1	11-2-16, 11:00	Burnt Park House, 60% Brick, 35% Wood, 5% cement				

Special Instructions

Relinquished by	Date	Time	Received by	Date	Time
Robert Jacque	11-2-16	18:00	CEU	11/3/16	10:20AM
Robert Jacque					

Unless scheduled, the turnaround time for all samples received after 3 pm will begin at 8 am the next business morning. Weekend or Holiday work must be scheduled ahead of time and is charged at 150% of the Rush TAT rate. There is a minimum charge of $100 for weekend work. A courier charge will be applied for same day and one-day turnaround times for offsite work.

SanAir covers Standard Overnight FedEx shipping. Shipments billed to SanAir with a faster shipping rate will result in additional charges.

Page 1 of 1

16040166

Cheyenne E. Urbine

From: Jordan L. Ridgeway
Sent: Friday, November 04, 2016 1:09 PM
To: Cheyenne E. Urbine; Elisa Moore; Maria E. Coker
Subject: FW: Smallwood State Park / 161031-4 / Missing Test Type

Jordan Ridgeway
Account Executive
SanAir Technologies Laboratory, Inc
1551 Oakbridge Drive, Suite B
Powhatan, Va 23139
Phone: 804.897.1177
Phone: 888.895.1177
Fax 804.897.0070

SanAir Technologies Laboratory
www.sanair.com

"The Identification Specialists"
Asbestos, Environmental Microbiology, Legionella, Materials Testing

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From: Robert Jacque [mailto:rjacque@greenstreet-environmental.com]
Sent: Friday, November 04, 2016 1:08 PM
To: Jordan L. Ridgeway <jridgeway@sanair.com>
Subject: Re: Smallwood State Park / 161031-4 / Missing Test Type

Jordan,

The test type should be TCLP for Lead only. Thank you.

-Bob Jacque

On Fri, Nov 4, 2016 at 12:50 PM, Jordan L. Ridgeway <jridgeway@sanair.com> wrote:

> RE: Smallwood State Park / 161031-4
>
> SanAir #16040166

CCU 11/4/16 1:11 PM

160401166

Hello,

Can you please provide the test type for the job above? I'm guessing it's a TCLP, but is it for Lead only? RCRA 8? Please advise.

Jordan Ridgeway

Account Executive

SanAir Technologies Laboratory, Inc

1551 Oakbridge Drive, Suite B

Powhatan, Va 23139

Phone: 804.897.1177

Phone: 888.895.1177

Fax 804.897.0070

SanAir
Technologies Laboratory

www.sanair.com

"The Identification Specialists"

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http://www.everycloudtech.com/mail

SanAir Technologies Laboratory, Inc.

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804.897.1177 Toll Free 888.895.1177 Fax: 804.897.0070
www.sanair.com email:iaq@sanair.com

SanAir ID Number
16040166
Final Report

Name: Green Street Environmental
Address: 6304 Blair Hill Lane
Ste 2
Baltimore, MD 21209

Project Number: 161031-4
P.O. Number:
Project Name: Smallwood State Park

Collected Date: 11/2/2016
Received Date: 11/3/2016 10:20 AM
Report Date: 11/09/2016 01:00PM
Analyst: Stacey Thomas

Analyte Requested: TCLP-Lead (Pb)
Test Method:EPA 1311/6010C

REPORT OF ANALYSIS

Lab Sample #	Field Sample #	Analyte	Sample Description	Results in mg/L	MRL (mg/L)
16040166-01	M1	Lead (Pb)	Burnt Park House, 60% Brick, 35% Wood, 5%	<0.500	<0.500

mg/L=ppm

MRL: Method Reporting Limit
Certification
SanAir Technologies Laboratory, Inc participates in the State of Virginia NELAC program for TCLP analysis.
VA Lab Id: 8353

Signature: S. Thomas
Date: 11/9/2016

Reviewed
Date: 11/9/2016

Disclaimer

- Results relate only to the items tested
- Results are not corrected for blanks
- All quality control results are acceptable unless otherwise noted
- SanAir Technologies Laboratory, Inc is not responsible for sample collection or interpretation made by others
- This report does not constitute endorsement by AIHA/NVLAP and/or any other U.S. governmental Agencies; and may not be certified by every local, state or federal regulatory agencies.

EPA Limits:

Silver (Ag): 5.0 mg/L
Arsenic (As): 5.0 mg/L
Barium (Ba): 100 mg/L
Cadmium (Cd): 1.0 mg/L
Chromium (Cr): 5.0 mg/L
Mercury (Hg): 0.2 mg/L
Lead (Pb): 5.0 mg/L
Selenium (Se): 1.0 mg/L

Maryland On-Site Sewage Disposal System Inspection Report

Property Information

Cover Photo	
Address:	2750 Sweden Point Rd
City, State, Zip code	Marbury, MD, 20658
Report Prepared for:	Philip Rooney
Permitted Number of Bedrooms	Unknown
Year Built:	Unknown
Water Supply	Well
Property Type:	Residential

Owner Information/Interview

Owner/Occupent Name	N/A
Number of Occupents	None
Number of Years Occupied	N/A
If Vacant, Date Vacated:(MM/DD/YYY)	2013
In Home Business:	No
Has The Property Recently Had A Septic Inspection:	No
Any Septic System Issues:	No

Document Search Information

Document Request date	01-22-2024
Any system information Recived:	No
Permitted Septic System Components:	Permitted Septic System Components:

On-site Inspection Date/Time

Start Date:	01-24-2024
Completion Date:	01-24-2024
Start Time	08:49 AM (-5 GMT)
Completion Time	11:45 AM (-5 GMT)

Crawlspace/Basement Evaluation

Number of Visible Drain Pipes Exiting Foundation Wall	None Visible

Maryland On-Site Sewage Disposal System Inspection Report

Describe Each Pipe and Source:	Number of pipes leaving the home is unknown as the home is boarded up
Does Plumbing Evaluation Confirm All Wastewater is Directed into the Septic System:	No
Comments	While there are no visible signs of plumbing fixtures, not tied into the OSDS from the exterior of the home, it cannot be confirmed as we have no access into the home as it is boarded up.
Multi Photo	   

Water Treatment

Does the House Have Any Water Treatment Devices:	No

Sewer Line Outside Of Foundation

Pipe Material:	PVC
Cracks/Breaks:	Yes
Multi Photo	 

Maryland On-Site Sewage Disposal System Inspection Report

Blockages:	No
Comments	No blockages present

Grease Trap

Grease Trap Present	No

Septic Tank(s)

Number of tanks	One
Total Size of tanks in Gallons	1250
Type of Tanks	Top Seam
Construction	Concrete
Liquid Level	Normal
Evidence of High Water Staining	No
Effluent Filter Present	Yes
Comments	The tank present is an advanced treatment unit/nitrogen reducing unit. This particular technology uses a filtration system that the effluent goes through before entering the soil absorption system, instead of an outlet baffle that a standard tank would use.
Multi Photo	
Inlet baffle	No
Outlet Baffle	No
Comments	An advanced treatment unit was present not a standard septic tank
Multi Photo	

Maryland On-Site Sewage Disposal System Inspection Report

Tank Access	Above grade
Multi Photo	  
Comments	An advanced treatment unit was present not a standard septic tank
Evidence of Ground or Surface Water Intrusion	No

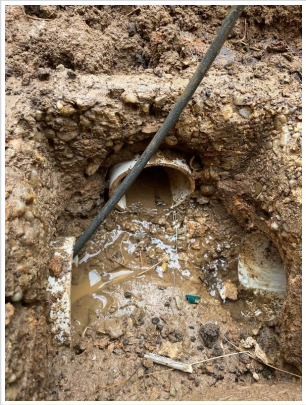
Best Available Technology (BAT)

BAT Unit	Yes
Manufacturer	Norweco Singulair
Model	TNT-500
Power To Control Panel	No
Control Panel Alarm	Yes
Last Service Date	10-09-2013
Was Last Service Date More Tank 365 Days	Yes
Multi Photo	 
Comments	The house the unit is associated with has no power or running water, as it is burnt down.

Distribution Box

Distribution Box Present	Yes
Number of Drain Lines Leaving Box	Three
Distribution Box Level	Yes

Maryland On-Site Sewage Disposal System Inspection Report

Multi Photo			
Is There Equal Distribution To Drainlines	No		
Multi Photo			
Video	Click to Download		
Liquid Level	Normal		
Multi Photo			

Maryland On-Site Sewage Disposal System Inspection Report

	
Comments	There are two distribution boxes present. This is a non-typical installation. The distribution boxes are in succession. The first distribution box has one trench that leaves the box as well as a pipe to a second distribution box that has two trenches leaving the box. The first distribution box appeared satisfactory at the time of the inspection. The second distribution box was heavily deteriorated and no longer water tight. This is allowing excess dirt and debris into the second distribution box and causing effluent to not distribute equally between the trenches.

Pumping Chamber

Pumping Chamber Present	No

Soil Absorption System

Absorption Type	Trenche(s)
Obsevation Pipe(s)	No
Trenches Probed	No
Evidence of Surfacing Effluent	No
Comments	All liquid introduced during the hydraulic load test appeared to be accepted. One of the three trenches accepted most of the liquid. The trench off of the first distribution box has a break and debris close to the start of the trench that limits flow entering this trench. The trench in the second distribution box that exits to the left of the inlet pipe appears to be accepting most of the liquid introduced. The third trench opposite of the second is full of mud and debris. The trenches off of the second distribution box are approximately 6 to 7 feet deep.

Other On-site Disposal System (OSDS) Components and Systems

Describe all other OSDS Components Not Covered In The Above Sections	Describe all other OSDS Components Not Covered In The Above Sections
Multi Photo	  

Maryland On-Site Sewage Disposal System Inspection Report

	
Comments	The front chamber access of the Norweco unit is below grade. This tank has plastic risers precast into it. This is a potential safety issue as the plastic lid is not loadbearing and should somebody run anything of excessive weight over the area not knowing it is there they can potentially go through the lid. The aerator chamber lid vent is broken. This can allow excess debris into the aerator chamber, potentially shortening the life of the aerator. The electrical conduit going into the aerator chamber riser is separated. This can allow the electrical going into the aerator to be damaged as it is not protected in areas above grade The distribution box has an observation pipe that is damaged and below grade. This observation pipe has no cap and can allow dirt and debris along with excess water not intended for the system to enter the soil absorption system.

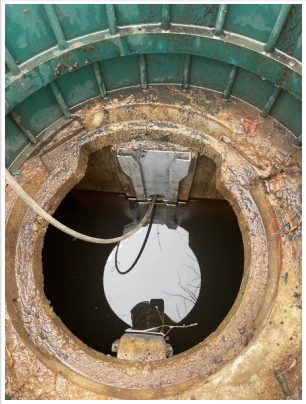
Hydraulic Load Test

Hydraulic Load Test Performed	Yes
Testing Volume in Gallons	275
Elapsed Time In Minutes	120

Dye Test

Dye Test Performed	No
Suspicious Liquid Discharge On Or Near The Property	No

Tank Pump Out

Tank(s) Pumped	No
Multi Photo	 
Number of Tanks Pumped	One

Maryland On-Site Sewage Disposal System Inspection Report

Total Gallons Pumped	N/A
Any Flow Into Tank From Outlet Pipe	No
Any Ground Water Entering Tank	No
Does The Tank Appear To Be Water Tight	Yes
Comments	No tanks were pumped out at the time of inspection

Summery/Conclusions

Wastewater Collection System Conveys All Wastewater to Sewer Line	Satisfactory With Concerns
Sewer Line	Satisfactory
Grease Trap	Not Applicable
Septic Tank	Not Applicable
BAT Unit	Satisfactory With Concerns
Distribution Box	Unsatisfactory
Pumping Chamber	Not Applicable
Soil Absorption System	Satisfactory With Concerns
All Other OSDS Components	Not Applicable
Does Any Component Of The OSDS Need To Be Repaired Or Replaced	Yes
Explain	The front lid of the bat system is below grade. Plastic risers should be above grade as they are not loadbearing. Recommend installation of additional risers by qualified, licensed, septic contractor. Vent on the aerator chamber lid is broke. Recommend replacement of aerator vent. The observation port on the distribution box is broken. Recommend replacement of distribution box, observation, port by qualified, licensed, septic contractor. The second distribution box is heavily, deteriorated and allowing excess dirt and debris and to the soil absorption system and box. Can shorten the life of the soil absorption system recommend replacement as deemed fit by a qualified, licensed septic contractor The soil absorption line off of the first distribution box is broken, restricting flow and we could not get our camera through recommend replacement of line as deemed fit by qualified, licensed, septic contractor
In My Professional The OSDS Is Properly Functioning Based On Permitted Capacity	No
Explain	Due to the lack of county records, we cannot determine if the system is functioning properly per the permitted capacity as we do not know what the permitted capacity was at the time of installation.
My Inspection Verifies The OSDS Is Consistent With The Septic Permit	No

Maryland On-Site Sewage Disposal System Inspection Report

Explain	Due to the lack of county records, it is unknown if the OSDS present is consistent with the permit
If Listed For Sale, Does The Number Of Bedrooms Advertised Match What Is Legally Permitted	No
Explain	Home is not for sale, so there is no sale listing stating number of bedrooms
****Check with Approving Authority for permitting requirements before any repair is performed.****	**Check with Approving Authority for permitting requirements before any repair is performed.**
****ATTACH ALL DOCUMENTS PROVIDED BY THE APPROVING AUTHORITY**	**ATTACH ALL DOCUMENTS PROVIDED BY THE APPROVING AUTHORITY
THIS INSPECTION REPORT DETAILS COMPONENTS AND THE PRESENT CONDITION OF THE ON-SITE SEWAGE DISPOSAL SYSTEM FOR THE ADDRESS LISTED IN THE PROPERTY INFORMATION SECTION OF THIS REPORT. THE CONCLUSIONS OF THIS REPORT DO NOT GUARANTEE OR WARRANTY THIS OSDS WILL FUNCTION IN THE FUTURE.	THIS INSPECTION REPORT DETAILS COMPONENTS AND THE PRESENT CONDITION OF THE ON-SITE SEWAGE DISPOSAL SYSTEM FOR THE ADDRESS LISTED IN THE PROPERTY INFORMATION SECTION OF THIS REPORT. THE CONCLUSIONS OF THIS REPORT DO NOT GUARANTEE OR WARRANTY THIS OSDS WILL FUNCTION IN THE FUTURE.
This inspection of the septic system is an evaluation of function and is not an evaluation that the system meets current State regulations. The owner should not assume future expansion of the home is possible without additional evaluation completed by the Approving Authority.	This inspection of the septic system is an evaluation of function and is not an evaluation that the system meets current State regulations. The owner should not assume future expansion of the home is possible without additional evaluation completed by the Approving Authority.
I attest that I have properly completed an inspection of the OSDS at this property. This inspection includes information obtained from the property owner, or representative, and a document search from the Approving Authority. I have completed all sections pertaining to components of this OSDS. The conclusions of this report are my professional opinions based on my training and experience inspecting OSDS.	I attest that I have properly completed an inspection of the OSDS at this property. This inspection includes information obtained from the property owner, or representative, and a document search from the Approving Authority. I have completed all sections pertaining to components of this OSDS. The conclusions of this report are my professional opinions based on my training and experience inspecting OSDS.
First Name	Shawn
Last Name	Britt
Signature	
Date/Time	01-24-2024

A.C. SCHULTES OF MARYLAND, INC.
WELL TEST REPORT

CUSTOMER Ziger / Snead Architects JOB # H9574 DATE: 8/7/2024

LOCATION Smallwood Park WELL NO. Old Farmhouse Well

WELL DIAMETER 4" WATER LEVEL DATUM TOC

OBSERVATION WELL N/A FEET AWAY

STATIC WELL LEVEL 20 MINUTES BEFORE START 134

STATIC WELL LEVEL 10 MINUTES BEFORE START

	CLOCK TIME	CAPACITY GPM	PUMPING LEVEL	DRAWDOWN	SPECIFIC CAPACITY
START	2:30 PM	7			
1 MIN	2:31 PM	7	139.00	5.00	1.40
2 MIN	2:32 PM	7	142.00	8.00	0.88
3 MIN	2:33 PM	7	144.00	10.00	0.70
4 MIN	2:34 PM	7	144.08	10.08	0.69
5 MIN	2:35 PM	7	144.20	10.20	0.69
6 MIN	2:36 PM	7	144.27	10.27	0.68
7 MIN	2:37 PM	7	144.33	10.33	0.68
8 MIN	2:38 PM	7	144.38	10.38	0.67
9 MIN	2:39 PM	7	144.42	10.42	0.67
10 MIN	2:40 PM	7	144.46	10.46	0.67
12 MIN	2:42 PM	7	144.51	10.51	0.67
14 MIN	2:44 PM	7	144.64	10.64	0.66
16 MIN	2:46 PM	7	144.66	10.66	0.66
18 MIN	2:48 PM	7	144.74	10.74	0.65
20 MIN	2:50 PM	7	144.82	10.82	0.65
22 MIN	2:52 PM	7	144.84	10.84	0.65
24 MIN	2:54 PM	7	144.91	10.91	0.64
26 MIN	2:56 PM	7	145.00	11.00	0.64
28 MIN	2:58 PM	7	145.00	11.00	0.64
30 MIN	3:00 PM	7	145.00	11.00	0.64
35 MIN	3:05 PM	7	145.12	11.12	0.63
40 MIN	3:10 PM	7	145.16	11.16	0.63

A.C. Schultes of MD, Inc. **Well Test Report**

Customer Ziger / Snead Architects Job # H9574 Date 8/7/2024

Location Smallwood Park Well No. Old Farmhouse Well

	CLOCK TIME	CAPACITY GPM	PUMPING LEVEL	DRAWDOWN	SPECIFIC CAPACITY
45 MIN	3:15 PM	7	145.26	11.26	0.62
50 MIN	3:20 PM	7	145.34	11.34	0.62
55 MIN	3:25 PM	7	145.34	11.34	0.62
60 MIN	3:30 PM	7	145.38	11.38	0.62

Chain of Custody Record

Water Testing Labs of Maryland, Inc.
Chesapeake Labs, Inc.
1000 Butterworth Court, Thompson Creek Business Park; Stevensville, MD 21666
Phone: 410-643-7711 Fax: 410-643-5034 www.wtlmd.com

CLIENT NAME: AC Schultes - MD

CLIENT ADDRESS/PHONE NUMBER/FAX NUMBER:
AC Schultes
8221 Cloverleaf Dr.
Millersville, MD 21108

ATTENTION:
brandon@acschultes.net
brad@acschultes.net
admin@acschultes.net

CC:

REQUESTED COMPLETION DATE: ASAP

PO#: 31822

PROJECT NAME/STATE: Smallwood Park/Marbury, MD

Job #: H9574

ANALYSIS REQUESTED

DATE	TIME	MATRIX CODE *	COMP	GRAB	SAMPLE IDENTIFICATION	# of CONTAINERS	Bacteria - MPN	ONSITE - Turbidity, Temperature °C, pH, Conductivity	Secondary Constituents	IOCs + lead and copper, NO2	VOCs + Trip Blank + Field Blank	1-Gross Alpha, 1-Radium 226, 1-Radium 228, 1-Uranium	Sulfide (No headspace)	TOC (No headspace)	LAB ID NUMBER
		CONTAINER:					S		P	P	V	L	V	V	
		PRESERV.:					6		7	7	1 8	7	7	1	
8/1/24	8:45A	DW	☐	☒		14	1	--	2	2	2	4	1	2	ACS24-08-02
8/01/24	8:20AM	DW ~~VOC Trip~~	☐	☒	Trip blank	1					1				ACS24-08-02TB
8/1/24	8:40AM	DW	☐	☐	Field blank	1					1				ACS24-08-02FB

CONTAINER TYPE
P – PLASTIC PINT
L – LITER PLASTIC
A – AMBER GLASS
G – CLEAR GLASS
V – VOA VIAL
S – STERILE
O – OTHER

PRESERVATION
1 – HCl, 4°
2 – H_2SO_4, 4°
3 – HNO_3, 4°
4 – NaOH, 4°
5 – NaOH/ZnAc, 4°
6 – $Na_2S_2O_3$, 4°
7 – 4°
8 – Ascorbic Acid
9 – None

*MATRIX CODES

DW – DRINKING WATER
WW – WASTE WATER
GW – GROUND WATER
ST – STORM WATER
SW – SURFACE WATER
S – SOIL
SL – SLUDGE
SD – SOLID
A – AIR
L – LIQUID
P – PRODUCT

ONSITE

FREE CL2: ___ TOTAL CL2: ___

INITIAL pH: 6.8 TEMP: 25 °C TURB: 8.5 NTU

FINAL pH: 7 CONDUCT: ~~1550~~ 155

SAMPLED BY: Jordan Montgomery

DATE/TIME: See Above

RELINQUISHED BY:

DATE/TIME:

RECEIVED BY:

DATE/TIME:

RELINQUISHED BY:

DATE/TIME:

RECEIVED BY:

DATE/TIME:

RELINQUISHED BY:

DATE/TIME:

FOR LAB USE ONLY

Comments:

LAB #

RECEIVED BY LAB: Meghan Santana

DATE/TIME: 8/1/24 1539

SAMPLE SHIPPED VIA: UPS FED-EX COURIER CLIENT/OTHER FIELD SERVICES

In-house location:

pH: Labeled Preserved

Ice: Yes or No

Temperature: 3.8°C

Custody Seal: Intact Broken/Missing

COOLER #

Entered into LIMS:

Please use Black Ink to complete form

© Water Testing Labs of MD

Water Testing Labs of Maryland

1000 Butterworth Ct.
Thompson Creek Business Park
Stevensville, MD 21666
(410) 643-7711
sales@wtlmd.com

AC Schultes
Attn: Brad
8221 Cloverleaf Drive
Millersville MD 21108

Reporting Date: 9/17/24
Report #: ACS2408-02
PO #: 31822
Job #: H9574

Submitted Sample ID: ACS2408-02
Well ID: CH-88-0494
Submitted Sample Source: Smallwood Park – Sample tap
Date/Time Collected: 8/1/24 0845
Date/Time Received: 8/1/24 1539
Sampler ID#: L. Montgomery of AC Schultes

ANALYTICAL RESULTS

Parameter	Result	Units	Method	MCL	Report Limit	Analysis Date
A. Bacteriological:						
Coliform: Total	<1.0	MPN/100ml	SM9223B	0	1.0	8/1/24
Coliform: E. Coli	<1.0	MPN/100ml	SM9223B	0	1.0	8/1/24
B. Misc.						
Turbidity	8.51	NTU	Client	10 NTU**** (MD Well Regs)	---	8/1/24
Temperature	25	ºC	Client	---	---	8/1/24
pH, initial	6.8	SU	Client	6.5–8.5** (SMCL)	---	8/1/24
Conductivity	155	µS	Client	---	---	8/1/24
C. Secondary Constituents:						
pH, final	7.0	SU	SM 4500 H^+B	6.5–8.5** (SMCL)	0.1	8/2/24
Chloride	3.0	mg/L	H8113	250** (SMCL)	1.0	8/2/24
Total Alkalinity as $CaCO_3$	84	mg/L	EPA 310.1	---	4	8/5/24
Hardness as $CaCO_3$	28	mg/L	SM2340B	---	4	8/5/24
Total Dissolved Solids	90	mg/L	SM2540C	500** (SMCL)	1	8/5/24
Sulfide	ND	mg/L	H8131	---	0.2	8/2/24
Calcium	4.5	mg/L	EPA 200.8	---	1.0	8/2/24
Iron	0.8	mg/L	H8008	0.30** (SMCL)	0.1	8/2/24
Manganese	0.0583	mg/L	EPA 200.8	0.05** (SMCL)	0.0010	8/2/24
Zinc	0.0035	mg/L	EPA 200.8	5** (SMCL)	0.0010	8/2/24
Color (Apparent/True)	19/14	CU	H8025	15** (SMCL)	5	8/2/24
Bromide	ND	mg/L	EPA300.0	---	1.0	8/5/24
Total Organic Carbon (TOC)	ND	mg/L	SM22 5310B	---	0.50	8/15/24

Parameter	Result	Units	Method	MCL	Report Limit	Analysis Date
D. Inorganic Compounds:						
Nitrate	ND	mg/L	EPA353.2	10.0	0.5	8/9/24
Nitrite	ND	mg/L	SM 4500-NO2-B	1.0	0.01	8/2/24
Antimony	ND	mg/L	EPA200.8	0.006	0.0010	8/2/24
Arsenic	ND	mg/L	EPA200.8	0.010	0.0010	8/2/24
Barium	0.0566	mg/L	EPA200.8	2.0	0.0010	8/2/24
Beryllium	ND	mg/L	EPA200.8	0.004	0.0010	8/2/24
Cadmium	ND	mg/L	EPA200.8	0.005	0.0010	8/2/24
Chromium	0.0024	mg/L	EPA200.8	0.1000	0.0010	8/2/24
Copper	ND	mg/L	EPA200.8	1.3*** (AL)	0.0010	8/5/24
Fluoride	0.2	mg/L	SM21 4500F-C	4.0	0.1	8/1/24
Lead	ND	mg/L	EPA200.8	0.015*** (AL)	0.0010	8/5/24
Mercury	ND	mg/L	SM21 3112B	0.002	0.0002	8/4/24
Nickel	ND	mg/L	EPA200.8	---	0.0010	8/2/24
Selenium	ND	mg/L	EPA200.8	0.05	0.0010	8/2/24
Sodium	25	mg/L	SM3111B	---	5.0	8/5/24
Thallium	ND	mg/L	EPA200.8	0.002	0.0010	8/2/24
E. Volatile Organic Compounds:						
Benzene	ND	ug/L	EPA524.2	5	0.50	8/13/24
Bromobenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Bromochloromethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
Bromodichloromethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
Bromoform	ND	ug/L	EPA524.2	---	1.0	8/13/24
Bromomethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
tert-Butylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
sec-Butylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
n--Butylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Carbon Tetrachloride	ND	ug/L	EPA524.2	5	0.50	8/13/24
Chlorobenzene	ND	ug/L	EPA524.2	100	0.50	8/13/24
Chloroethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
Chloroform	ND	ug/L	EPA524.2	---	0.50	8/13/24
Chloromethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
2-Chlorotoluene	ND	ug/L	EPA524.2	---	0.50	8/13/24
4-Chlorotoluene	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,2-Dibromo-3-Chloropropane	ND	ug/L	EPA524.2	---	5.0	8/13/24
Dibromochloromethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,2-Dibromoethane (EDB)	ND	ug/L	EPA524.2	---	0.50	8/13/24
Dibromomethane	ND	ug/L	EPA524.2	5	0.50	8/13/24
1,2-Dichlorobenzene	ND	ug/L	EPA524.2	600	0.50	8/13/24
1,3-Dichlorobenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,4-Dichlorobenzene	ND	ug/L	EPA524.2	75	0.50	8/13/24
Dichlorodifluoromethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,1-Dichloroethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,2-Dichloroethane	ND	ug/L	EPA524.2	5	0.50	8/13/24
cis-1,2-Dichloroethene	ND	ug/L	EPA524.2	70	0.50	8/13/24
trans-1,2-Dichloroethene	ND	ug/L	EPA524.2	100	0.50	8/13/24
1,1-Dichloroethene	ND	ug/L	EPA524.2	7	0.50	8/13/24
1,2-Dichloropropane	ND	ug/L	EPA524.2	5	0.50	8/13/24
1,3-Dichloropropane	ND	ug/L	EPA524.2	---	0.50	8/13/24

Parameter	Result	Units	Method	MCL	Report Limit	Analysis Date
2,2-Dichloropropane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,1-Dichloropropene	ND	ug/L	EPA524.2	---	0.50	8/13/24
cis-1,3-Dichloropropene	ND	ug/L	EPA524.2	---	0.50	8/13/24
trans-1,3-Dichloropropene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Ethylbenzene	ND	ug/L	EPA524.2	700	0.50	8/13/24
Hexachlorobutadiene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Isopropylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
4-Isopropyltoluene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Methylene Chloride	ND	ug/L	EPA524.2	---	0.50	8/13/24
Methyl-t-butyl ether	ND	ug/L	EPA524.2	---	0.50	8/13/24
Napthalene	ND	ug/L	EPA524.2	---	0.50	8/13/24
n-Propylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Styrene	ND	ug/L	EPA524.2	100	0.50	8/13/24
1,1,1,2-Tetrachloroethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,1,2,2-Tetrachloroethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
Tetrachloroethene	ND	ug/L	EPA524.2	5	0.50	8/13/24
Toluene	ND	ug/L	EPA524.2	1000	0.50	8/13/24
1,2,3-Trichlorobenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,2,4-Trichlorobenzene	ND	ug/L	EPA524.2	70	0.50	8/13/24
1,1,1-Trichloroethane	ND	ug/L	EPA524.2	200	0.50	8/13/24
1,1,2-Trichloroethane	ND	ug/L	EPA524.2	5	0.50	8/13/24
Trichloroethene	ND	ug/L	EPA524.2	5	0.50	8/13/24
Trichlorofluoromethane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,2,3-Trichloropropane	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,2,4-Trimethylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
1,3,5-Trimethylbenzene	ND	ug/L	EPA524.2	---	0.50	8/13/24
Vinyl Chloride	ND	ug/L	EPA524.2	2	0.50	8/13/24
o-Xylene	ND	ug/L	EPA524.2	---	0.50	8/13/24
m,p-Xylenes	ND	ug/L	EPA524.2	---	1.0	8/13/24
G. Radiologicals:						
Gross Alpha	ND	pCi/L	EPA900.0	15	2.583	8/13/24
Radium – 226	ND	pCi/L	EPA 903.0	Combined 5 pCi/L	0.47	9/4/24
Radium – 228	ND	pCi/L	EPA 904.0		0.59	8/21/24

Notes:

1. ND: Not Detected
2. Bacteriological analysis of this sample indicates that it is **safe/unsafe** for human consumption.
3. Maximum Contaminant Level (MCL) Type –

   EPA Primary Maximum Contaminant Level: The highest level of contaminant that is allowed in drinking water. Primary MCL's are enforceable standards. Results that exceed the Primary MCL will be in **BOLD**.

   ****EPA (SMCL) Secondary Maximum Contaminant Level**: Non-enforceable guidelines regulating contaminants that cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste or odor) in drinking water.

   *****(AL) Action Level**: Defined in treatment techniques which are required processes intended to reduce the level of a contaminant in drinking water.

   ***** **MD Well Regulations** - See Code of Maryland Regulations (COMAR) 26.04.04.16E(5).
4. VOC's analyzed by lab #179; Radium analyzed by Lab #331, all other analysis by Lab #214.
5. SM - Greenberg, Clesceri and Eaton, *Standard Methods for the Examination of Water and Wastewater* 20th ed, except where noted as SM21 then 21st ed.

Reported by,

T. Davis

T. Davis, Customer Service

MARYLAND DEPARTMENT OF THE ENVIRONMENT

WATER SUPPLY PROGRAM

1800 Washington Blvd. Baltimore, MD 21230
(410) 537-3729 (800) 633-6101ext. 3729 http://www.mde.maryland.gov

INORGANIC SELF-MONITORING REPORT

SAMPLED FOR COMPLIANCE: (YES/NO) Yes ☒ No ☐

PWSID: MD [ ][ ][ ] - [ ][ ][ ][ ] SYSTEM NAME: Smallwood Park COUNTY CH

LAB SAMPLE ID: ACS2408-02

SAMPLE TYPE (Choose One): ROUTINE ☐ REPEAT ☐ SPECIAL ☒ CONFIRMATION ☐

SAMPLE POINT ID* [W][L][ ][ ] SAMPLE LOCATION Sample Tap

SAMPLE SITE ADDRESS

COLLECTION DATE 8/1/24 TIME 0845

LAB CERT#: 214 LABORATORY Water Testing Labs of MD, Inc PHONE 410-643-7711

SAMPLER ID SAMPLER NAME L. Montgomery-AC Schultes PHONE

REMARKS:

Analyte Name	Analyte Code	MCL (mg/l)	Result (mg/l)	Reporting Level (mg/l)	Method Code	Analysis Date
Nitrate	1040	10	ND	0.5	EPA 353.2	8/9/24
Nitrite	1041	1	ND	0.01	SM4500-NO2	8/2/24
Nitrate+Nitrite	1038	10				
Antimony	1074	0.006	ND	0.0010	EPA 200.8	8/2/24
Arsenic	1005	0.010	ND	0.0010	EPA 200.8	8/2/24
Barium	1010	2	0.0566	0.0010	EPA 200.8	8/2/24
Beryllium	1075	0.004	ND	0.0010	EPA 200.8	8/2/24
Cadmium	1015	0.005	ND	0.0010	EPA 200.8	8/2/24
Chromium	1020	0.1	0.0024	0.0010	EPA 200.8	8/2/24
Cyanide	1024	0.2				
Fluoride	1025	4.0	0.2	0.1	SM 4500-F-C	8/1/24
Mercury	1035	0.002	ND	0.0002	SM 3112B	8/4/24
Nickel	1036	------	ND	0.0010	EPA 200.8	8/2/24
Selenium	1045	0.05	ND	0.0010	EPA 200.8	8/2/24
Sodium	1052	----	25	5.0	SM 3111B	8/5/24
Thallium	1085	0.002	ND	0.0010	EPA 200.8	8/2/24
Unregulated						
Sulfate	1055					

ND – Not Detected

* SAMPLE POINT ID: For water treatment plants: TP + Plant ID (example:TP01)
For source/raw water well: WL+ Source ID (example: WL01)
For reservoir: RS + Source ID (example: RS01)

I do hereby affirm that this record contains no willful misrepresentations or falsifications and that this information given by me is true to the best of my knowledge and belief. I further certify that the methods and quality control measures used to produce these laboratory results were implemented in accordance with the requirements of this laboratory's certification under COMAR 26.08.05.

T. Davis

SIGNED _____ DATE 8/13/24

Mail to:

MARYLAND DEPARTMENT OF THE ENVIRONMENT

WATER SUPPLY PROGRAM

1800 Washington Blvd., STE. 450, Baltimore, Maryland 21230-1708
(410) 537-3729 (800) 633-6101 ext. 3729 http://www.mde.state.md.us

VOLATILE ORGANIC SELF-MONITORING REPORT

PWSID_____SYSTEM NAME__Smallwood Park___COUNTY____CH_____

PLANT ID_____PLANT NAME_____

SAMPLE SITE ADDRESS_____Well Tag #: CH-88-0494_____

SAMPLE TYPE: RAW___X_ FINISHED_____SAMPLE LOCATION (well, sample tap, sink, etc.)_Sample Port___

DATE COLLECTED__8/1/24____TIME__0845_____

SAMPLER ID_____SAMPLER NAME__L. Montgomery of AC Schultes__PHONE__410-643-7711_____

LAB CERT#:__214__LABORATORY__Water Testing Labs of MD, Inc____ PHONE_____410-643-7711_____

LAB SAMPLE ID_ACS2408-02__DATE RECEIVED__8/1/24___ REPORTED____9/17/24__EPA TEST METHOD_524.2_____

REMARKS:___Analyzed by lab # 179_____

CONTAMINANT	EPA ID	MCL ppb	ACTUAL LEVEL(ppb)
REGULATED			
Benzene	2990	5	<0.50
Carbon Tetrachloride	2982	5	<0.50
o-Dichlorobenzene	2968	600	<0.50
p-Dichlorobenzene	2969	75	<0.50
1,2-Dichloroethane	2980	5	<0.50
1,1-Dichloroethene	2977	7	<0.50
cis-1,2-Dichloroethene	2380	70	<0.50
trans-1,2-Dichloroethene	2979	100	<0.50
Dichloromethane	2964	5	<0.50
1,2-Dichloropropane	2983	5	<0.50
Ethylbenzene	2992	700	<0.50
Monochlorobenzene	2989	100	<0.50
Styrene	2996	100	<0.50
Tetrachloroethene (PCE)	2987	5	<0.50
Toluene	2991	1000	<0.50
1,2,4-Trichlorobenzene	2378	70	<0.50
1,1,1-Trichloroethane	2981	200	<0.50
1,1,2-Trichloroethane	2985	5	<0.50
Trichloroethene (TCE)	2984	5	<0.50
Vinyl Chloride	2976	2	<0.50
Xylenes (Total)	2955	10000	<1.0
TRIHALOMETHANES			
Bromodichloromethane	2943		<0.50
Bromoform	2942		<1.0
Chloroform	2941		<0.50
Dibromochloromethane	2944		<0.50

CONTAMINANT	EPA ID	ACTUAL LEVEL(ppb)
UNREGULATED		
Chloromethane	2210	<0.50
Bromobenzene	2993	<0.50
Bromochloromethane	2430	<0.50
Bromomethane	2214	<0.50
n-Butylbenzene	2422	<0.50
Sec-butylbenzene	2428	<0.50
Tert-butylbenzene	2426	<0.50
Chloroethane	2216	<0.50
o-Chlorotoluene	2965	<0.50
p-Chlorotoluene	2966	<0.50
m-Dichlorobenzene	2967	<0.50
Dibromomethane	2408	<0.50
1,1-Dichloroethane	2978	<0.50
1,3-Dichloropropane	2412	<0.50
2,2-Dichloropropane	2416	<0.50
1,1-Dichloropropene	2410	<0.50
1,3-Dichloropropene	2413	<1.0
Dichlorodifluoromethane	2212	<0.50
Hexachlorobutadiene	2246	<0.50
Isopropylbenzene	2994	<0.50
p-Isopropyltoluene	2030	<0.50
MTBE	2251	<0.50
Naphthalene	2248	<0.50
n-Propylbenzene	2998	<0.50
1,1,1,2-Tetrachloroethane	2986	<0.50
1,1,2,2-Tetrachloroethane	2988	<0.50
1,2,3-Trichlorobenzene	2420	<0.50
Trichlorofluoromethane	2218	<0.50
1,2,3-Trichloropropane	2414	<0.50
1,2,4-Trimethylbenzene	2418	<0.50
1,3,5-Trimethylbenzene	2424	<0.50
m,p-xylenes	2995	<1.0
o-xylene	2997	<0.50

MCL - Maximum Contaminant Level
NT - Not Tested
ppb - parts per billion (micrograms per liter)

I do hereby certify that this record contains no willful misrepresentations or falsifications and that this information given by me is true to the best of my knowledge and belief. I further certify that the methods and quality control measures used to produce these laboratory results were implemented in accordance with the requirements of this laboratory's certification under COMAR 26.08.05.

T. Davis

SIGNED_____**DATE**_____**9/17/24**_____

Keystone
Preservation
Group

Historic Preservation
Architectural Conservation

Christopher Frey, Principal
Elizabeth Lissy Covolus, Associate

Characterization/Analysis of Historic Mortar
Grinder House: Charles County, MD

March 14, 2019

Keystone Preservation Group
P.O. Box 831
Doylestown, PA 18901
215.348.4919

www.keystonepreservation.com

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Project Team

Project: Grinder House: Charles County, MD

Conservator: Keystone Preservation Group:
Christopher Frey, Principal Conservator

Characterization/Analysis of Historic Mortars

Introduction
The intent of mortar characterization/analysis is to provide information that will be useful in understanding the history of a building and also to provide insight into materials which could be appropriate for repair or restoration campaigns. For this project, Keystone Preservation Group was provided with three mortar samples from the Grinder House in Charles County, MD (1868), the following of which was taken from the interior of the wall and which was deemed most representative of what would likely have been used historically:

- Sample 01: Historic mortar

Replication
Pursuant to conversations with Barton Ross, Keystone Preservation recommended the use of a Natural Hydraulic Lime-based binder (NHL) for repointing. NHL a traditional building material which offers certain advantages over non-hydraulic lime materials, lime-cement hybrids and cement-based materials. Whereas materials based on slaked lime putty or dolomitic lime cure with a process of carbonation over extended periods of time, NHL achieves a cure time more quickly. Additionally, materials based on NHL are typically more durable than those based on lime putty, yet are also more flexible and more vapor-permeable than lime-cement hybrids or cementitious materials.

It was determined that the mortar could be replicated without the use of pigment. When mixed in the field, pigmented mixes can sometimes vary in color given that each "batch" of repointing mortar requires that pigments be carefully weighed and added into the mortar mix. Based on these factors (multiple mortars, necessity of pigment, and variability of field mixes), Keystone recommended that the historic mortar be matched with pre-blended stock mix which to which pigment has already been added and which is available in controlled, standard formulation. The match which was selected is a pre-mixed, pigmented NHL stock mortar produced by Limeworks.us. It is a very close, but not exact match for the historic mortar; however, Keystone believes that the very slight color difference will be indiscernible from the historic mortar when viewed by 25 feet (a distance which is typically deemed acceptable for architectural projects. Furthermore, the use of a stock, pre-mixed, materially appropriate mortar will not only facilitate installation in the field, but will also be more cost-effective than a custom mix.

Replication discs were mixed and cured within a controlled interior environment with ambient temperature and humidity. Noting that factors such as temperature, humidity, moisture content, tooling and conditions with the surrounding masonry can impact the final appearance of any material, Keystone strongly recommends that mock-ups be installed within the wall surface and allowed to cure in accordance with standard practice for a minimum of 7 days before being evaluated. Pursuant to project specifications or specific direction from an Architect/Engineer, standard repair practice includes the following:

- Properly raking out joints which are to be repointed, typically to a depth of 2–2½ times the width of the joint (depending on the type of existing joint). Cleaning joints so that they are free of dirt, mold and debris. Joint-cutting should not damage the surrounding masonry.
- Stabilizing backup/bedding mortar.
- Backpointing, if required.
- Combining pointing materials (NHL and screened inclusions if desired) and water in sufficient measure to achieve a plastic, trowelable consistency.
- Pre-wetting joints and allowing them to dry to a damp condition (no pooling water).
- Installing pointing mortar in lifts to avoid shrinkage (if specified).
- Tooling pointing mortar to match the profile of the surrounding joints.

- Maintaining pointing mortar in a damp condition for a period of 72 to 96 hours after installation, the intent being to avoid rapid drying which can result in both shrinkage cracks and lower resistance to weathering.
- Pre-wetting the surface of the joint again before brushing with a nylon brush to expose aggregate, then rinsing with low pressure water spray to remove dust. Note that for this project, replication discs were allowed to cure for a period of 72 hours at room temperature before brushing and rinsing; conditions in the field may vary.
- Final clean up.

In the summary that follows, NHL refers to www.limeworks.us DGM 025 with inclusions (pre-mixed, pigmented, sanded mortar based on St. Astier's Natural Hydraulic Lime).

Matching the mortar discussed herein will require that the masonry contractor carefully weigh, mix and cure all of the component parts.

Summary of Findings

Sample 01: Historic mortar

The physical properties and reactive characteristics of this mortar are consistent with what would be expected from a mix based on lime, sand and clay and brick dust – with an approximate ratio of 2 parts binder (lime and clay) and 5 parts aggregate (sand).

- Color: The core color of this mortar is *very pale brown* (Munsell 10YR 8/2-8/3), a shade which can be attributed to the combination of lime (white), sand (light reddish brown) and clay (light brown-reddish brown).
- Hardness: Traditional mortars which are based primarily or completely on lime tend to be softer and much easier to crush than those which are based on cement or a combination of lime and cement. This mortar requires minimal impact to crush and further pulverize – a characteristic which is consistent with what might be expected from a binder based on lime putty with clay. It is not known whether clay was added to the mix, or included as part of the original sand component.
- Reactivity: When reacted with hydrochloric acid, this mortar produced a substantial evolution of carbon dioxide – the volume of which suggests a binder based primarily on lime.



Grinder House (photo provided by Barton Ross).



Photomicrograph of bulk sample and replication disc (10x magnification in reflected light).

Noting that mock-ups will be required to confirm acceptability in the field, the following mix may be considered a starting point to replicate the appearance of the historic mortar:

Replication mix
Limeworks DGM 025 (stock mix available from Limeworks.us, 215-536-6706)

It is recommended that the replication disc produced by Keystone Preservation be evaluated on site and, if deemed acceptable, mock-ups would then proceed.



Bulk sample of historic mortar (left) and replication disc (right). Left half of disc has been brushed to expose aggregate, while right half represents a freshly-struck surface.

(right).

The replication disc produced by Keystone's laboratory is considered a *close* match for the color and texture of the samples which were analyzed. It was misted periodically for 72 hours, allowed to dry thoroughly at room temperature, and then dry-brushed with a nylon brush to expose aggregate and rinsed afterwards. Similar procedures, especially brushing, will be required to reproduce this characteristic in the field. Factors including water content, in-wall moisture content, permeability of the surrounding masonry, and weather conditions during installation and cure all impact the final color of any mortar. Industry standards for preparation, mixing, installation and temperature during cure should all be monitored.

When evaluated at the Limeworks facility, the historic mortar was a nearly-exact match for DGM 025; however, laboratory mixes were very slightly lighter in color. However, Keystone believes that the color of the aforementioned replication mortar should be indiscernible from the existing mortar (cleaned) when viewed at a distance of 25 feet, which is the industry standard by which mortar matches are typically judged. Slight adjustments may be required depending on conditions in the field (e.g. in-wall moisture levels, exposure).

Methodology

The primary objective of this document is to provide direction for repair and repointing; it should not be considered a comprehensive technical/compositional analysis of existing/historic material. With direction from an architectural conservator and execution by an experienced masonry preservation contractor, the level of examination provided herein was deemed sufficient to provide basic information on the existing mortar and direction on how to match important characteristics such as color and texture.

Each specimen was examined according to properties of color, texture, hardness, homogeneity, stability and relative porosity. Samples were examined visually and microscopically with a Nikon SMZ-2T trinocular reflected light microscope and/or a Leica DMLM polarizing light microscope.

The approximate composition of the material was determined with a calcimeter conforming to the parameters of the Jedrzejewska analytical method.[1] This technique essentially breaks down a sample into constituent parts and provides data on the nature of the binder by gauging the extent of its reaction with hydrochloric acid (HCl). As HCl dissolves bicarbonates of calcium carbonate-based ($CaCO_3$) compounds found in lime and (to a lesser extent) cement binders, carbon dioxide (CO_2) is produced.[2] Data obtained during experimentation was compared with published experimental standards based on known mixes to arrive at conclusions about the composition of all samples.[3] Aggregate which forms the insoluble portion of the material was isolated, retained and washed, while extremely fine particulates were separated from solution, filtered and retained. The aggregate was dried and weighed, evaluated according to particulate size with a Standard U.S. Sieve Series Tyler Equivalent Sieve Stack, and examined microscopically for particle shape, color, opacity and mineralogy.

Petrographic analysis including examination of thin sections in transmitted polarizing light and elemental analysis would be required to identify mineral phases which are specific to different types of cementing material and to unequivocally quantify the amount of lime and/or cement present. If analysis in accordance with testing procedures described in ASTM C1324 is desired, microchemical analysis may be expanded upon with elemental analysis using techniques such as X-Ray Diffraction (XRD), petrography and/or physical characterization of thin sections using transmitted and polarized light microscopy.

[1] Hanna Jedrzejewska, "Old Mortars in Poland: A New Method of Investigation," Studies in Conservation, Volume 5, Number 4, 132-138.

[2] Calcimeter analysis provides information beyond standard gravimetric/acid digestion. Although not unequivocal and subject to interpretation, it provides data on acid-soluble portions which do not evolve carbon dioxide when reacted with HCl. This is especially important to the analysis of cementitious mortars that naturally contain complex soluble silicates which dissolve in acid but do not evolve carbon dioxide. Limitations to this analytical method include the lack of published standards on common masonry mixes and mixes which incorporate natural and artificial pigments.

[3] John Stewart and James Moore, "Chemical Techniques of Historic Mortar Analysis," Bulletin of the Association for Preservation Technology, Volume 14, Number 1 (Washington: Association for Preservation Technology, 1982), 11-16.

Compositional Characteristics

Binders

Analyzing the nature of the binder provides information valuable in determining the composition of the original material. Binders are generally composed of calcium-carbonate based materials with impurities and additives incorporated to affect physical properties such as cure, hardness, color and durability. The data below represents the percentage weight within the sample that may be attributed to calcium carbonate, complex soluble silicates (solubles, including soluble material from cements and pigments) and aggregate.

Standards referenced below[4] have been culled from previously-completed research and experimentation to provide benchmark data regarding compositional percentages for standard mixes. Although imperfect, experimental data below exists for compositional proportions based on weight only; conclusions are based on the mathematical conversion of weight percentages to volumetric mixes.

	Mix	$CaCO_3$	Solubles	Sand
1:3	lime:sand (SM)[5]	10.0 ± 0.4%	2.4 ± 0.7%	87.6 ± 0.3%
1:3	lime:calcareous sand (SM)	26.2 ± 1.3%	3.0 ± 0.9%	70.9 ± 2.2%
1:3	lime:clayey sand (SM)	10.2 ± 0.2%	13.2 ± 0.6%	76.6 ± 0.9%
2:5	hydraulic lime:clayey sand (JCF)[6]	8.78± 0.06%	17.69 ± 3.01%	73.54 ± 2.95%
2:5	dolomitic lime:clayey sand (JCF)	6.57± 0.25%	10.10 ± 0.63%	83.33 ± 0.98%
2:5	high calcium lime putty: clayey sand (JCF)	13.49 ± 1.27%	5.78 ± 1.02%	80.72 ± 2.29%
1:1:5	Portland cement: high calcium lime:clayey sand (JCF)	10.60 ± 0.87%	21.76 ± 5.99%	67.65 ± 6.87%
2:1:5	lime:pozzolanic cement:sand (SM)	11.0 ± 0.1%	6.6 ± 0.4%	82.4 ± 0.3%
100%	Portland cement (SM)	7.2 ± 0.4%	92.1 ± 0.3%	0.6 ± 0.2%
1:3	Portland cement:clayey sand (SM)	7.9 ± 0.1%	29.6 ± 1.6%	62.6 ± 1.6%
1:3	Portland cement:sand (SM)	6.4 ± 0.4%	27.4 ± 3.0%	66.2 ± 3.4%
1:3	Roman cement: sand (SM)	8.5 ± 0.6%	16.1 ± 0.2%	75.3 ± 0.4%

[4] In the chart, "SM" refers to standards published in Stewart and Moore's article and "JCF" refers to data from Frey's thesis.

[5] Total calcium carbonate content includes soluble bicarbonates from calcareous (calcium-based) aggregate such as crushed limestone or marble dust.

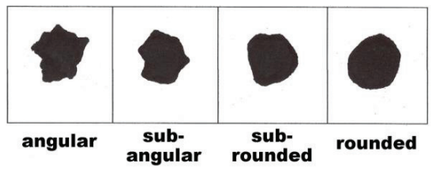
[6] Analysis performed on replication mix evaluated (five years after cure) in J. Christopher Frey *Exterior Stuccoes as an Interpretive and Conservation Asset: The Aiken-Rhett House, Charleston, SC* (Masters' Thesis in Historic Preservation, University of Pennsylvania, 1997). Please note that data is provided for comparative purposes only; actual volumetric percentages will vary based on types of lime, types of sand, mix consistency, etc.

Aggregate

Because sand is so important in determining not only how a material performs but also in producing its color and texture, a careful examination of the aggregate was conducted. Laboratory examination included visual analysis for sand grain shape and an evaluation of particle size.

Grain Shape

Sands are visually inspected with a Nikon SMZ-2T trinocular reflected light microscope at various magnifications. Roundness is a measure of the sharpness of a sand grain's corners and edges, regardless of overall shape of the particle. Sphericity is a measure of the overall shape of the sand grain which evaluates the degree to which the particle approaches the shape of a perfect sphere, which is extremely rare in nature. These physical properties are visually assessed using roundness scale charts, such as the one pictured below.



Typical grain shapes within sand components.

Particle Size

All sands were passed through a U.S. Standard Sieve Series Sieve Stack to evaluate the average distribution.[7] The sieve screens used in this analysis possess the following dimensional equivalents:

Screen #	Tyler equivalent mesh	Opening (inches)	Opening (metric)
8	8	.0937	2.36 mm
16	14	.0469	1.18 mm
30	28	.0234	600 µ
50	48	.0117	300 µ
100	100	.0059	150µ
200	200	.0029	75µ

Materials with rough surface textures tend to be based on sands whose grains are retained on the lower-numbered screens. Smoother materials are often based on finer particulates. Well-graded materials are characterized by relatively even distribution of particulates across all screens. Data reported from the sieve gradation test provides a comparative analysis for the distribution of grain sizes.

[7] Sieves are graded in a series so that particles progressively pass through a series of screens (with screen #8 representing the largest mesh and screen #200 the smallest) until they are retained. The amount of material retained on each screen is recorded and then compared with the amounts retained on other screens to provide numerical averages for different particulate sizes.

Sample 01: Historic mortar

The physical properties and reactive characteristics of this mortar are consistent with what would be expected from a mix which is based on lime, sand and clay.

Analytical Method

Calcimeter	✓
ASTM C1324	
Basic/acid digestion	✓

Binder

$CaCO_3$	~ 14.00%
Solubles	~ 11.37%
Sand	~ 74.63%



Historic mortar, core (photomicrograph, 10x magnification in color-balanced light).



Sands from historic mortar (photomicrograph, 10x magnification in color-balanced light).

Reacting this material with hydrochloric acid (HCl) produced results that are consistent with a binder based on lime and clay. A moderate evolution of carbon dioxide (CO_2), when exposed to hydrochloric acid (HCl) suggests the presence of carbonate material (CO_3), which is the principal component in lime, either as calcium carbonate (high calcium, $CaCO_3$) or calcium magnesium carbonate (dolomitic, Ca, $MgCO_3$). In this mortar, the percentage of non-evolving soluble material is moderate and can likely be attributed to soluble silicate material which is typically associated with clay. Elemental analysis and petrography would be required to confirm compositional quantities as well as to identify specific compounds and mineral phases.

Physical Properties

The unweathered core of this mortar is *very pale brown* (Munsell 10YR 8/2-8/3) – a shade which can be attributed to the presence of lime (white), sand (light reddish brown) and clay (light brown-reddish brown). Lime blebs are visible in some parts of the sample. This mortar is reasonably cohesive. As would be expected from a material with a binder based on lime putty and clay, it can be crushed with minimal impact from a mortar and pestle, and requires minimal impact to further pulverize.

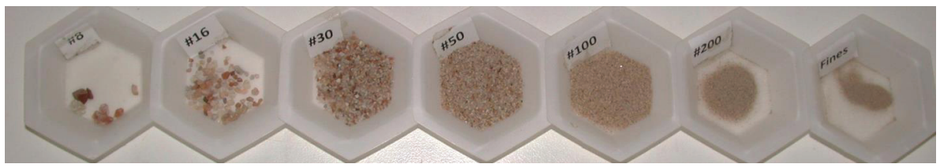
Aggregate

This is a *light reddish brown* sand which is based primarily on quartz and feldspar, with minor accessory inclusions. Particle clarity ranges from transparent to opaque. Grain shape ranges primarily from rounded to subangular, although some angular grains are present as well.

Extracted sands were recorded by weight using the sieve gradation analysis and converted to percentages of the sample. The table below documents quantitative results from sieve gradation analysis of the extracted sands from the historic mortar.

Screen Size	#8	#16	#30	#50	#100	#200	Fines
Sands (retained) %	5.22	8.70	22.63	37.34	19.77	5.06	1.27

The percentage of sand grains retained on each sieve screen are visually represented below. The grain size decreases from left to right.



APPENDIX C

CALCULATIONS

SMALLWOOD STATE PARK
GRINDER HOUSE RENOVATION

STRUCTURAL DESIGN CALCULATIONS

FINAL SUBMISSION

SEPTEMBER 27, 2024
REVISED MARCH 28, 2025

ALBRECHT ENGINEERING INC
3500 Boston Street
Suite 329 MS-12
Baltimore, MD 21224
410-522-5870

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland, License No. 23393, Expiration Date: 8/25/2026.

SMALLWOOD STATE PARK
GRINDER HOUSE RENOVATION

FINAL SUBMISSION - STRUCTURAL DESIGN CALCULATIONS

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ALBRECHT ENGINEERING INC

Project	Grinder House				
Subject	Loading			Job No.	2023-011
				Sheet No.	of
Computed By	EB	Date	7/24/2024	Checked By	Date

STRUCTURAL DESIGN LOADS

Roof Dead Load

Asphalt shingle roofing		1.0	psf
3/4" plywood sheathing		2.4	psf
Wood framing		5.0	psf
1/2" gypsum board ceiling		2.2	psf
MEP & ductwork		4.0	psf
Misc		0.4	psf
	DL =	**15.0**	psf

Roof Live Load

Typical flat roof	**LL =**	**30.0**	psf

Floor Dead Load

Wood Flooring		4.0	psf
3/4" plywood sheathing		2.4	psf
Wood framing		5.0	psf
1/2" gypsum board ceiling		2.2	psf
MEP & ductwork		4.0	psf
Misc		2.4	psf
	DL =	**20.0**	psf

Floor Live Load

Office	**LL =**	**50.0**	psf

⚠ This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

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Hazards by Location

Search Information

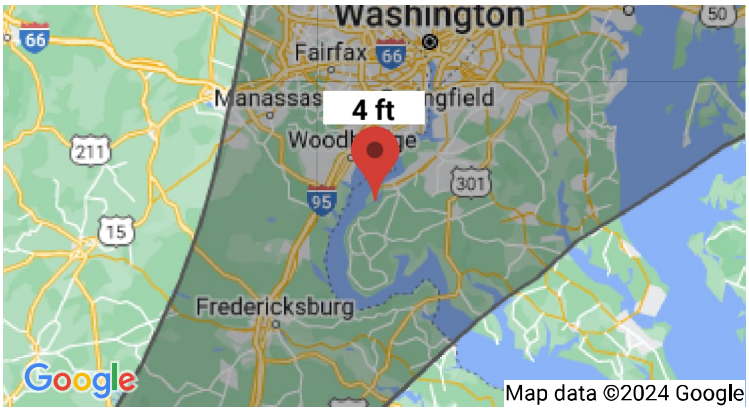
Address: 2750 Sweden Point Rd, Marbury, MD 20658, USA

Coordinates: 38.55851639999999, -77.1886293

Elevation: 4 ft

Timestamp: 2024-02-01T03:40:45.639Z

Hazard Type: Snow



ASCE 7-16	ASCE 7-10	ASCE 7-05
Ground Snow Load ---------- 25 lb/sqft	Ground Snow Load ------- 25 lb/sqft	Ground Snow Load ---------- 25 lb/sqft

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

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Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer.

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SNOW LOADING

In accordance with ASCE7-16

Tedds calculation version 1.0.10

Building details

Roof type	Hip and gable
Width of roof (left on elevation)	b_1 = **8.00** ft
Width of roof (right on elevation)	b_2 = **8.00** ft
Slope of roof (left on elevation)	α_1 = **35.00** deg
Slope of roof (right on elevation)	α_2 = **35.00** deg

Ground snow load

Ground snow load (Figure 7.2-1)	p_g = **30.00** lb/ft^2
Density of snow	$\gamma = \min(0.13 \times p_g / 1\text{ft} + 14\text{lb/ft}^3, 30\text{lb/ft}^3)$ = **17.90** lb/ft^3
Terrain typeSect. 26.7	C
Exposure condition (Table 7.3-1)	Partially exposed
Exposure factor (Table 7.3-1)	C_e = **1.00**
Thermal condition (Table 7.3-2)	All
Thermal factor (Table 7.3-2)	C_t = **1.00**
Importance category (Table 1.5-1)	II
Importance factor (Table 1.5-2)	I_s = **1.00**
Flat roof snow load (Sect 7.3)	$p_f = 0.7 \times C_e \times C_t \times I_s \times p_g$ = **21.00** lb/ft^2

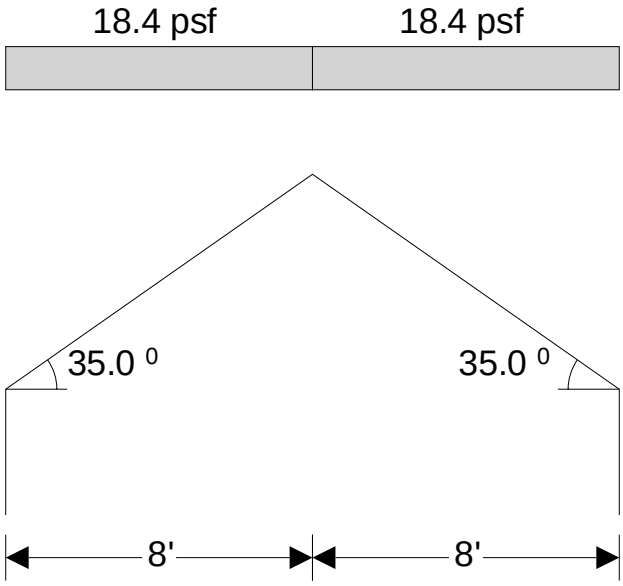
Warm roof slope factor (C_t <= 1.0)

Roof surface type	Non slippery
Ventilation	Ventilated
Thermal resistance (R-value)	R = **30.00** ^{o}F h ft^2 / Btu
Roof slope factor - left Fig 7.4-1a (solid line)	C_{s_l} = **0.88**
Roof slope factor - right Fig 7.4-1a (solid line)	C_{s_r} = **0.88**

Hip and gable roof loads

Balanced sloped snow load - left (Cl.7.4)	$p_{s_l} = C_{s_l} \times p_f$ = **18.38** lb/ft^2
Balanced sloped snow load - right (Cl.7.4)	$p_{s_r} = C_{s_r} \times p_f$ = **18.38** lb/ft^2
Slope of left roof	$S_l = 1 / \tan(\alpha_1)$ = **1.43**
Slope of right roof	$S_r = 1 / \tan(\alpha_2)$ = **1.43**

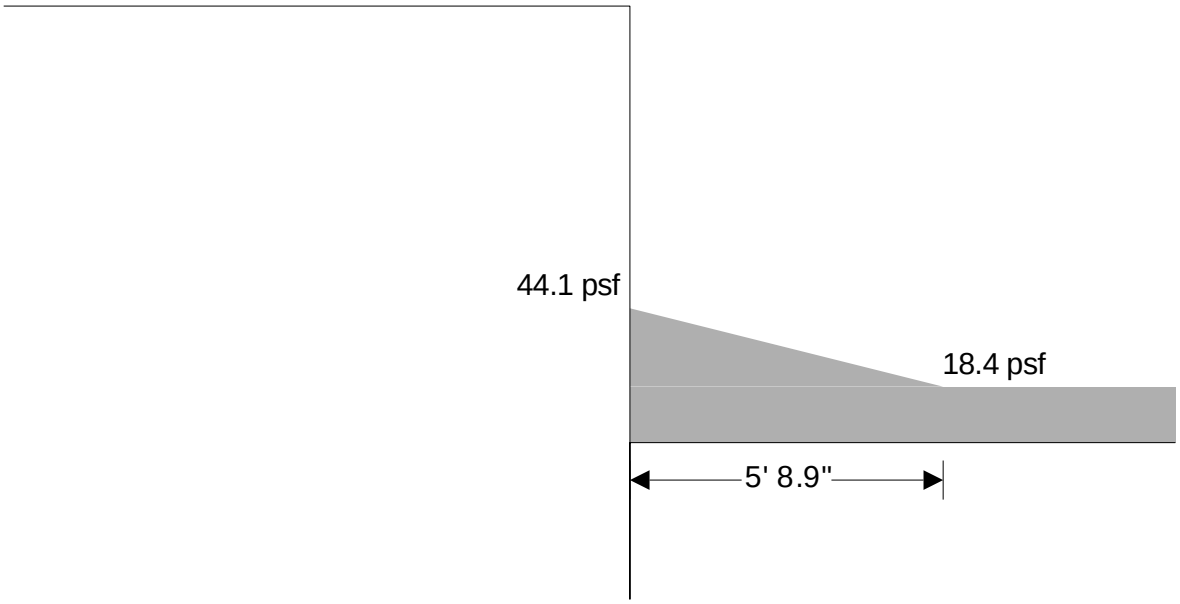
Balanced load



Roof elevation

Drift calculations

Balanced snow load height	$h_b = \max(p_{s_l}, p_{s_r}) / \gamma =$ **1.03** ft
Length of upper roof	$l_u =$ **16.00** ft
Length of lower roof	$l_l =$ **10.00** ft
Height diff between uppper and lower roofs	$h_{diff} =$ **8.00** ft
Height from balance load to top of upper roof	$h_c = h_{diff} - h_b =$ **6.97** ft
Drift height leeward drift	$h_{d_l} = \min(\sqrt{(l_s)} \times (0.43 \times (\max(20\ ft, l_u) \times 1ft^2)^{1/3} \times (p_g / 1lb/ft^2 + 10)^{1/4} - 1.5ft), 0.6 \times l_l, \sqrt{(l_s \times p_g \times l_u / (4 \times \gamma))}) =$ **1.44** ft
Drift height windward drift	$h_{d_w} = \min(0.75 \times \sqrt{(l_s)} \times (0.43 \times (\max(20\ ft, l_l) \times 1ft^2)^{1/3} \times (p_g / 1lb/ft^2 + 10)^{1/4} - 1.5ft), \sqrt{(l_s \times p_g \times l_l / (4 \times \gamma))}) =$ **1.08** ft
Maximum lw/ww drift height	$h_{d_max} = \max(h_{d_w}, h_{d_l}) =$ **1.44** ft
Drift height	$h_d = \min(h_{d_max}, h_c) =$ **1.44** ft
Drift width	$W_d = \min(4 \times h_{d_max}, 8 \times h_c) =$ **5.74** ft
Drift surcharge load	$p_d = h_d \times \gamma =$ **25.69** lb/ft^2



Elevation on snow drift

⚠ This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

ℹ The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Hazards by Location

Search Information

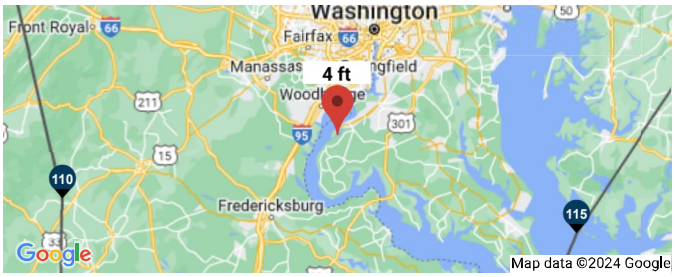
Address: 2750 Sweden Point Rd, Marbury, MD 20658, USA

Coordinates: 38.55851639999999, -77.1886293

Elevation: 4 ft

Timestamp: 2024-02-01T03:38:17.027Z

Hazard Type: Wind



ASCE 7-16

MRI 10-Year	75 mph
MRI 25-Year	81 mph
MRI 50-Year	87 mph
MRI 100-Year	94 mph
Risk Category I	103 mph
Risk Category II	111 mph
Risk Category III	119 mph
Risk Category IV	124 mph

ASCE 7-10

MRI 10-Year	76 mph
MRI 25-Year	84 mph
MRI 50-Year	90 mph
MRI 100-Year	96 mph
Risk Category I	105 mph
Risk Category II	115 mph
Risk Category III-IV	120 mph

ASCE 7-05

ASCE 7-05 Wind Speed	90 mph

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Disclaimer

Hazard loads are interpolated from data provided in ASCE 7 and rounded up to the nearest whole integer. Per ASCE 7, islands and coastal areas outside the last contour should use the last wind speed contour of the coastal area – in some cases, this website will extrapolate past the last wind speed contour and therefore, provide a wind speed that is slightly higher. NOTE: For queries near wind-borne debris region boundaries, the resulting determination is sensitive to rounding which may affect whether or not it is considered to be within a wind-borne debris region.

Mountainous terrain, gorges, ocean promontories, and special wind regions shall be examined for unusual wind conditions.

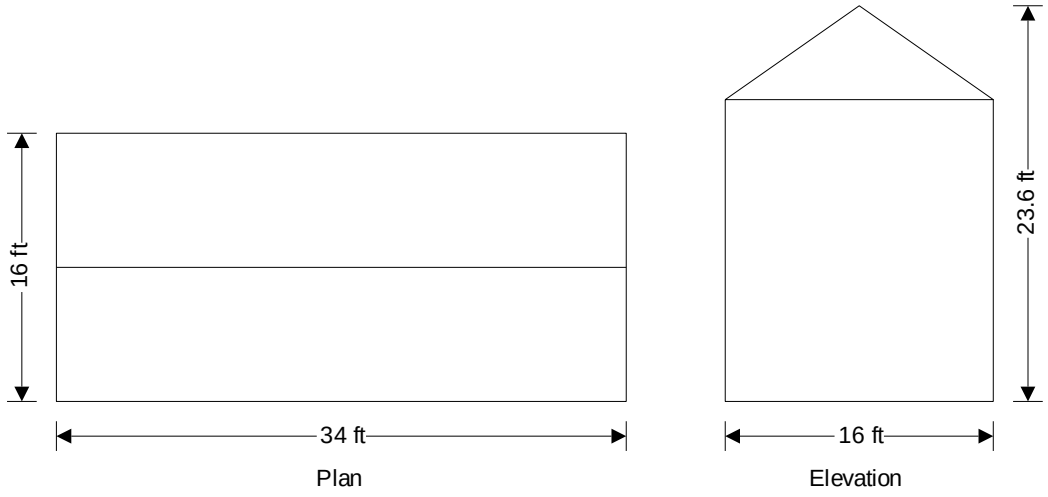
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WIND LOADING

In accordance with ASCE7-16

Using the components and cladding design method

Tedds calculation version 2.1.10



Building data

Type of roof	Gable
Length of building	b = **34.00** ft
Width of building	d = **16.00** ft
Height to eaves	H = **18.00** ft
Pitch of roof	α_0 = **35.0** deg
Mean height	h = **20.80** ft

General wind load requirements

Basic wind speed	V = **115.0** mph
Risk category	II
Velocity pressure exponent coef (Table 26.6-1)	K_d = **0.85**
Ground elevation above sea level	z_{gl} = **0** ft
Ground elevation factor	$K_e = \exp(-0.0000362 \times z_{gl}/1ft)$ = **1.00**
Exposure category (cl 26.7.3)	C
Enclosure classification (cl.26.12)	Enclosed buildings
Internal pressure coef +ve (Table 26.13-1)	GC_{pi_p} = **0.18**
Internal pressure coef –ve (Table 26.13-1)	GC_{pi_n} = **-0.18**
Gust effect factor	G_f = **0.85**

Topography

Topography factor not significant	K_{zt} = 1.0

Velocity pressure

Velocity pressure coefficient (Table 26.10-1)	K_z = **0.91**
Velocity pressure	$q_h = 0.00256 \times K_z \times K_{zt} \times K_d \times K_e \times V^2 \times 1psf/mph^2$ = **26.1** psf

Peak velocity pressure for internal pressure

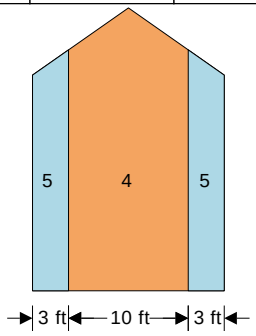
Peak velocity pressure – internal (as roof press.)	q_i = **26.08** psf

Equations used in tables

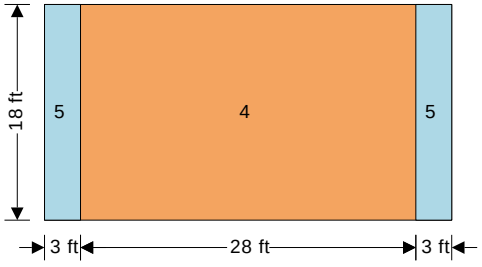
Net pressure $p = q_h \times [GC_p - GC_{pi}]$

Components and cladding pressures - Wall (Table 30.3-1)

Component	Zone	Length (ft)	Width (ft)	Eff. area (ft^2)	$+GC_p$	$-GC_p$	Pres (+ve) (psf)	Pres (-ve) (psf)
Wall panel	4	8.0	1.0	21.3	0.94	-1.04	29.3	-31.9
Wall panel	5	8.0	1.0	21.3	0.94	-1.28	29.3	-38.2
<10 sf	4	-	-	10.0	1.00	-1.10	30.8	-33.4
<10 sf	5	-	-	10.0	1.00	-1.40	30.8	-41.2



Elevation of gable wall

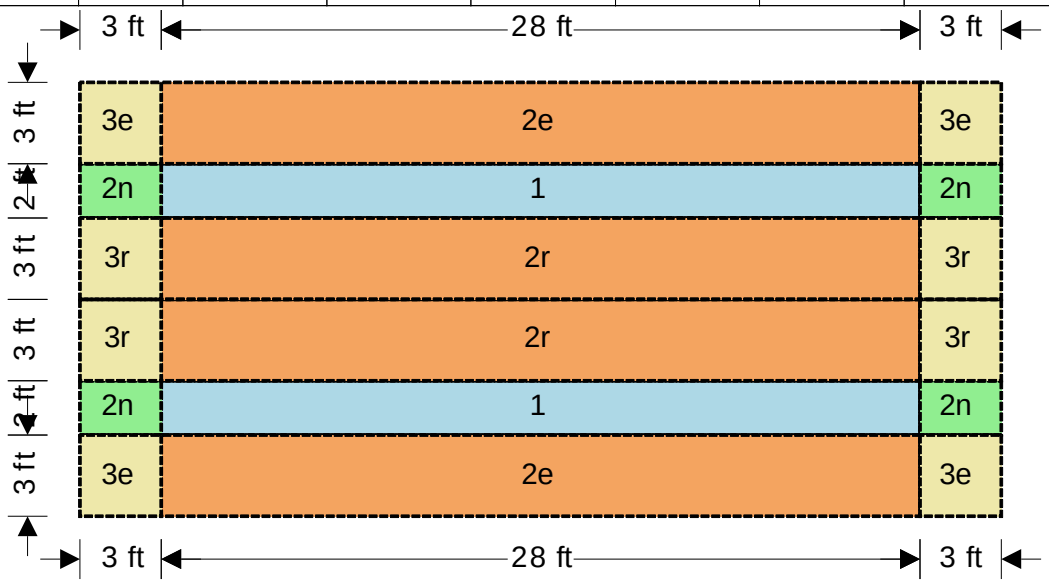


Elevation of side wall

Components and cladding pressures - Roof (Figure 30.3-2D)

Component	Zone	Length (ft)	Width (ft)	Eff. area (ft^2)	$+GC_p$	$-GC_p$	Pres (+ve) (psf)	Pres (-ve) (psf)
<=2 sf	1	-	-	2.0	0.90	-1.80	28.2	-51.6
Rafters	1	10.0	1.0	33.3	0.69	-1.28	22.7	-38.0
<=2 sf	2e	-	-	2.0	0.90	-1.80	28.2	-51.6
Rafters	2e	10.0	1.0	33.3	0.69	-1.28	22.7	-38.0
<=2 sf	2n	-	-	2.0	0.90	-2.00	28.2	-56.9
Rafters	2n	10.0	1.0	33.3	0.69	-1.60	22.7	-46.4
<=2 sf	2r	-	-	2.0	0.90	-1.80	28.2	-51.6
Rafters	2r	10.0	1.0	33.3	0.69	-1.28	22.7	-38.0
<=2 sf	3e	-	-	2.0	0.90	-3.20	28.2	-88.2
Rafters	3e	10.0	1.0	33.3	0.69	-1.96	22.7	-55.9

Component	Zone	Length (ft)	Width (ft)	Eff. area (ft^2)	+GC_p	-GC_p	Pres (+ve) (psf)	Pres (-ve) (psf)
<=2 sf	3r	-	-	2.0	0.90	-2.00	28.2	-56.9
Rafters	3r	10.0	1.0	33.3	0.69	-1.60	22.7	-46.4



Plan on roof

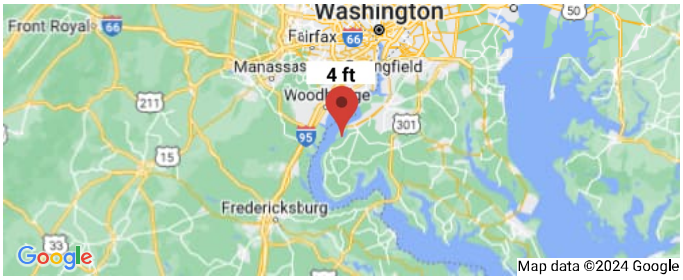
This is a beta release of the new ATC Hazards by Location website. Please contact us with feedback.

The ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

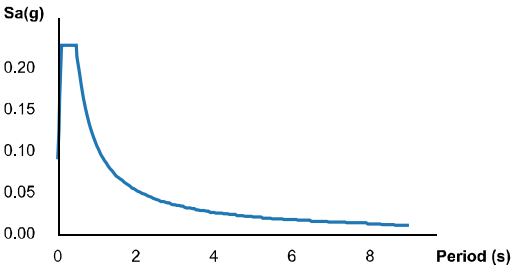
Hazards by Location

Search Information

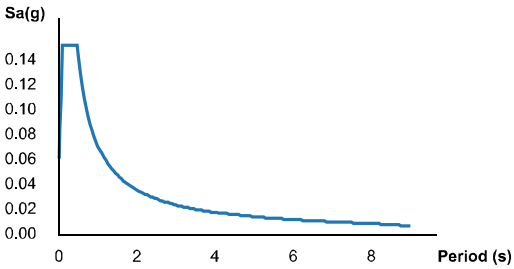
Address:	2750 Sweden Point Rd, Marbury, MD 20658, USA
Coordinates:	38.55851639999999, -77.1886293
Elevation:	4 ft
Timestamp:	2024-02-01T03:34:22.752Z
Hazard Type:	Seismic
Reference Document:	ASCE7-16
Risk Category:	II
Site Class:	D-default



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.142	MCE_R ground motion (period=0.2s)
S_1	0.045	MCE_R ground motion (period=1.0s)
S_{MS}	0.228	Site-modified spectral acceleration value
S_{M1}	0.107	Site-modified spectral acceleration value
S_{DS}	0.152	Numeric seismic design value at 0.2s SA
S_{D1}	0.071	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	B	Seismic design category
F_a	1.6	Site amplification factor at 0.2s
F_v	2.4	Site amplification factor at 1.0s
CR_S	0.935	Coefficient of risk (0.2s)
CR_1	0.923	Coefficient of risk (1.0s)
PGA	0.075	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.12	Site modified peak ground acceleration
T_L	8	Long-period transition period (s)
SsRT	0.142	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.152	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.045	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.048	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)

S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.5	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Please note that the ATC Hazards by Location website will not be updated to support ASCE 7-22. Find out why.

Disclaimer

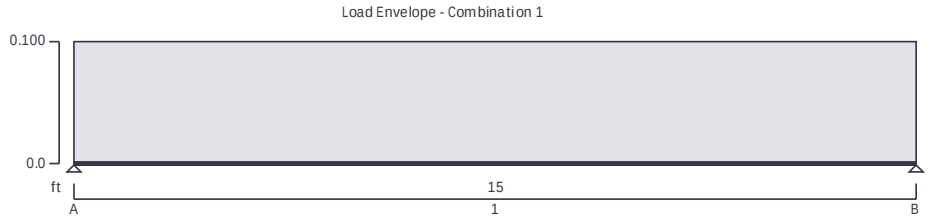
Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

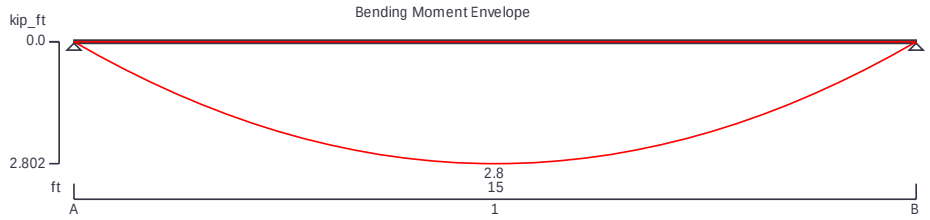
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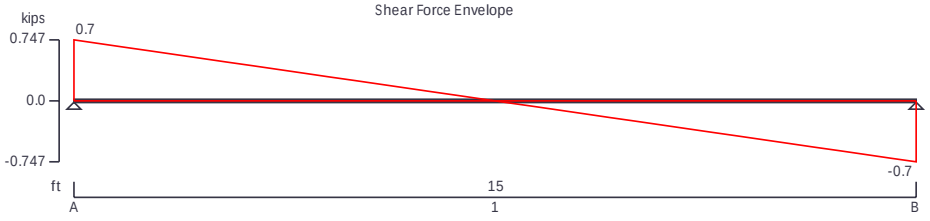
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10







Applied loading

Beam loads

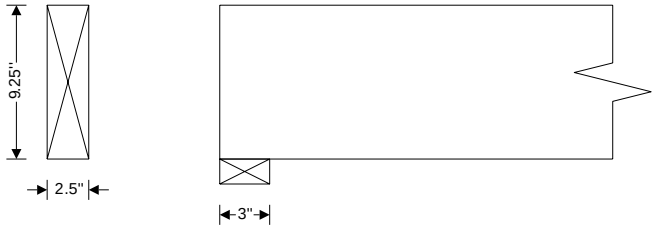
Dead self weight of beam × 1
Dead full UDL 27 lb/ft
Live full UDL 67 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
	Span 1	Dead × 1.00
		Live × 1.00
	Support B	Dead × 1.00
		Live × 1.00

Analysis results

Maximum moment	M_{max} = **2802** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **2802** lb_ft	
Maximum shear	F_{max} = **747** lb	F_{min} = **-747** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **747** lb	
Total load on member	W_{tot} = **1494** lb	
Reaction at support A	R_{A_max} = **747** lb	R_{A_min} = **747** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **245** lb	
Unfactored live load reaction at support A	R_{A_Live} = **502** lb	
Reaction at support B	R_{B_max} = **747** lb	R_{B_min} = **747** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **245** lb	
Unfactored live load reaction at support B	R_{B_Live} = **502** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **3** in
Dressed breadth of sections	b = **2.5** in
Nominal depth of sections	d_{nom} = **10** in
Dressed depth of sections	d = **9.25** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **2.5** in
Species, grade and size classification	Hem-Fir, No.1 grade, 2" & wider
Bending parallel to grain	F_b = **975** lb/in^2
Tension parallel to grain	F_t = **625** lb/in^2
Compression parallel to grain	F_c = **1350** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1500000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **550000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **93750** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **15** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	A = N × b × d = **23.12** in^2

Section modulus	$S_x = N \times b \times d^2 / 6 =$ **35.65** in^3
	$S_y = d \times (N \times b)^2 / 6 =$ **9.64** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **164.89** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **12.04** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Size factor for bending - Table 4A	$C_{Fb} =$ **1.10**
Size factor for tension - Table 4A	$C_{Ft} =$ **1.10**
Size factor for compression - Table 4A	$C_{Fc} =$ **1.00**
Flat use factor - Table 4A	$C_{fu} =$ **1.20**
Incising factor for modulus of elasticity - Table 4.3.8	
	$C_{iE} =$ **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	$C_i =$ **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	$C_{ic_perp} =$ **1.00**
Repetitive member factor - cl.4.3.9	$C_r =$ **1.15**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom}) =$ **3.33**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	$C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c_perp}' = F_{c_perp} \times C_t \times C_{ic_perp} \times C_b =$ **405** lb/in^2
Applied compression stress perpendicular to grain	$f_{c_perp} = R_{B_max} / (N \times b \times L_b) =$ **100** lb/in^2
	$f_{c_perp} / F_{c_perp}' =$ **0.246**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1233** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **943** lb/in^2
	$f_b / F_b' =$ **0.765**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress	$F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **48** lb/in^2
	$f_v / F_v' =$ **0.323**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

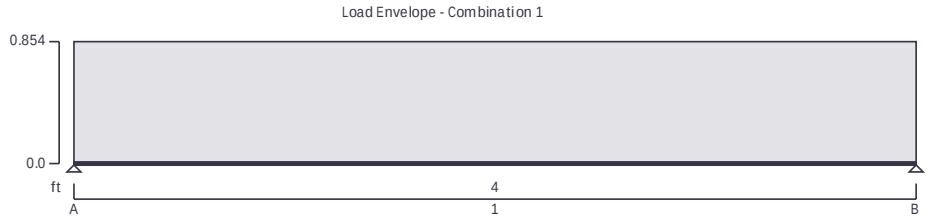
Modulus of elasticity for deflection	$E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1500000** lb/in^2
Design deflection	$\delta_{adm} = 0.0027 \times L_{s1} =$ **0.486** in
Total deflection	$\delta_{b_s1} =$ **0.459** in
	$\delta_{b_s1} / \delta_{adm} =$ **0.944**

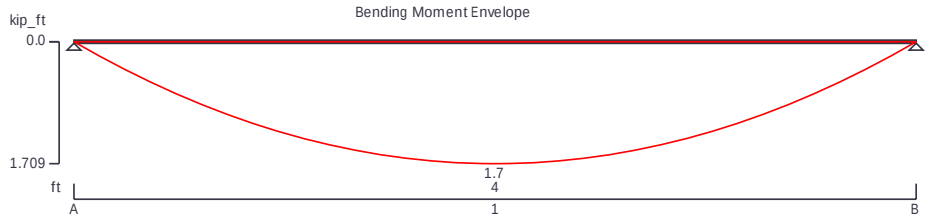
PASS - Total deflection is less than design deflection

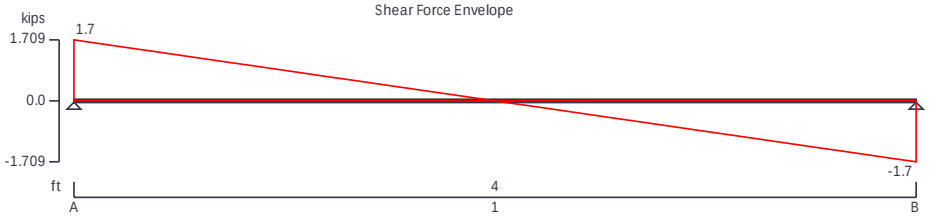
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10







Applied loading

Beam loads

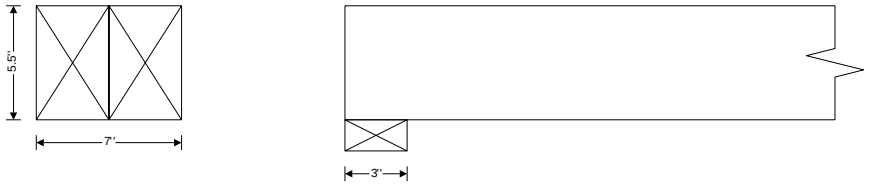
	Dead self weight of beam × 1
Floor	Dead full UDL 150 lb/ft
Floor	Live full UDL 375 lb/ft
Wall	Dead full UDL 320 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
	Span 1	Dead × 1.00
		Live × 1.00
	Support B	Dead × 1.00
		Live × 1.00

Analysis results

Maximum moment	M_{max} = **1709** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **1709** lb_ft	
Maximum shear	F_{max} = **1709** lb	F_{min} = **-1709** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **1709** lb	
Total load on member	W_{tot} = **3417** lb	
Reaction at support A	R_{A_max} = **1709** lb	R_{A_min} = **1709** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **959** lb	
Unfactored live load reaction at support A	R_{A_Live} = **750** lb	
Reaction at support B	R_{B_max} = **1709** lb	R_{B_min} = **1709** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **959** lb	
Unfactored live load reaction at support B	R_{B_Live} = **750** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **4** in
Dressed breadth of sections	b = **3.5** in
Nominal depth of sections	d_{nom} = **6** in
Dressed depth of sections	d = **5.5** in
Number of sections in member	N = **2**
Overall breadth of member	b_b = N × b = **7** in
Species, grade and size classification	Hem-Fir, No.1 grade, 2" & wider
Bending parallel to grain	F_b = **975** lb/in^2
Tension parallel to grain	F_t = **625** lb/in^2
Compression parallel to grain	F_c = **1350** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1500000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **550000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **93750** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **4** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

Section properties

Cross sectional area of member	A = N × b × d = **38.50** in^2
Section modulus	S_x = N × b × d^2 / 6 = **35.29** in^3
	S_y = d × (N × b)^2 / 6 = **44.92** in^3

Second moment of area $I_x = N \times b \times d^3 / 12 =$ **97.05** in^4

$I_y = d \times (N \times b)^3 / 12 =$ **157.21** in^4

Adjustment factors

Load duration factor - Table 2.3.2 $C_D =$ **1.00**

Temperature factor - Table 2.3.3 $C_t =$ **1.00**

Size factor for bending - Table 4A $C_{Fb} =$ **1.30**

Size factor for tension - Table 4A $C_{Ft} =$ **1.30**

Size factor for compression - Table 4A $C_{Fc} =$ **1.10**

Flat use factor - Table 4A $C_{fu} =$ **1.05**

Incising factor for modulus of elasticity - Table 4.3.8

$C_{iE} =$ **1.00**

Incising factor for bending, shear, tension & compression - Table 4.3.8

$C_i =$ **1.00**

Incising factor for perpendicular compression - Table 4.3.8

$C_{ic_perp} =$ **1.00**

Repetitive member factor - cl.4.3.9 $C_r =$ **1.00**

Bearing area factor - cl.3.10.4 $C_b =$ **1.00**

Depth-to-breadth ratio $d_{nom} / (N \times b_{nom}) =$ **0.75**

- Beam is fully restrained

Beam stability factor - cl.3.3.3 $C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain $F_{c_perp}' = F_{c_perp} \times C_t \times C_{ic_perp} \times C_b =$ **405** lb/in^2

Applied compression stress perpendicular to grain $f_{c_perp} = R_{A_max} / (N \times b \times L_b) =$ **81** lb/in^2

$f_{c_perp} / F_{c_perp}' =$ **0.201**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress $F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1268** lb/in^2

Actual bending stress $f_b = M / S_x =$ **581** lb/in^2

$f_b / F_b' =$ **0.458**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress $F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2

Actual shear stress - eq.3.4-2 $f_v = 3 \times F / (2 \times A) =$ **67** lb/in^2

$f_v / F_v' =$ **0.444**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

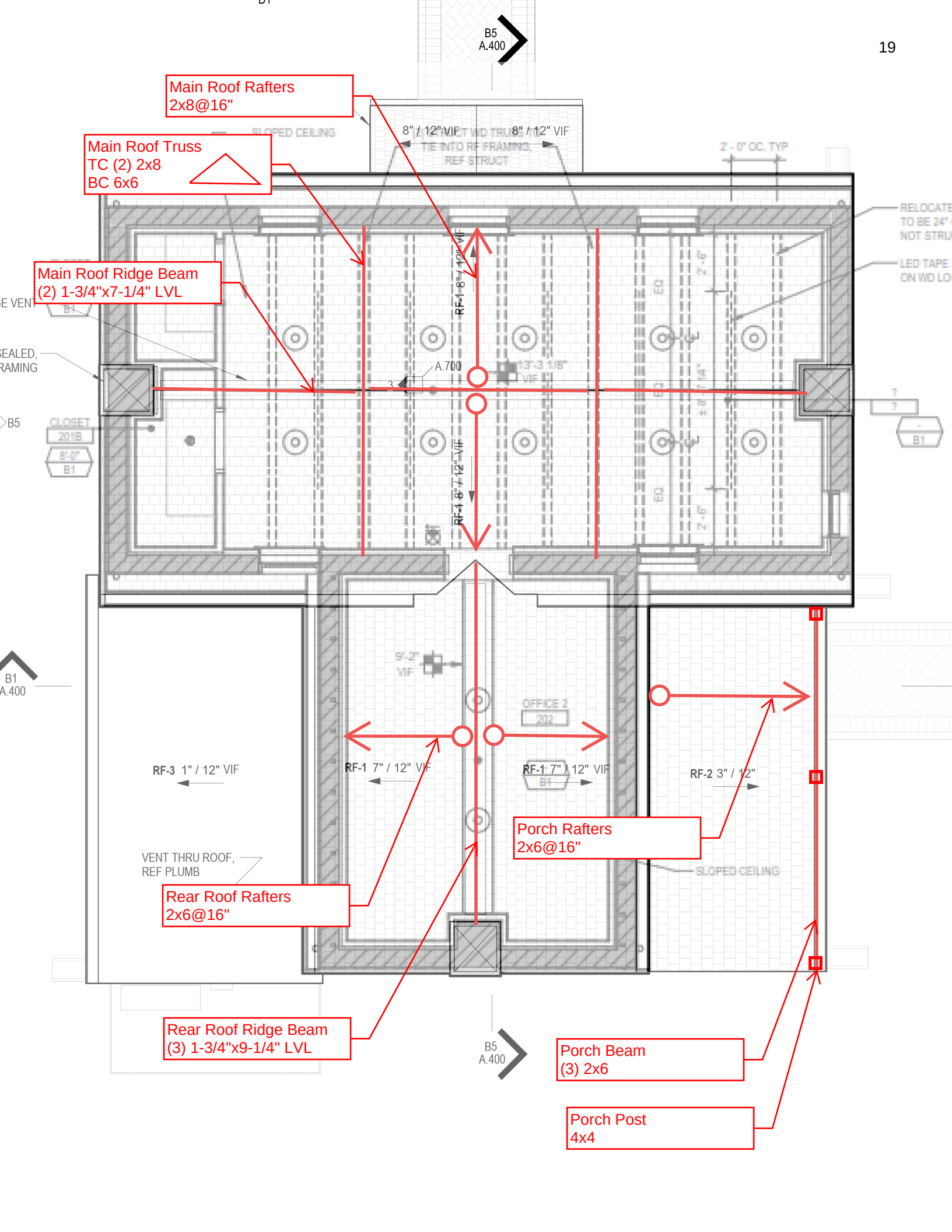
Modulus of elasticity for deflection $E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1500000** lb/in^2

Design deflection $\delta_{adm} = 0.0017 \times L_{s1} =$ **0.082** in

Total deflection $\delta_{b_s1} =$ **0.034** in

$\delta_{b_s1} / \delta_{adm} =$ **0.414**

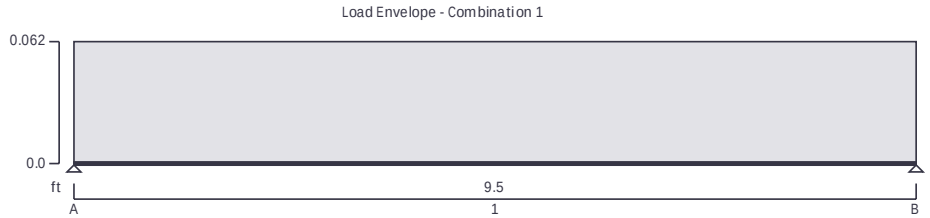
PASS - Total deflection is less than design deflection

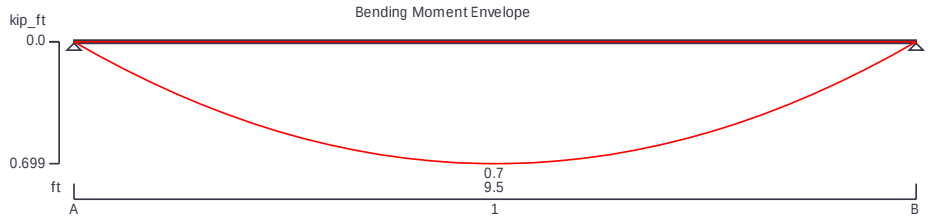

Main Roof Rafters
2x8@16"
Main Roof Truss
TC (2) 2x8
BC 6x6
Main Roof Ridge Beam
(2) 1-3/4"x7-1/4" LVL
Rear Roof Rafters
2x6@16"
Rear Roof Ridge Beam
(3) 1-3/4"x9-1/4" LVL
Porch Rafters
2x6@16"
Porch Beam
(3) 2x6
Porch Post
4x4
8" / 12" VIF
8" / 12" VIF
RF-1 8" / 12" VIF
RF-1 8" / 12" VIF
RF-3 1" / 12" VIF
RF-1 7" / 12" VIF
RF-1 7" / 12" VIF
RF-2 3" / 12"
OFFICE 2
202
SLOPED CEILING
VENT THRU ROOF,
REF PLUMB
B5
A.400
A.700
CLOSET
201B

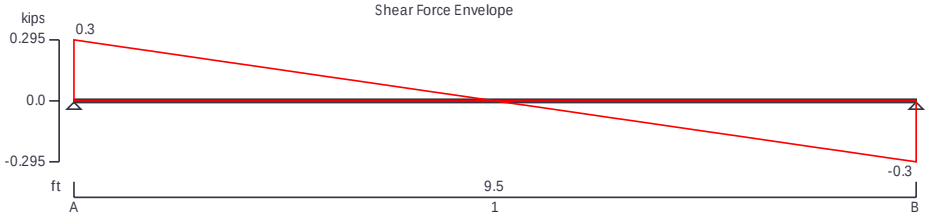
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10







Applied loading

Beam loads

Dead self weight of beam × 1
Dead full UDL 20 lb/ft
Live full UDL 40 lb/ft

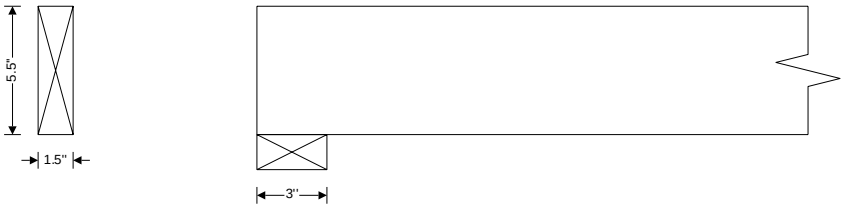
Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
		Wind × 1.00
	Span 1	Dead × 1.00
		Live × 1.00
		Wind × 1.00
	Support B	Dead × 1.00
		Live × 1.00

Wind × 1.00

Analysis results

Maximum moment	M_{max} = **699** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **699** lb_ft	
Maximum shear	F_{max} = **295** lb	F_{min} = **-295** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **295** lb	
Total load on member	W_{tot} = **589** lb	
Reaction at support A	R_{A_max} = **295** lb	R_{A_min} = **295** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **105** lb	
Unfactored live load reaction at support A	R_{A_Live} = **190** lb	
Reaction at support B	R_{B_max} = **295** lb	R_{B_min} = **295** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **105** lb	
Unfactored live load reaction at support B	R_{B_Live} = **190** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **6** in
Dressed depth of sections	d = **5.5** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **1.5** in
Species, grade and size classification	Hem-Fir, No.2 grade, 2" & wider
Bending parallel to grain	F_b = **850** lb/in^2
Tension parallel to grain	F_t = **525** lb/in^2
Compression parallel to grain	F_c = **1300** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1300000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **470000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **81250** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **9.5** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	A = N × b × d = **8.25** in^2

Section modulus	$S_x = N \times b \times d^2 / 6 =$ **7.56** in^3
	$S_y = d \times (N \times b)^2 / 6 =$ **2.06** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **20.80** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **1.55** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Size factor for bending - Table 4A	$C_{Fb} =$ **1.30**
Size factor for tension - Table 4A	$C_{Ft} =$ **1.30**
Size factor for compression - Table 4A	$C_{Fc} =$ **1.10**
Flat use factor - Table 4A	$C_{fu} =$ **1.15**
Incising factor for modulus of elasticity - Table 4.3.8	
	$C_{iE} =$ **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	$C_i =$ **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	$C_{ic_perp} =$ **1.00**
Repetitive member factor - cl.4.3.9	$C_r =$ **1.15**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom}) =$ **3.00**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	$C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c_perp}' = F_{c_perp} \times C_t \times C_{ic_perp} \times C_b =$ **405** lb/in^2
Applied compression stress perpendicular to grain	$f_{c_perp} = R_{B_max} / (N \times b \times L_b) =$ **65** lb/in^2
	$f_{c_perp} / F_{c_perp}' =$ **0.162**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1271** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **1110** lb/in^2
	$f_b / F_b' =$ **0.873**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress	$F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **54** lb/in^2
	$f_v / F_v' =$ **0.357**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection	$E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1300000** lb/in^2
Design deflection	$\delta_{adm} = 0.0042 \times L_{s1} =$ **0.479** in
Total deflection	$\delta_{b_s1} =$ **0.420** in
	$\delta_{b_s1} / \delta_{adm} =$ **0.878**

PASS - Total deflection is less than design deflection

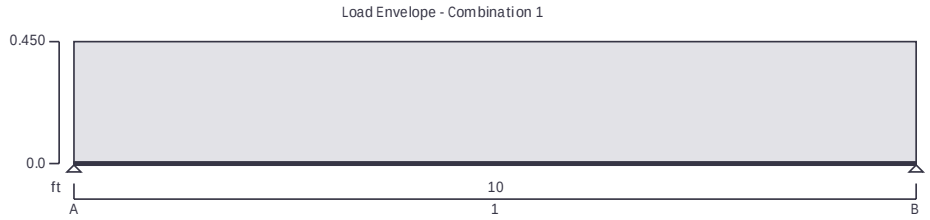
Albrecht Engineering, Inc.
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224

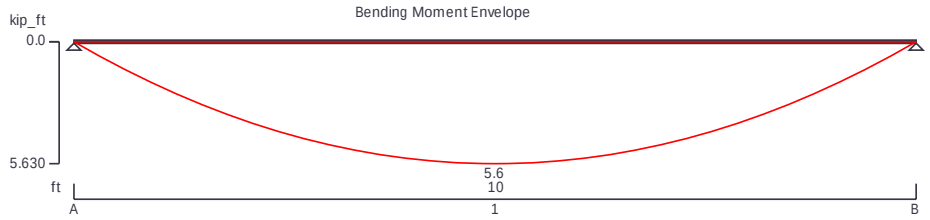
Project				Job Ref.	23
Grinder House				2023-011	
Section				Sheet no./rev.	
Main Roof Rafters				4	
Calc. by	Date	Chk'd by	Date	App'd by	Date
EB	7/25/2024				

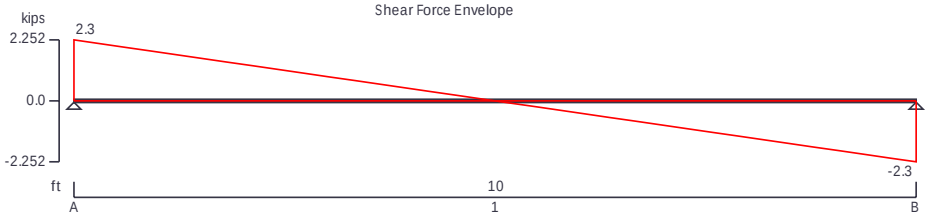
STRUCTURAL COMPOSITE LUMBER MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10







Applied loading

Beam loads

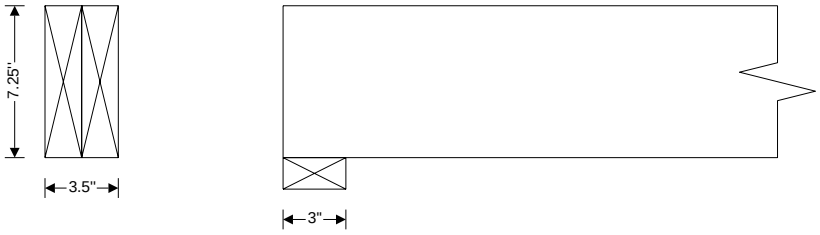
Dead self weight of beam × 1
Dead full UDL 158 lb/ft
Live full UDL 285 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
	Span 1	Dead × 1.00
		Live × 1.00
	Support B	Dead × 1.00
		Live × 1.00

Analysis results

Maximum moment	M_{max} = **5630** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **5630** lb_ft	
Maximum shear	F_{max} = **2252** lb	F_{min} = **-2252** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **2252** lb	
Total load on member	W_{tot} = **4504** lb	
Reaction at support A	R_{A_max} = **2252** lb	R_{A_min} = **2252** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **827** lb	
Unfactored live load reaction at support A	R_{A_Live} = **1425** lb	
Reaction at support B	R_{B_max} = **2252** lb	R_{B_min} = **2252** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **827** lb	
Unfactored live load reaction at support B	R_{B_Live} = **1425** lb	



Composite section details

Breadth of composite section	b = **1.75** in
Depth of composite section	d = **7.25** in
Number of composite sections in member	N = **2**
Overall breadth of composite member	b_b = N × b = **3.5** in
Composite type and grade	Microllam LVL, 2.0E-2600Fb grade
Bending parallel to grain	F_b = **2600** lb/in^2
Tension parallel to grain	F_t = **1555** lb/in^2
Compression parallel to grain	F_c = **2510** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **750** lb/in^2
Shear parallel to grain	F_v = **285** lb/in^2
Modulus of elasticity	E = **2000000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **1017000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **125000** lb/in^2
Average density	ρ = **42** lb/ft^3

Member details

Service condition	**Dry**
Length of span	L_{s1} = **10** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

Section properties

Cross sectional area of member	A = N × b × d = **25.37** in^2
Section modulus	S_x = N × b × d^2 / 6 = **30.66** in^3
	S_y = d × (N × b)^2 / 6 = **14.80** in^3

Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **111.15** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **25.90** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Volume factor	$C_V = (12 \text{ in} / \max(d, 3.5 \text{ in}))^{0.136} =$ **1.07**
Repetitive member factor - cl.8.3.7	$C_r =$ **1.00**
Length factor	$C_{Len} = (4 \text{ ft} / L_{s1})^{0.085} =$ **0.93**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d / (N \times b) =$ **2.07**
Effective laterally unsupported span length	$l_e =$ **1.333** ft
Slenderness ratio for bending members - eq.3.3-5	$R_b = \sqrt{[l_e \times d / (N \times b)^2]} =$ **3.077**
Adjusted bending design value for bending	$F_b^* = F_b \times C_D \times C_M \times C_t \times C_r =$ **2600** lb/in^2
Adjusted modulus of elasticity for member stability	$E_{min}' = E_{min} \times C_M \times C_t =$ **1017000** lb/in^2
Critical buckling design value for bending	$F_{bE} = 1.2 \times E_{min}' / R_b^2 =$ **128911** lb/in^2
Beam stability factor - eq.3.3-6	
	$C_L = [1 + (F_{bE} / F_b^*)] / 1.9 - \sqrt{[([1 + (F_{bE} / F_b^*)] / 1.9)^2 - (F_{bE} / F_b^*) / 0.95]} =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c_perp}' = F_{c_perp} \times C_t \times C_b =$ **750** lb/in^2
Applied compression stress perpendicular to grain	$f_{c_perp} = R_{A_max} / (N \times b \times L_b) =$ **214** lb/in^2
	$f_{c_perp} / F_{c_perp}' =$ **0.286**
	PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

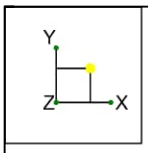
Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_V \times C_r =$ **2782** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **2203** lb/in^2
	$f_b / F_b' =$ **0.792**
	PASS - Design bending stress exceeds actual bending stress

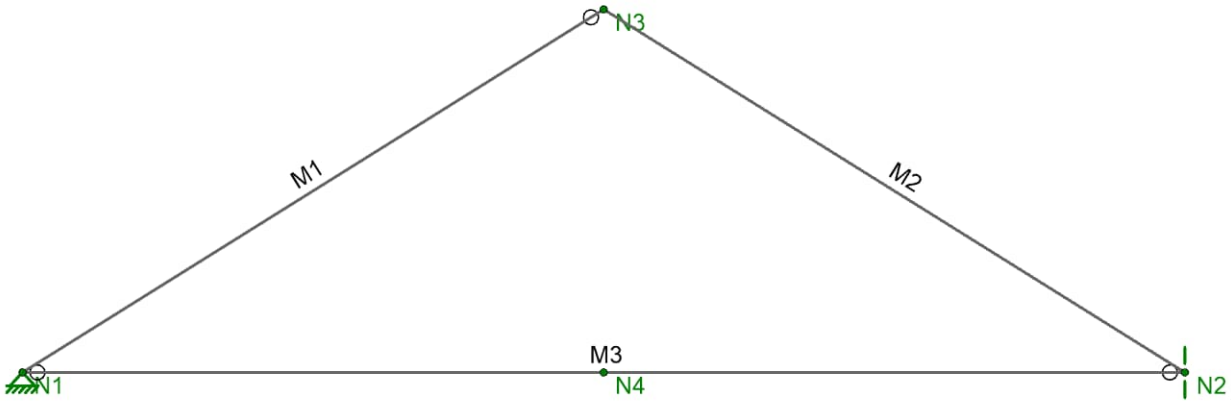
Strength in shear parallel to grain - cl.3.4.1

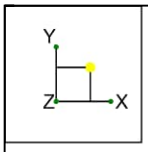
Design shear stress	$F_v' = F_v \times C_D \times C_t =$ **285** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **133** lb/in^2
	$f_v / F_v' =$ **0.467**
	PASS - Design shear stress exceeds actual shear stress

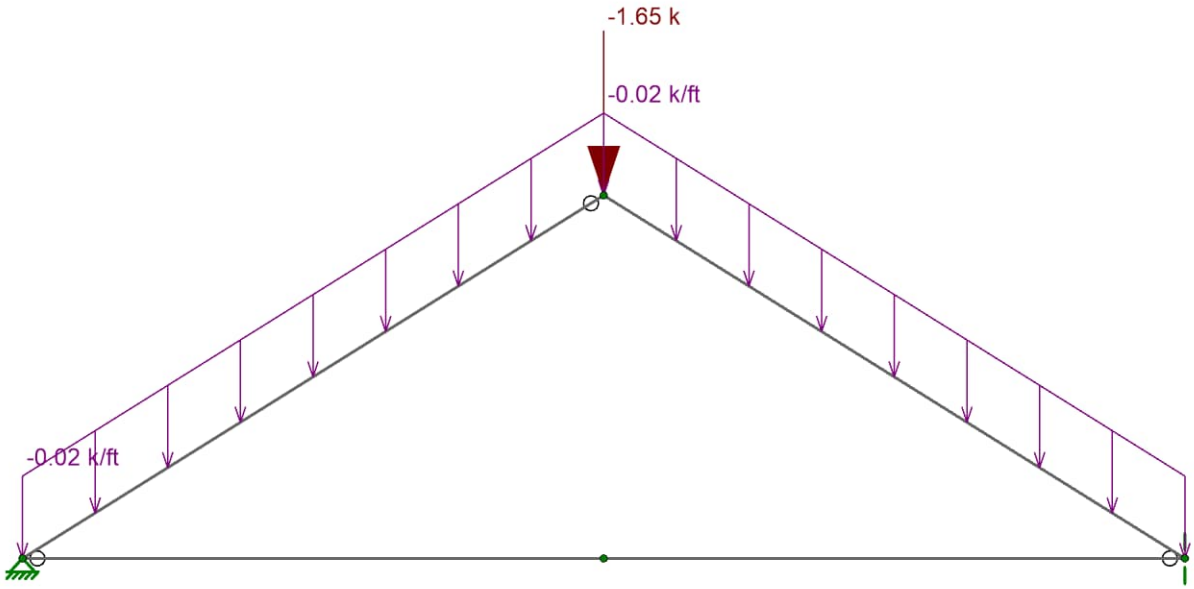
Deflection - cl.3.5.1

Modulus of elasticity for deflection	$E' = E \times C_M \times C_t =$ **2000000** lb/in^2
Design deflection	$\delta_{adm} = 0.0042 \times L_{s1} =$ **0.504** in
Total deflection	$\delta_{b_s1} =$ **0.456** in
	$\delta_{b_s1} / \delta_{adm} =$ **0.905**
	PASS - Total deflection is less than design deflection


Y
Z
X

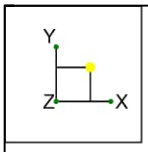

N3
M1
M2
M3
N1
N4
N2

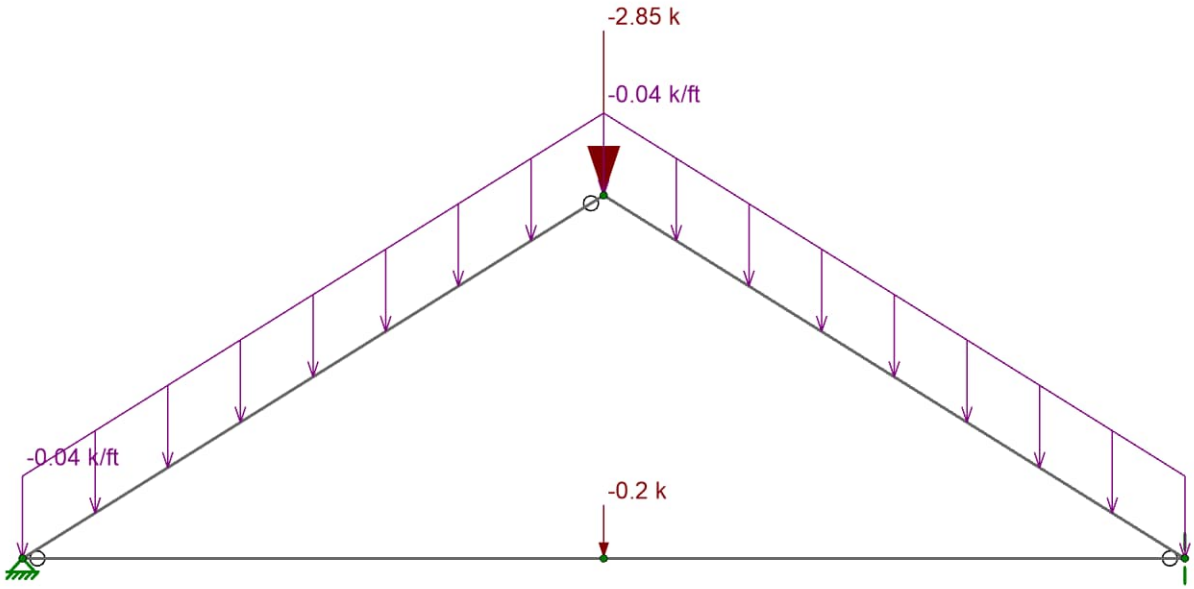




Loads: BLC 1, D

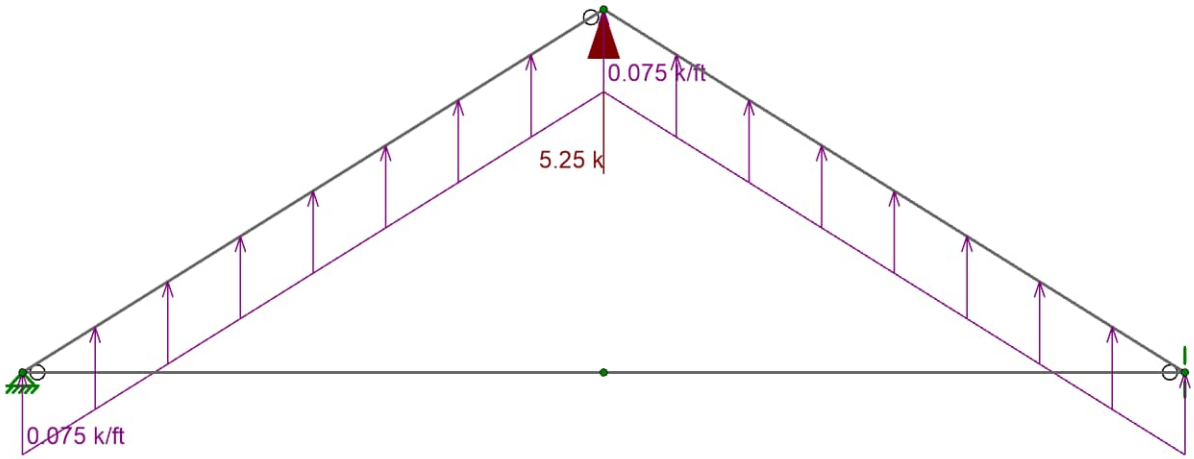
RISA A NEMETSCHEK COMPANY	Albrecht Engineering	Main Roof Truss	SK-5
	Evelyn Bravo		Sep 20, 2024 at 11:22 AM
	2023-011		Main Roof Truss.r3d





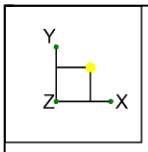
Loads: BLC 2, Lr

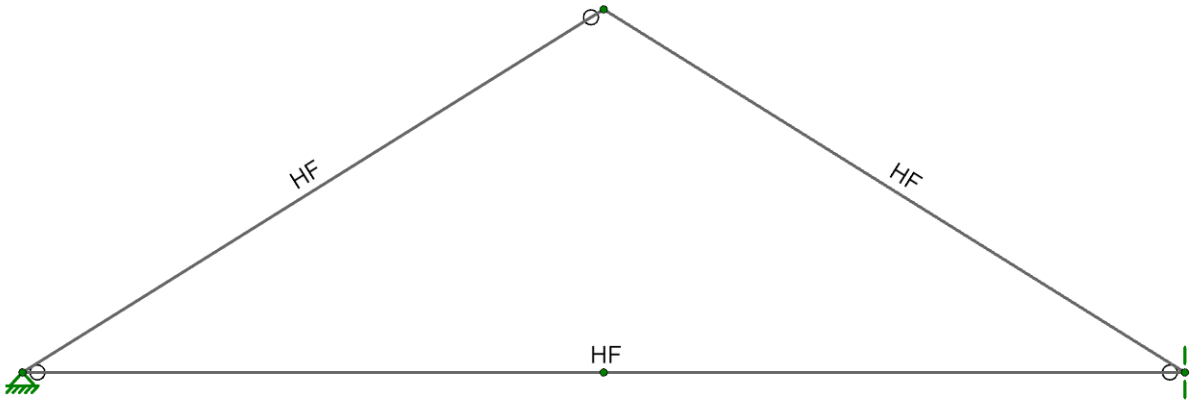
IRISA A NEMETSCHEK COMPANY	Albrecht Engineering	Main Roof Truss	SK-6
	Evelyn Bravo		Sep 20, 2024 at 11:22 AM
	2023-011		Main Roof Truss.r3d

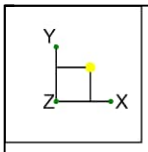


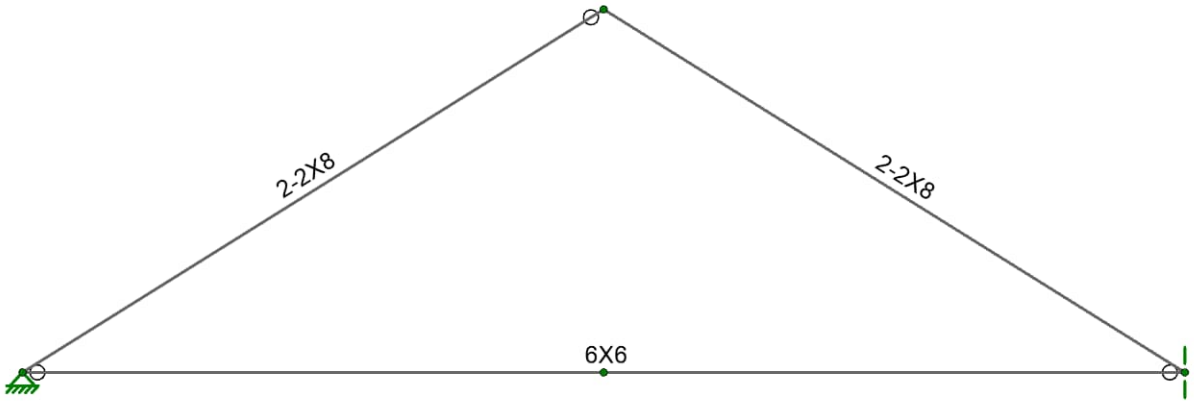
Loads: BLC 3, W

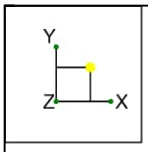
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	2023-011		Main Roof Truss.r3d

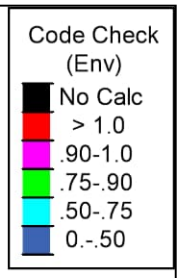

Y
Z
X

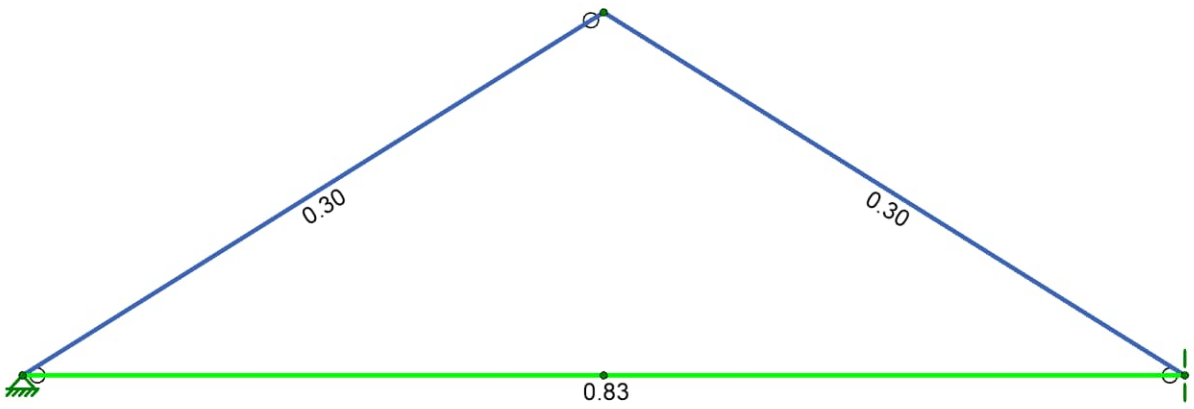

HF
HF
HF


Y
Z
X


2-2X8
2-2X8
6X6

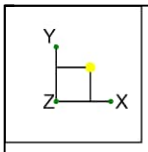


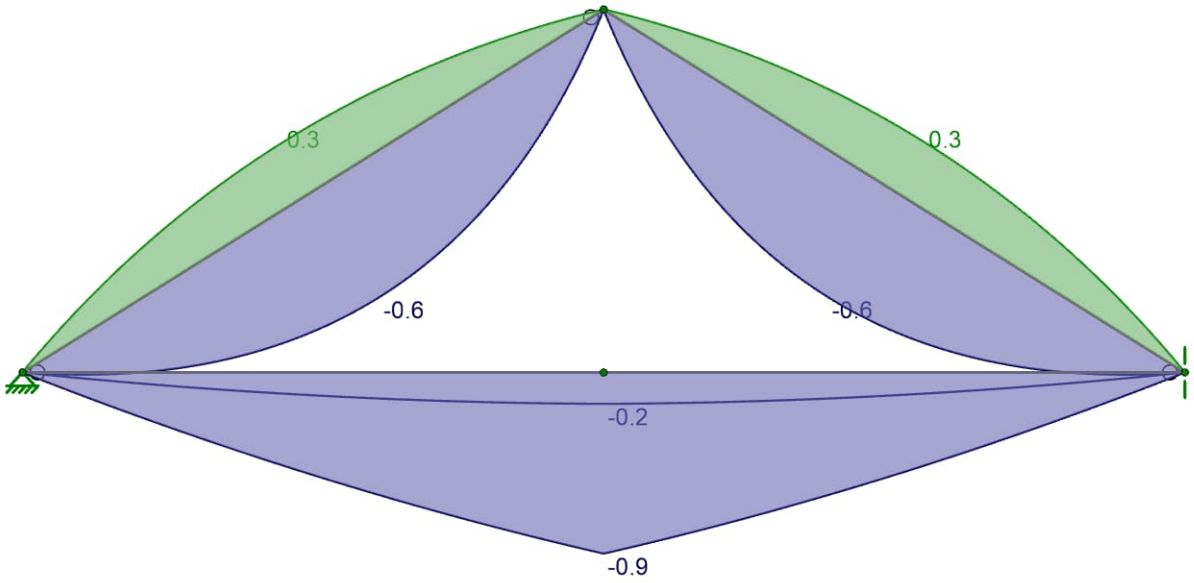




Member Code Checks Displayed (Enveloped)

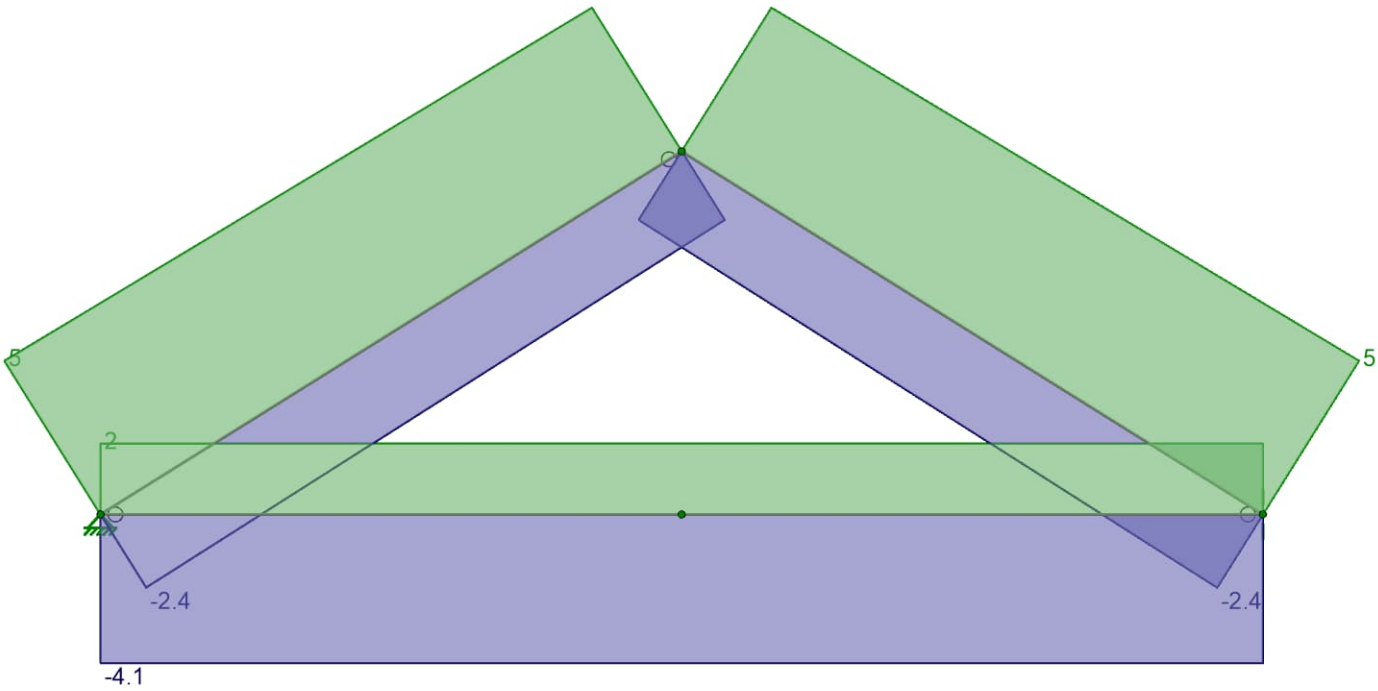
RISA A NEMETSCHEK COMPANY	Albrecht Engineering	Main Roof Truss	SK-4
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	2023-011		Main Roof Truss.r3d





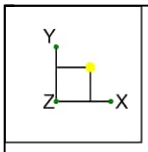
Member z Bending Moments (kip-ft) (Enveloped)

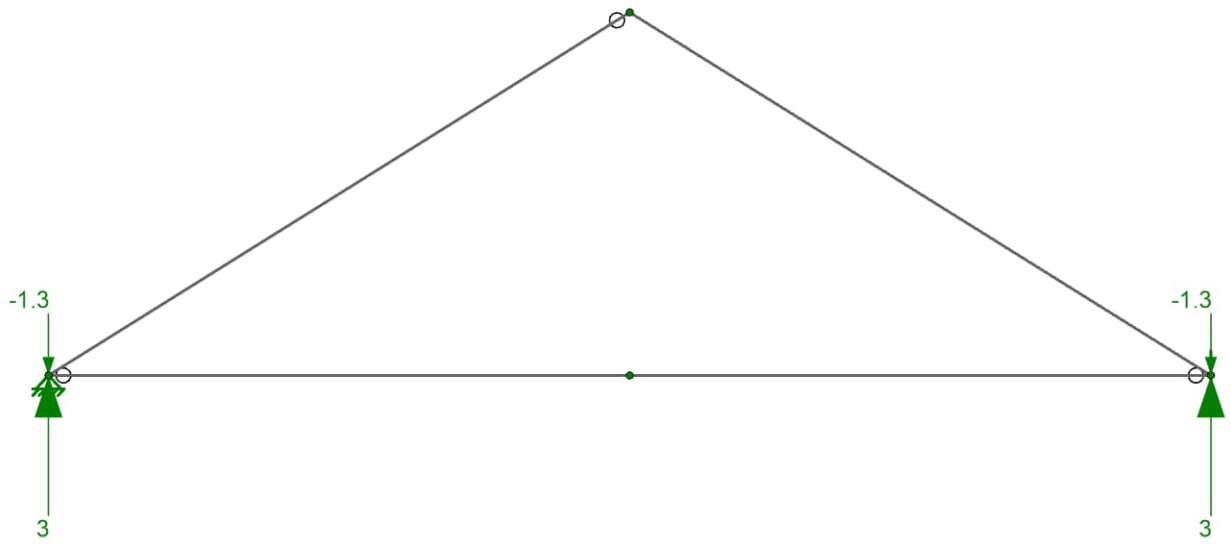
RISA A NEMETSCHEK COMPANY	Albrecht Engineering	Main Roof Truss	SK-10
	Evelyn Bravo		Sep 20, 2024 at 11:26 AM
	2023-011		Main Roof Truss.r3d



Member Axial Forces (kips) (Enveloped)

IRISA A NEMETSCHEK COMPANY	Albrecht Engineering	Main Roof Truss	SK-9
	Evelyn Bravo		Sep 20, 2024 at 11:25 AM
	2023-011		Main Roof Truss.r3d





Reaction and Moment Units are kips and kip-ft (Enveloped)

RISA A NEMETSCHEK COMPANY	Albrecht Engineering	Main Roof Truss	SK-8
	Evelyn Bravo		Sep 20, 2024 at 11:24 AM
	2023-011		Main Roof Truss.r3d

Node Coordinates

	Label	X [ft]	Y [ft]	Z [ft]	Detach From Diaphragm
1	N1	0	0	0	
2	N2	16	0	0	
3	N3	8	5	0	
4	N4	8	0	0	

Node Boundary Conditions

	Node Label	X [k/in]	Y [k/in]	Z [k/in]
1	N1	Reaction	Reaction	Reaction
2	N2		Reaction	Reaction

Wood Properties

	Label	Type	Database	Species	Grade	Cm	Ci	Emod	Nu	Therm. Coeff. [1e⁵°F⁻¹]	Density [k/ft³]
1	DF	Solid Sawn	Visually Graded	Douglas Fir-Larch	No.1			1	0.3	0.3	0.035
2	SP	Solid Sawn	Visually Graded	Southern Pine	No.1			1	0.3	0.3	0.035
3	HF	Solid Sawn	Visually Graded	Hem-Fir	No.2			1	0.3	0.3	0.035
4	SPF	Solid Sawn	Visually Graded	Spruce-Pine-fir	No.1			1	0.3	0.3	0.035
5	24F-1.8E DF Balanced	Glulam	NDS Table 5A	24F-1.8E_DF_BAL	na			1	0.3	0.3	0.035
6	24F-1.8E DF Unbalanced	Glulam	NDS Table 5A	24F-1.8E_DF_UNBAL	na			1	0.3	0.3	0.035
7	24F-1.8E SP Balanced	Glulam	NDS Table 5A	24F-1.8E_SP_BAL	na			1	0.3	0.3	0.035
8	24F-1.8E SP Unbalanced	Glulam	NDS Table 5A	24F-1.8E_SP_UNBAL	na			1	0.3	0.3	0.035
9	1.3E-1600F_VERSALAM	SCL	Boise Cascade	1.3E-1600F_VERSALAM	na			1	0.3	0.3	0.035
10	1.35E LSL_SolidStart	SCL	Louisiana Pacific	1.35E LSL_SolidStart	na			1	0.3	0.3	0.035
11	1.4E_RIGIDLAM LVL	SCL	Roseburg Forest Products_2023	1.4E_RIGIDLAM LVL	na			1	0.3	0.3	0.035
12	2.0E_DF Parallam PSL	SCL	TrusJoist	2.0E_DF Parallam PSL	na			1	0.3	0.3	0.035
13	LVL_PRL_1.5E_2250F	Custom	N/A	LVL_PRL_1.5E_2250F	na			1	0.3	0.3	0.035
14	LVL_Microlam_1.9E_2600F	Custom	N/A	LVL_Microllam_1.9E_2600F	na			1	0.3	0.3	0.035
15	PSL_Parallam_2.0E_2900F	Custom	N/A	PSL_Parallam_2.0E_2900F	na			1	0.3	0.3	0.035
16	LSL_TimberStrand_1.55E_2325F	Custom	N/A	LSL_TimberStrand_1.55E_2325F	na			1	0.3	0.3	0.035

Member Primary Data

	Label	I Node	J Node	Section/Shape	Type	Design List	Material	Design Rule
1	M1	N1	N3	2-2X8	Beam	Rectangular	HF	Typical
2	M2	N3	N2	2-2X8	Beam	Rectangular	HF	Typical
3	M3	N1	N2	6X6	Beam	Rectangular	HF	Typical

Node Loads and Enforced Displacements (BLC 1 : D)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N3	L	Y	-1.65

Node Loads and Enforced Displacements (BLC 2 : Lr)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N3	L	Y	-2.85
2	N4	L	Y	-0.2

Node Loads and Enforced Displacements (BLC 3 : W)

	Node Label	L, D, M	Direction	Magnitude [(k, k-ft), (in, rad), (k*s²/ft, k*s²*ft)]
1	N3	L	Y	5.25

Member Distributed Loads (BLC 1 : D)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	Y	-0.02	-0.02	0	%100
2	M2	Y	-0.02	-0.02	0	%100

Member Distributed Loads (BLC 2 : Lr)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	Y	-0.04	-0.04	0	%100
2	M2	Y	-0.04	-0.04	0	%100

Member Distributed Loads (BLC 3 : W)

	Member Label	Direction	Start Magnitude [k/ft, F, ksf, k-ft/ft]	End Magnitude [k/ft, F, ksf, k-ft/ft]	Start Location [(ft, %)]	End Location [(ft, %)]
1	M1	Y	0.075	0.075	0	%100
2	M2	Y	0.075	0.075	0	%100

Basic Load Cases

	BLC Description	Category	Y Gravity	Nodal	Distributed
1	D	DL	-1	1	2
2	Lr	RLL		2	2
3	W	WL		1	2

Load Combinations

	Description	Solve	P-Delta	BLC	Factor	BLC	Factor
1	IBC 16-8	Yes	Y	DL	1		
2	IBC 16-10 (a)	Yes	Y	DL	1	RLL	1
3	IBC 16-15	Yes	Y	DL	0.6	WL	0.6

Envelope Member Section Forces

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
0	M1	1	max	4.993	2	0.261	2	0	3	0	3	0	3	0	3
1			min	-2.377	3	-0.119	3	0	1	0	1	0	1	0	1
2		2	max	4.912	2	0.131	2	0	3	0	3	0	3	0.211	3
3			min	-2.34	3	-0.06	3	0	1	0	1	0	1	-0.462	2
4		3	max	4.83	2	0	3	0	3	0	3	0	3	0.281	3
5			min	-2.302	3	0	1	0	1	0	1	0	1	-0.616	2
6		4	max	4.748	2	0.06	3	0	3	0	3	0	3	0.211	3
7			min	-2.265	3	-0.131	2	0	1	0	1	0	1	-0.462	2
8		5	max	4.667	2	0.119	3	0	3	0	3	0	3	0	3
9			min	-2.228	3	-0.261	2	0	1	0	1	0	1	0	1
10	M2	1	max	4.667	2	0.261	2	0	3	0	3	0	3	0	3
11			min	-2.228	3	-0.119	3	0	1	0	1	0	1	0	1
12		2	max	4.748	2	0.131	2	0	3	0	3	0	3	0.211	3
13			min	-2.265	3	-0.06	3	0	1	0	1	0	1	-0.462	2
14		3	max	4.83	2	0	3	0	3	0	3	0	3	0.281	3

Envelope Member Section Forces (Continued)

	Member	Sec		Axial[k]	LC	y Shear[k]	LC	z Shear[k]	LC	Torque[k-ft]	LC	y-y Moment[k-ft]	LC	z-z Moment[k-ft]	LC
15			min	-2.302	3	0	1	0	1	0	1	0	1	-0.616	2
16		4	max	4.912	2	0.06	3	0	3	0	3	0	3	0.211	3
17			min	-2.34	3	-0.131	2	0	1	0	1	0	1	-0.462	2
18		5	max	4.993	2	0.119	3	0	3	0	3	0	3	0	3
19			min	-2.377	3	-0.261	2	0	1	0	1	0	1	0	1
20	M3	1	max	1.952	3	0.141	2	0	3	0	3	0	3	0	3
21			min	-4.097	2	0.037	3	0	1	0	1	0	1	0	1
22		2	max	1.952	3	0.111	2	0	3	0	3	0	3	-0.113	3
23			min	-4.097	2	0.019	3	0	1	0	1	0	1	-0.505	2
24		3	max	1.952	3	0.082	2	0	3	0	3	0	3	-0.155	3
25			min	-4.097	2	-0.002	1	0	1	0	1	0	1	-0.892	2
26		4	max	1.952	3	-0.019	3	0	3	0	3	0	3	-0.113	3
27			min	-4.097	2	-0.111	2	0	1	0	1	0	1	-0.505	2
28		5	max	1.952	3	-0.037	3	0	3	0	3	0	3	0	3
29			min	-4.097	2	-0.141	2	0	1	0	1	0	1	0	1

Envelope Node Reactions

	Node Label		X [k]	LC	Y [k]	LC	Z [k]	LC	MX [k-ft]	LC	MY [k-ft]	LC	MZ [k-ft]	LC
0	N1	max	0	3	3.025	2	0	3	LOCKED		0	3	0	3
1		min	0	2	-1.326	3	0	1	LOCKED		0	1	0	1
2	N2	max	0	3	3.025	2	0	3	0	3	0	3	0	3
3		min	0	1	-1.326	3	0	1	0	1	0	1	0	1
4	Totals:	max	0	3	6.049	2	0	3						
5		min	0	2	-2.652	3	0	1						

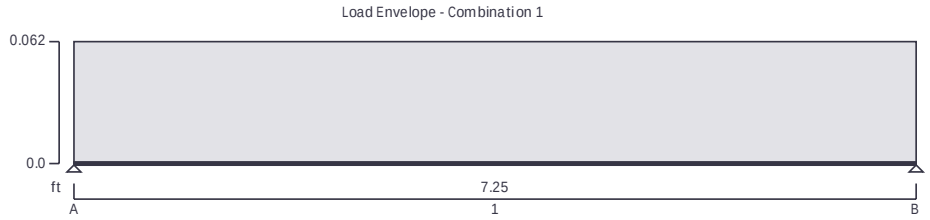
Envelope Beam Deflections

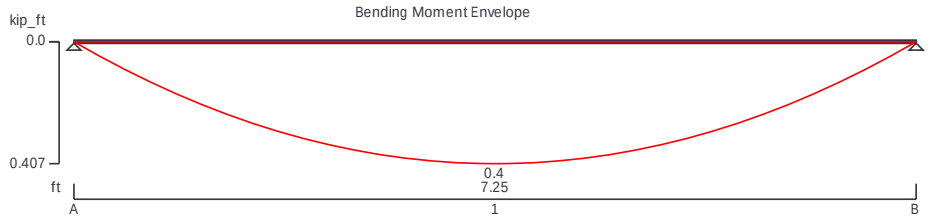
	Member Label	Span		Location [ft]	y' [in]	(n) L'/y' Ratio	LC
0	M1	1	max	1.179	0.001	NC	2
1		1	min	9.434	0.256	885	2
2	M2	1	max	7.763	-0.001	NC	3
3		1	min	0	0.255	888	2
4	M3	1	max	15.833	-0.003	NC	3
5		1	min	8	-0.419	458	2

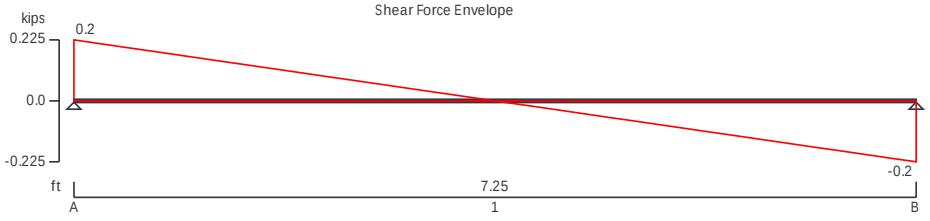
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10







Applied loading

Beam loads

Dead self weight of beam × 1
Dead full UDL 20 lb/ft
Live full UDL 40 lb/ft

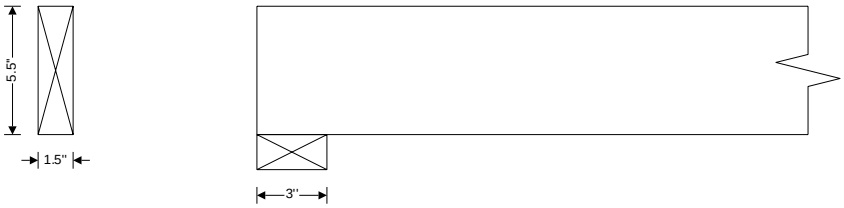
Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
		Wind × 1.00
	Span 1	Dead × 1.00
		Live × 1.00
		Wind × 1.00
	Support B	Dead × 1.00
		Live × 1.00

Wind × 1.00

Analysis results

Maximum moment	M_{max} = **407** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **407** lb_ft	
Maximum shear	F_{max} = **225** lb	F_{min} = **-225** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **225** lb	
Total load on member	W_{tot} = **450** lb	
Reaction at support A	R_{A_max} = **225** lb	R_{A_min} = **225** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **80** lb	
Unfactored live load reaction at support A	R_{A_Live} = **145** lb	
Reaction at support B	R_{B_max} = **225** lb	R_{B_min} = **225** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **80** lb	
Unfactored live load reaction at support B	R_{B_Live} = **145** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **6** in
Dressed depth of sections	d = **5.5** in
Number of sections in member	N = **1**
Overall breadth of member	b_b = N × b = **1.5** in
Species, grade and size classification	Hem-Fir, No.2 grade, 2" & wider
Bending parallel to grain	F_b = **850** lb/in^2
Tension parallel to grain	F_t = **525** lb/in^2
Compression parallel to grain	F_c = **1300** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1300000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **470000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **81250** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **7.25** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	A = N × b × d = **8.25** in^2

Section modulus	$S_x = N \times b \times d^2 / 6 =$ **7.56** in^3
	$S_y = d \times (N \times b)^2 / 6 =$ **2.06** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **20.80** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **1.55** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Size factor for bending - Table 4A	$C_{Fb} =$ **1.30**
Size factor for tension - Table 4A	$C_{Ft} =$ **1.30**
Size factor for compression - Table 4A	$C_{Fc} =$ **1.10**
Flat use factor - Table 4A	$C_{fu} =$ **1.15**
Incising factor for modulus of elasticity - Table 4.3.8	
	$C_{iE} =$ **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	$C_i =$ **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	$C_{ic_perp} =$ **1.00**
Repetitive member factor - cl.4.3.9	$C_r =$ **1.15**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom}) =$ **3.00**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	$C_L =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c_perp}' = F_{c_perp} \times C_t \times C_{ic_perp} \times C_b =$ **405** lb/in^2
Applied compression stress perpendicular to grain	$f_{c_perp} = R_{B_max} / (N \times b \times L_b) =$ **50** lb/in^2
	$f_{c_perp} / F_{c_perp}' =$ **0.123**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1271** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **646** lb/in^2
	$f_b / F_b' =$ **0.509**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress	$F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **41** lb/in^2
	$f_v / F_v' =$ **0.272**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection	$E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1300000** lb/in^2
Design deflection	$\delta_{adm} = 0.0042 \times L_{s1} =$ **0.365** in
Total deflection	$\delta_{b_s1} =$ **0.143** in
	$\delta_{b_s1} / \delta_{adm} =$ **0.390**

PASS - Total deflection is less than design deflection

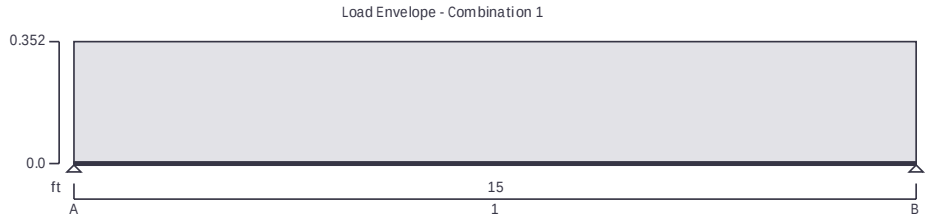
Albrecht Engineering, Inc.
3500 Boston Street
Suite 329, MS-12
Baltimore, MD 21224

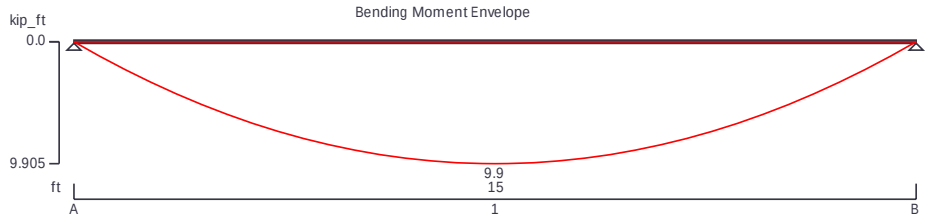
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Grinder House				2023-011	
Section				Sheet no./rev.	
Rear Roof Rafters				4	
Calc. by	Date	Chk'd by	Date	App'd by	Date
EB	7/25/2024				

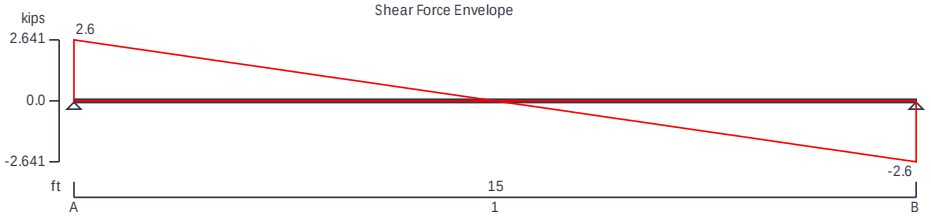
STRUCTURAL COMPOSITE LUMBER MEMBER ANALYSIS & DESIGN (NDS)

In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10







Applied loading

Beam loads

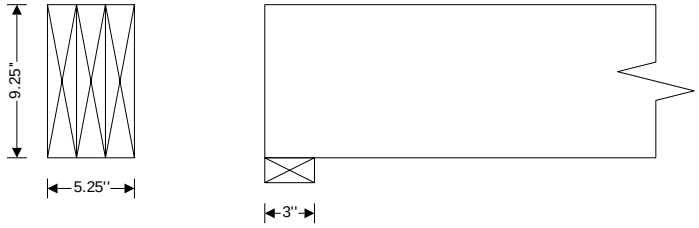
Dead self weight of beam × 1
Dead full UDL 120 lb/ft
Live full UDL 218 lb/ft

Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
	Span 1	Dead × 1.00
		Live × 1.00
	Support B	Dead × 1.00
		Live × 1.00

Analysis results

Maximum moment	M_{max} = **9905** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **9905** lb_ft	
Maximum shear	F_{max} = **2641** lb	F_{min} = **-2641** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **2641** lb	
Total load on member	W_{tot} = **5282** lb	
Reaction at support A	R_{A_max} = **2641** lb	R_{A_min} = **2641** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **1006** lb	
Unfactored live load reaction at support A	R_{A_Live} = **1635** lb	
Reaction at support B	R_{B_max} = **2641** lb	R_{B_min} = **2641** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **1006** lb	
Unfactored live load reaction at support B	R_{B_Live} = **1635** lb	



Composite section details

Breadth of composite section	b = **1.75** in
Depth of composite section	d = **9.25** in
Number of composite sections in member	N = **3**
Overall breadth of composite member	b_b = N × b = **5.25** in
Composite type and grade	Microllam LVL, 2.0E-2600Fb grade
Bending parallel to grain	F_b = **2600** lb/in^2
Tension parallel to grain	F_t = **1555** lb/in^2
Compression parallel to grain	F_c = **2510** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **750** lb/in^2
Shear parallel to grain	F_v = **285** lb/in^2
Modulus of elasticity	E = **2000000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **1017000** lb/in^2
Mean shear modulus	G_{def} = E / 16 = **125000** lb/in^2
Average density	ρ = **42** lb/ft^3

Member details

Service condition	**Dry**
Length of span	L_{s1} = **15** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

Section properties

Cross sectional area of member	A = N × b × d = **48.56** in^2
Section modulus	S_x = N × b × d^2 / 6 = **74.87** in^3
	S_y = d × (N × b)^2 / 6 = **42.49** in^3

Second moment of area	$I_x = N \times b \times d^3 / 12 =$ **346.26** in^4
	$I_y = d \times (N \times b)^3 / 12 =$ **111.54** in^4

Adjustment factors

Load duration factor - Table 2.3.2	$C_D =$ **1.00**
Temperature factor - Table 2.3.3	$C_t =$ **1.00**
Volume factor	$C_V = (12 \text{ in} / \max(d, 3.5 \text{ in}))^{0.136} =$ **1.04**
Repetitive member factor - cl.8.3.7	$C_r =$ **1.00**
Length factor	$C_{Len} = (4 \text{ ft} / L_{s1})^{0.085} =$ **0.89**
Bearing area factor - cl.3.10.4	$C_b =$ **1.00**
Depth-to-breadth ratio	$d / (N \times b) =$ **1.76**
Effective laterally unsupported span length	$l_e =$ **1.333** ft
Slenderness ratio for bending members - eq.3.3-5	$R_b = \sqrt{[l_e \times d / (N \times b)^2]} =$ **2.317**
Adjusted bending design value for bending	$F_b^* = F_b \times C_D \times C_M \times C_t \times C_r =$ **2600** lb/in^2
Adjusted modulus of elasticity for member stability	$E_{min}' = E_{min} \times C_M \times C_t =$ **1017000** lb/in^2
Critical buckling design value for bending	$F_{bE} = 1.2 \times E_{min}' / R_b^2 =$ **227336** lb/in^2
Beam stability factor - eq.3.3-6	
	$C_L = [1 + (F_{bE} / F_b^*)] / 1.9 - \sqrt{[([1 + (F_{bE} / F_b^*)] / 1.9)^2 - (F_{bE} / F_b^*) / 0.95]} =$ **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain	$F_{c_perp}' = F_{c_perp} \times C_t \times C_b =$ **750** lb/in^2
Applied compression stress perpendicular to grain	$f_{c_perp} = R_{A_max} / (N \times b \times L_b) =$ **168** lb/in^2
	$f_{c_perp} / F_{c_perp}' =$ **0.224**
	PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress	$F_b' = F_b \times C_D \times C_t \times C_L \times C_V \times C_r =$ **2692** lb/in^2
Actual bending stress	$f_b = M / S_x =$ **1588** lb/in^2
	$f_b / F_b' =$ **0.590**
	PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress	$F_v' = F_v \times C_D \times C_t =$ **285** lb/in^2
Actual shear stress - eq.3.4-2	$f_v = 3 \times F / (2 \times A) =$ **82** lb/in^2
	$f_v / F_v' =$ **0.286**
	PASS - Design shear stress exceeds actual shear stress

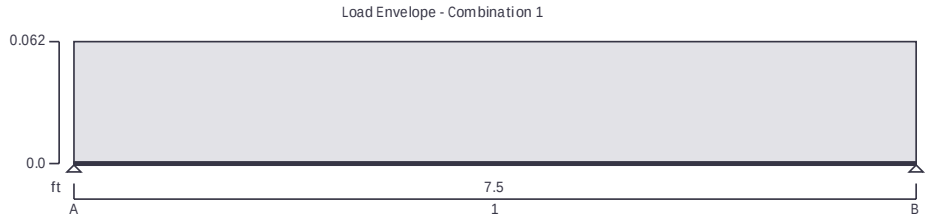
Deflection - cl.3.5.1

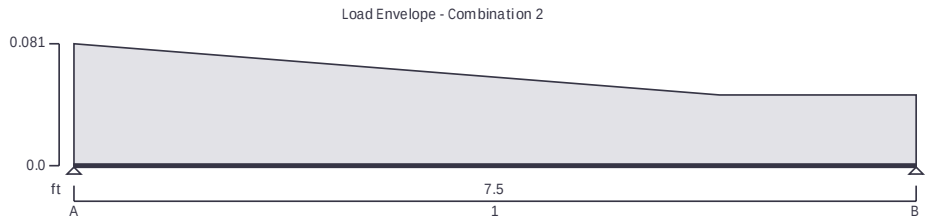
Modulus of elasticity for deflection	$E' = E \times C_M \times C_t =$ **2000000** lb/in^2
Design deflection	$\delta_{adm} = 0.0042 \times L_{s1} =$ **0.756** in
Total deflection	$\delta_{b_s1} =$ **0.579** in
	$\delta_{b_s1} / \delta_{adm} =$ **0.766**
	PASS - Total deflection is less than design deflection

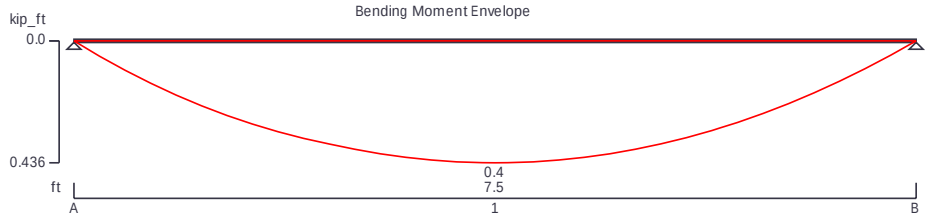
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

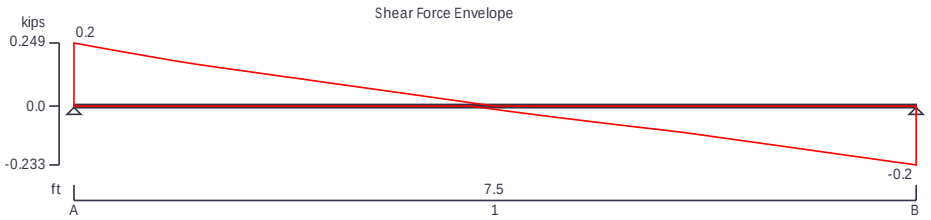
In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10









Applied loading

Beam loads

Dead self weight of beam × 1
Dead full UDL 20 lb/ft
Live full UDL 40 lb/ft
Snow full UDL 25 lb/ft

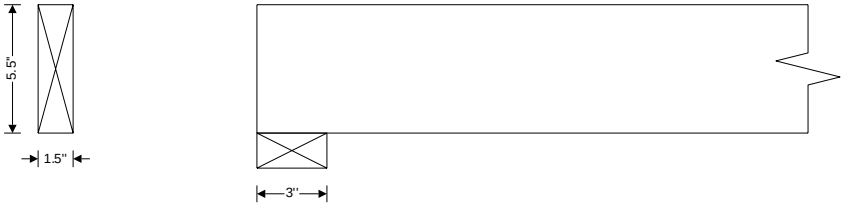
Snow partial VDL 34 lb/ft at 0.00 in to 0 lb/ft at 69.00 in

Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
		Snow × 0.00
	Span 1	Dead × 1.00
		Live × 1.00
		Snow × 0.00
	Support B	Dead × 1.00
		Live × 1.00
		Snow × 0.00
Load combination 2	Support A	Dead × 1.00
		Live × 0.00
		Snow × 1.00
	Span 1	Dead × 1.00
		Live × 0.00
		Snow × 1.00
	Support B	Dead × 1.00
		Live × 0.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **436** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **436** lb_ft	
Maximum shear	F_{max} = **249** lb	F_{min} = **-233** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **249** lb	
Total load on member	W_{tot} = **465** lb	
Reaction at support A	R_{A_max} = **249** lb	R_{A_min} = **233** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **83** lb	
Unfactored live load reaction at support A	R_{A_Live} = **150** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **167** lb	
Reaction at support B	R_{B_max} = **233** lb	R_{B_min} = **201** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **83** lb	
Unfactored live load reaction at support B	R_{B_Live} = **150** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **119** lb	



Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in

Dressed breadth of sections	b = **1.5** in
Nominal depth of sections	d_{nom} = **6** in
Dressed depth of sections	d = **5.5** in
Number of sections in member	N = **1**
Overall breadth of member	$b_b = N \times b$ = **1.5** in
Species, grade and size classification	Hem-Fir, No.2 grade, 2" & wider
Bending parallel to grain	F_b = **850** lb/in^2
Tension parallel to grain	F_t = **525** lb/in^2
Compression parallel to grain	F_c = **1300** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1300000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **470000** lb/in^2
Mean shear modulus	$G_{def} = E / 16$ = **81250** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **7.5** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

The beam is one of three or more repetitive members

Section properties

Cross sectional area of member	$A = N \times b \times d$ = **8.25** in^2
Section modulus	$S_x = N \times b \times d^2 / 6$ = **7.56** in^3
	$S_y = d \times (N \times b)^2 / 6$ = **2.06** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12$ = **20.80** in^4
	$I_y = d \times (N \times b)^3 / 12$ = **1.55** in^4

Adjustment factors

Load duration factor - Table 2.3.2	C_D = **1.00**
Temperature factor - Table 2.3.3	C_t = **1.00**
Size factor for bending - Table 4A	C_{Fb} = **1.30**
Size factor for tension - Table 4A	C_{Ft} = **1.30**
Size factor for compression - Table 4A	C_{Fc} = **1.10**
Flat use factor - Table 4A	C_{fu} = **1.15**
Incising factor for modulus of elasticity - Table 4.3.8	
	C_{iE} = **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	C_i = **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	C_{ic_perp} = **1.00**
Repetitive member factor - cl.4.3.9	C_r = **1.15**
Bearing area factor - cl.3.10.4	C_b = **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom})$ = **3.00**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	C_L = **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain $F_{c_perp}' = F_{c_perp} \times C_t \times C_{ic_perp} \times C_b =$ **405** lb/in^2

Applied compression stress perpendicular to grain $f_{c_perp} = R_{A_max} / (N \times b \times L_b) =$ **55** lb/in^2

$f_{c_perp} / F_{c_perp}' =$ **0.137**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress $F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1271** lb/in^2

Actual bending stress $f_b = M / S_x =$ **692** lb/in^2

$f_b / F_b' =$ **0.544**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress $F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2

Actual shear stress - eq.3.4-2 $f_v = 3 \times F / (2 \times A) =$ **45** lb/in^2

$f_v / F_v' =$ **0.302**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection $E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1300000** lb/in^2

Design deflection $\delta_{adm} = 0.0042 \times L_{s1} =$ **0.378** in

Total deflection $\delta_{b_s1} =$ **0.261** in

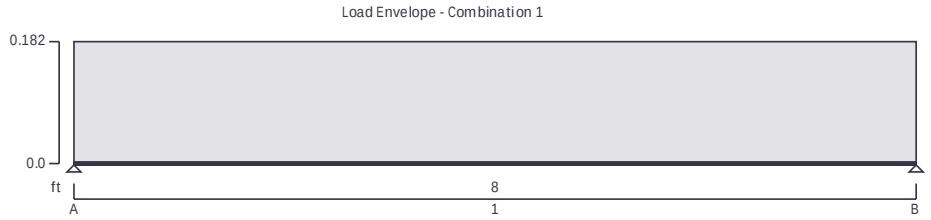
$\delta_{b_s1} / \delta_{adm} =$ **0.692**

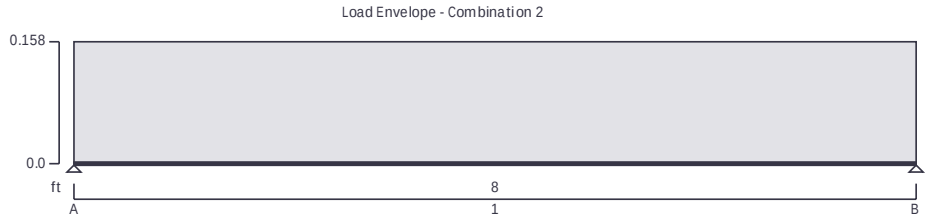
PASS - Total deflection is less than design deflection

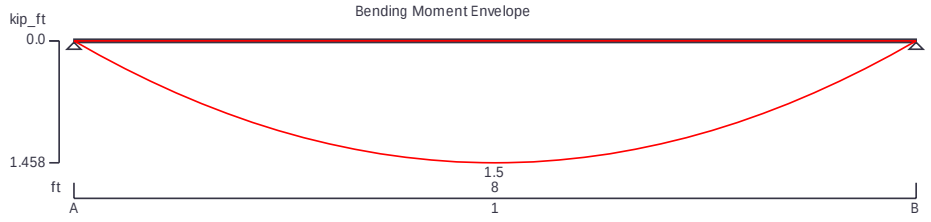
STRUCTURAL WOOD MEMBER ANALYSIS & DESIGN (NDS)

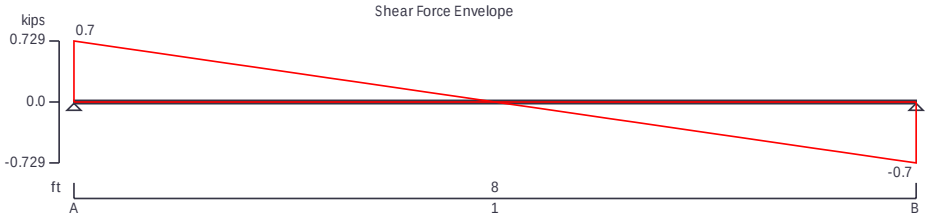
In accordance with the ANSI/AF&PA NDS-2015 using the ASD method

Tedds calculation version 1.7.10









Applied loading

Beam loads

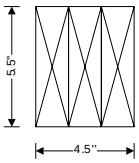
Dead self weight of beam × 1
Dead full UDL 62 lb/ft
Live full UDL 113 lb/ft
Snow full UDL 89 lb/ft

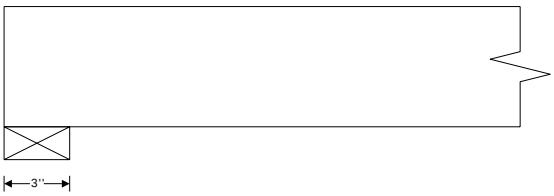
Load combinations

Load combination 1	Support A	Dead × 1.00
		Live × 1.00
		Snow × 0.00
	Span 1	Dead × 1.00
		Live × 1.00
		Snow × 0.00
	Support B	Dead × 1.00
		Live × 1.00
		Snow × 0.00
Load combination 2	Support A	Dead × 1.00
		Live × 0.00
		Snow × 1.00
	Span 1	Dead × 1.00
		Live × 0.00
		Snow × 1.00
	Support B	Dead × 1.00
		Live × 0.00
		Snow × 1.00

Analysis results

Maximum moment	M_{max} = **1458** lb_ft	M_{min} = **0** lb_ft
Design moment	M = max(abs(M_{max}),abs(M_{min})) = **1458** lb_ft	
Maximum shear	F_{max} = **729** lb	F_{min} = **-729** lb
Design shear	F = max(abs(F_{max}),abs(F_{min})) = **729** lb	
Total load on member	W_{tot} = **1458** lb	
Reaction at support A	R_{A_max} = **729** lb	R_{A_min} = **633** lb
Unfactored dead load reaction at support A	R_{A_Dead} = **277** lb	
Unfactored live load reaction at support A	R_{A_Live} = **452** lb	
Unfactored snow load reaction at support A	R_{A_Snow} = **356** lb	
Reaction at support B	R_{B_max} = **729** lb	R_{B_min} = **633** lb
Unfactored dead load reaction at support B	R_{B_Dead} = **277** lb	
Unfactored live load reaction at support B	R_{B_Live} = **452** lb	
Unfactored snow load reaction at support B	R_{B_Snow} = **356** lb	





Sawn lumber section details

Nominal breadth of sections	b_{nom} = **2** in
Dressed breadth of sections	b = **1.5** in

Nominal depth of sections	d_{nom} = **6** in
Dressed depth of sections	d = **5.5** in
Number of sections in member	N = **3**
Overall breadth of member	$b_b = N \times b$ = **4.5** in
Species, grade and size classification	Hem-Fir, No.2 grade, 2" & wider
Bending parallel to grain	F_b = **850** lb/in^2
Tension parallel to grain	F_t = **525** lb/in^2
Compression parallel to grain	F_c = **1300** lb/in^2
Compression perpendicular to grain	F_{c_perp} = **405** lb/in^2
Shear parallel to grain	F_v = **150** lb/in^2
Modulus of elasticity	E = **1300000** lb/in^2
Modulus of elasticity, stability calculations	E_{min} = **470000** lb/in^2
Mean shear modulus	$G_{def} = E / 16$ = **81250** lb/in^2

Member details

Service condition	**Dry**
Length of span	L_{s1} = **8** ft
Length of bearing	L_b = **3** in
Load duration	**Ten years**

Section properties

Cross sectional area of member	$A = N \times b \times d$ = **24.75** in^2
Section modulus	$S_x = N \times b \times d^2 / 6$ = **22.69** in^3
	$S_y = d \times (N \times b)^2 / 6$ = **18.56** in^3
Second moment of area	$I_x = N \times b \times d^3 / 12$ = **62.39** in^4
	$I_y = d \times (N \times b)^3 / 12$ = **41.77** in^4

Adjustment factors

Load duration factor - Table 2.3.2	C_D = **1.00**
Temperature factor - Table 2.3.3	C_t = **1.00**
Size factor for bending - Table 4A	C_{Fb} = **1.30**
Size factor for tension - Table 4A	C_{Ft} = **1.30**
Size factor for compression - Table 4A	C_{Fc} = **1.10**
Flat use factor - Table 4A	C_{fu} = **1.15**
Incising factor for modulus of elasticity - Table 4.3.8	
	C_{iE} = **1.00**
Incising factor for bending, shear, tension & compression - Table 4.3.8	
	C_i = **1.00**
Incising factor for perpendicular compression - Table 4.3.8	
	C_{ic_perp} = **1.00**
Repetitive member factor - cl.4.3.9	C_r = **1.15**
Bearing area factor - cl.3.10.4	C_b = **1.00**
Depth-to-breadth ratio	$d_{nom} / (N \times b_{nom})$ = **1.00**
- Beam is fully restrained	
Beam stability factor - cl.3.3.3	C_L = **1.00**

Bearing perpendicular to grain - cl.3.10.2

Design compression perpendicular to grain $F_{c_perp}' = F_{c_perp} \times C_t \times C_{ic_perp} \times C_b =$ **405** lb/in^2

Applied compression stress perpendicular to grain $f_{c_perp} = R_{A_max} / (N \times b \times L_b) =$ **54** lb/in^2

$f_{c_perp} / F_{c_perp}' =$ **0.133**

PASS - Design compressive stress exceeds applied compressive stress at bearing

Strength in bending - cl.3.3.1

Design bending stress $F_b' = F_b \times C_D \times C_t \times C_L \times C_{Fb} \times C_i \times C_r =$ **1271** lb/in^2

Actual bending stress $f_b = M / S_x =$ **771** lb/in^2

$f_b / F_b' =$ **0.607**

PASS - Design bending stress exceeds actual bending stress

Strength in shear parallel to grain - cl.3.4.1

Design shear stress $F_v' = F_v \times C_D \times C_t \times C_i =$ **150** lb/in^2

Actual shear stress - eq.3.4-2 $f_v = 3 \times F / (2 \times A) =$ **44** lb/in^2

$f_v / F_v' =$ **0.294**

PASS - Design shear stress exceeds actual shear stress

Deflection - cl.3.5.1

Modulus of elasticity for deflection $E' = E \times C_{ME} \times C_t \times C_{iE} =$ **1300000** lb/in^2

Design deflection $\delta_{adm} = 0.0042 \times L_{s1} =$ **0.403** in

Total deflection $\delta_{b_s1} =$ **0.308** in

$\delta_{b_s1} / \delta_{adm} =$ **0.764**

PASS - Total deflection is less than design deflection

WOOD MEMBER DESIGN (NDS 2015)

In accordance with the ANSI/AF&PA NDS 2015 using the ASD method

Tedds calculation version 2.2.13

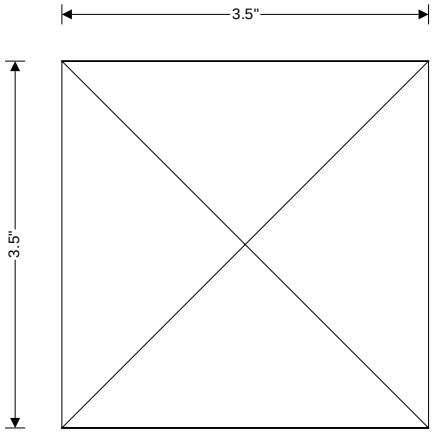
Design section 1

Member details

Service condition	Dry
Load duration - Table 2.3.2	Ten years

Sawn lumber section details

Number of sections in member	N = **1**
Nominal breadth of sections	b_{nom} = **4** in
Breadth of sections	b = **3.5** in
Nominal depth of sections	d_{nom} = **4** in
Depth of sections	d = **3.5** in
Material	**Hem-Fir, 2'' && wider, No.2 grade**



4''x4" sawn lumber section
Cross-sectional area, A, 12.25 in²
Section modulus, S_x, 7.1 in³
Section modulus, S_y, 7.1 in³
Second moment of area, I_x, 12.5 in⁴
Second moment of area, I_y, 12.5 in⁴
Radius of gyration, r_x, 1.01 in
Radius of gyration, r_y, 1.01 in
Hem-Fir, 2'' & wider, No.2 grade
Bending, F_b, 850 psi
Shear parallel to grain, F_v, 150 psi
Compression parallel to grain, F_c, 1300 psi
Compression perpendicular to grain, F_{c_perp}, 405 psi
Tension parallel to grain, F_t, 525 psi
Modulus of elasticity, E, 1300000 psi
Minimum modulus of elasticity, E_{min}, 470000 psi
Density, ρ, 29.743 lbm/ft³
Specific gravity, G, 0.43

Span details

Unbraced length - Major axis	L_x = **7** ft
Effective bending length - Major axis	$L_{e,x} = 1.63 \times L_x + 3 \times b$ = **12.285** ft
Column buckling length - Major axis	$L_{b,x} = L_x$ = **7** ft
Unbraced length - Minor axis	L_y = **7** ft
Effective bending length - Minor axis	$L_{e,y} = 1.63 \times L_y + 3 \times d$ = **12.285** ft
Column buckling length - Minor axis	$L_{b,y} = L_y$ = **7** ft

Analysis results

Design bending moment - Major axis	M_x = **155** lb_ft
Design axial compression force	P = **930** lb

Section s1 results summary	Unit	Capacity	Maximum	Utilization	Result
Bending stress	lb/in²	1268	260	0.205	PASS
Compressive stress	lb/in²	593	76	0.128	PASS
Bending and axial force				0.248	PASS

Adjustment factors - Table 4.3.1

Load duration factor - Table 2.3.2 C_D = **1**

Size factor for bending - Table 4A C_{Fb} = **1.5**

Size factor for compression - Table 4A C_{Fc} = **1.15**

Depth-to-breadth ratio d_{nom} / b_{nom} = **1.00**

Slenderness ratio - eq.3.3-5 $R_B = \sqrt{(L_{e,y} \times d / b^2)}$ = **6.490**

Reference bending design value $F_b^* = F_b \times C_D \times C_{Fb}$ = **1275** lb/in^2

Adjusted modulus of elasticity $E_{min}' = E_{min}$ = **470000** lb/in^2

Critical buckling design value - cl.3.3.3.8 $F_{bE} = 1.2 \times E_{min}' / R_B^2$ = **13390** lb/in^2

Beam stability factor - eq.3.3-6

$$C_L = [1 + (F_{bE} / F_b^*)] / 1.9 - \sqrt{[([1 + (F_{bE} / F_b^*)] / 1.9)^2 - (F_{bE} / F_b^*) / 0.95]} = \mathbf{0.995}$$

Reference compression design value $F_c^* = F_c \times C_D \times C_{Fc}$ = **1495** lb/in^2

Adjusted modulus of elasticity $E_{min}' = E_{min}$ = **470000** lb/in^2

Critical buckling design value $F_{cE} = 0.822 \times E_{min}' / (L_{b,y} / b)^2$ = **671** lb/in^2

Column stability factor - eq.3.7-1

$$C_P = (1 + (F_{cE} / F_c^*)) / 1.6 - \sqrt{(((1 + (F_{cE} / F_c^*)) / 1.6)^2 - (F_{cE} / F_c^*) / 0.8)} = \mathbf{0.397}$$

Compression members - General - cl.3.6

Design axial compression force P = **930** lb

Design compression parallel to grain - Table 4.3.1 $F_c' = F_c \times C_D \times C_{Fc} \times C_P$ = **593** lb/in^2

Actual compression parallel to grain $f_c = P / (b \times d)$ = **76** lb/in^2

f_c / F_c' = **0.128**

PASS - Design compression stress exceeds actual compression stress

Bending members - Flexure - cl.3.3

Design bending moment M_x = **155** lb_ft

Design bending stress - Table 4.3.1 $F_{b,x}' = F_b \times C_D \times C_L \times C_{Fb}$ = **1268** lb/in^2

Actual bending stress - eq.3.3-2 $f_{b,x} = M_x / S_x$ = **260** lb/in^2

$f_{b,x} / F_{b,x}'$ = **0.205**

PASS - Design bending stress exceeds actual bending stress

Combined bending and axial loading - cl.3.9

Critical buckling design value in x-axis $F_{cE1} = 0.822 \times E_{min}' / (L_{b,x} / d)^2$ = **671** lb/in^2

Critical buckling design value in y-axis $F_{cE2} = 0.822 \times E_{min}' / (L_{b,y} / b)^2$ = **671** lb/in^2

Bending and compression check - eqs.3.9-3 and 3.9-4

$$\max((f_c / F_c')^2 + f_{b,x} / (F_{b,x}' \times (1 - (f_c / F_{cE1}))), (f_c / F_{cE2})) = \mathbf{0.248} < 1.0$$

PASS - Combined bending and compressive stresses are within permissible limits

ALBRECHT ENGINEERING INC

Project	Grinder House				
Subject	Existing Footing Load Analysis		Job No.	2023-011	
			Sheet No.		of
Computed By	EB	Date ######### Checked By		Date	

Existing Wall Loading

Roof span =	16	ft
DL =	15	psf
LL =	30	psf
TL =	45	psf
W =	360	plf
Floor span =	16	ft
DL =	20	psf
LL =	40	psf
TL =	60	psf
W =	480	plf
Wall Height =	17	ft
DL =	100	psf
W =	1700	plf
Total W =	2540	plf

Proposed Wall Loading

Roof span =	16	ft	
DL =	15	psf	
LL =	30	psf	
TL =	45	psf	
W =	360	plf	
Floor span =	16	ft	
DL =	20	psf	
LL =	50	psf	
TL =	70	psf	
W =	560	plf	
Wall Height =	17	ft	
DL =	100	psf	
W =	1700	plf	
Total W =	2620	plf	1.031 <5%

Gravity Load Analysis

The increase in gravity load due to the renovation is less than 5%, so the existing walls and foundations are permitted to remain unaltered.

Lateral Load Analysis

Since seismic loads are based on the weight of the structure which is not changing, the seismic loads are not increased so the existing structure is permitted to remain unaltered. Since the size of the structure is not changing, the wind loads are not increased and the existing structure is permitted to remain unaltered.

FOOTING ANALYSIS

In accordance with ACI318-19

Tedds calculation version 3.3.03

Summary results

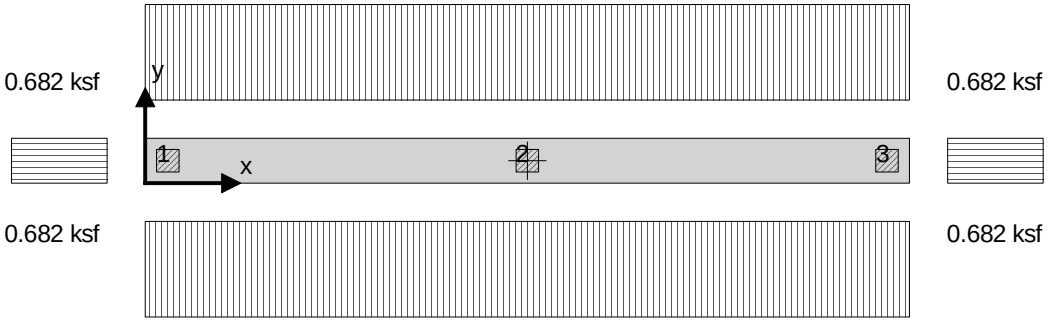
Overall design status	PASS
Overall design utilisation	0.426

Description	Unit	Applied	Resisting	FoS	Result
Uplift verification	kips	11.6			Pass

Description	Unit	Applied	Resisting	Utilization	Result
Soil bearing	ksf	0.682	1.6	0.426	Pass

Pad footing details

Length of footing	L_x = **17** ft
Width of footing	L_y = **1** ft
Footing area	$A = L_x \times L_y$ = **17** ft^2
Depth of footing	h = **30** in
Depth of soil over footing	h_{soil} = **0** in
Density of concrete	γ_{conc} = **150.0** lb/ft^3



Column no.1 details

Length of column	l_{x1} = **6.00** in
Width of column	l_{y1} = **6.00** in
position in x-axis	x_1 = **6.00** in
position in y-axis	y_1 = **6.00** in

Column no.2 details

Length of column	l_{x2} = **6.00** in
Width of column	l_{y2} = **6.00** in
position in x-axis	x_2 = **102.00** in
position in y-axis	y_2 = **6.00** in

Column no.3 details

Length of column	l_{x3} = **6.00** in
Width of column	l_{y3} = **6.00** in
position in x-axis	x_3 = **198.00** in

position in y-axis — y_3 = **6.00** in

Soil properties

Net allowable bearing pressure — q_{allow_Net} = **1.5** ksf using a soil factor of safety, FS_{soil}, of 3

Density of soil — γ_{soil} = **120.0** lb/ft^3

Angle of internal friction — ϕ_b = **30.0** deg

Design base friction angle — δ_{bb} = **30.0** deg

Coefficient of base friction — $\tan(\delta_{bb})$ = **0.577**

Footing loads

Dead surcharge load — F_{Dsur} = **75** psf

Live surcharge load — F_{Lsur} = **60** psf

Self weight — $F_{swt} = h \times \gamma_{conc}$ = **375** psf

Column no.1 loads

Dead load in z — F_{Dz1} = **0.3** kips

Live load in z — F_{Lz1} = **0.5** kips

Column no.2 loads

Dead load in z — F_{Dz2} = **0.6** kips

Live load in z — F_{Lz2} = **0.9** kips

Column no.3 loads

Dead load in z — F_{Dz3} = **0.3** kips

Live load in z — F_{Lz3} = **0.5** kips

Footing analysis for soil and stability

Load combinations per ASCE 7-16

1.0D (0.322)

1.0D + 1.0L (0.426)

Combination 2 results: 1.0D + 1.0L

Forces on footing

Force in z-axis — $F_{dz} = \gamma_D \times A \times (F_{swt} + F_{Dsur}) + \gamma_L \times A \times F_{Lsur} + \gamma_D \times (F_{Dz1}) + \gamma_L \times F_{Lz1} + \gamma_D \times (F_{Dz2}) + \gamma_L \times F_{Lz2} + \gamma_D \times (F_{Dz3}) + \gamma_L \times F_{Lz3}$ = **11.6** kips

Moments on footing

Moment in x-axis, about x is 0 — $M_{dx} = \gamma_D \times (A \times (F_{swt} + F_{Dsur}) \times L_x / 2) + \gamma_L \times A \times F_{Lsur} \times L_x / 2 + \gamma_D \times (F_{Dz1} \times x_1) + \gamma_L \times (F_{Lz1} \times x_1) + \gamma_D \times (F_{Dz2} \times x_2) + \gamma_L \times (F_{Lz2} \times x_2) + \gamma_D \times (F_{Dz3} \times x_3) + \gamma_L \times (F_{Lz3} \times x_3)$ = **98.5** kip_ft

Moment in y-axis, about y is 0 — $M_{dy} = \gamma_D \times (A \times (F_{swt} + F_{Dsur}) \times L_y / 2) + \gamma_L \times A \times F_{Lsur} \times L_y / 2 + \gamma_D \times (F_{Dz1} \times y_1) + \gamma_L \times (F_{Lz1} \times y_1) + \gamma_D \times (F_{Dz2} \times y_2) + \gamma_L \times (F_{Lz2} \times y_2) + \gamma_D \times (F_{Dz3} \times y_3) + \gamma_L \times (F_{Lz3} \times y_3)$ = **5.8** kip_ft

Uplift verification

Vertical force — F_{dz} = **11.59** kips

PASS - Footing is not subject to uplift

Bearing resistance

Eccentricity of base reaction

Eccentricity of base reaction in x-axis — $e_{dx} = M_{dx} / F_{dz} - L_x / 2$ = **0** in

Eccentricity of base reaction in y-axis $e_{dy} = M_{dy} / F_{dz} - L_y / 2 =$ **0** in

Pad base pressures

$q_1 = F_{dz} \times (1 - 6 \times e_{dx} / L_x - 6 \times e_{dy} / L_y) / (L_x \times L_y) =$ **0.682** ksf

$q_2 = F_{dz} \times (1 - 6 \times e_{dx} / L_x + 6 \times e_{dy} / L_y) / (L_x \times L_y) =$ **0.682** ksf

$q_3 = F_{dz} \times (1 + 6 \times e_{dx} / L_x - 6 \times e_{dy} / L_y) / (L_x \times L_y) =$ **0.682** ksf

$q_4 = F_{dz} \times (1 + 6 \times e_{dx} / L_x + 6 \times e_{dy} / L_y) / (L_x \times L_y) =$ **0.682** ksf

Minimum base pressure $q_{min} = \min(q_1,q_2,q_3,q_4) =$ **0.682** ksf

Maximum base pressure $q_{max} = \max(q_1,q_2,q_3,q_4) =$ **0.682** ksf

Allowable bearing capacity

Allowable bearing capacity $q_{allow} = q_{allow_Net} + ((h + h_{soil}) \times \gamma_{soil}) / FS_{soil} =$ **1.6** ksf

$q_{max} / q_{allow} =$ **0.426**

PASS - Allowable bearing capacity exceeds design base pressure