PROJECT MANUAL
FOR
FIRE STATION NO. 3
1204 McCormick Street
Denton, Texas

OWNER: CITY OF DENTON

ARCHITECT:
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Denton, Texas 76201
940.387.8182 voice
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DATE: 02 January 2019 Issued for Bid

REGISTERED ARCHITECT DAVID M. ROBINSON STATE OF TEXAS

STATE OF TEXAS KEVIN L. GOODMAN 66787 REGISTERED PROFESSIONAL ENGINEER 6/4/18

SEAL IS FOR STRUCTURAL SPECIFICATIONS LISTED ON THE ATTACHED "TABLE OF CONTENTS STRUCTURAL SPECIFICATIONS" BY FWNA

STATE OF TEXAS MICHAEL JOSEPH SMITH 87383 LICENSED PROFESSIONAL ENGINEER 6/8/18

STATE OF TEXAS JOHN VINCENT 108939 LICENSED PROFESSIONAL ENGINEER 6-8-18 ELECTRICAL

REGISTERED LANDSCAPE ARCHITECT CHRISTOPHER A. RUSSELL 1892 STATE OF TEXAS 06.12.18

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Structural Specifications

Frank W. Neal & Assoc., Inc.
Texas Firm Registration No.: F-296

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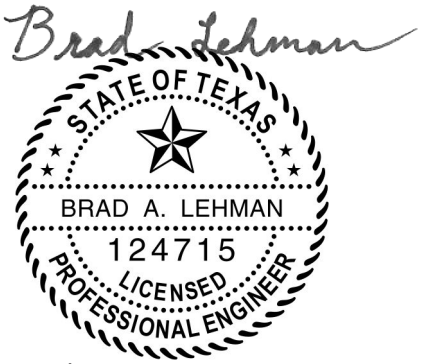

MJ Thomas Engineering, LLC.
F-9435
06/12/2018

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Structural Specifications

Frank W. Neal & Assoc., Inc.
Texas Firm Registration No.: F-296

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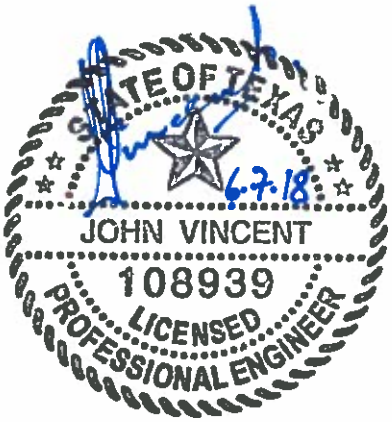

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DOCUMENT 003132 - GEOTECHNICAL DATA

1.1 SUMMARY

A. This document includes information pertaining to geotechnical data.

1.2 INVESTIGATION

A. An investigation of subsurface soil conditions at the building site was authorized by the Owner, and was subsequently performed by D&S Engineering Labs, Report #15-0441, dated April 4, 2016.

1.3 REPORT

A. The Geotechnical Investigation Report is for information only, and is not a warranty of subsurface conditions.

B. The Report is made available for information only, and is not a Contract Document.

C. The information contained in the Report represents design criteria, recommendations, and guidelines that were utilized as the basis of design for the engineering of the earthwork operations, paving design, and foundation design indicated in the Contract Documents. No changes in this design criteria will be considered or permitted. Where options are indicated, the options were considered by the respective design team members and implemented in the construction documents.

1.4 RESPONSIBILITY

A. Bidders are expected to examine the site and subsurface investigation reports and then decide for themselves the character of the materials to be encountered.

B. The Architect and Owner assume no responsibility for variations in subsoil conditions, quality, or stability, or for the presence, level, and extent of underground water.

C. The Architect and Owner assume no responsibility for Bidder's interpretation of data contained in the Report.

END OF DOCUMENT

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Project information.
   2. Work covered by Contract Documents.
   3. Work by Owner.
   4. Owner-furnished products.
   5. Access to site.
   6. Work restrictions.
   7. Specification and drawing conventions.

1.3 PROJECT INFORMATION

A. Project Identification: Replacement Fire Station, No. 3.
   1. Project Location: 1204 McCormick St., Denton, Texas

B. Owner: City of Denton, Texas

C. Architect: Kirkpatrick Architecture Studio

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:
   1. 15,951 s.f. one story fire station with four apparatus bays, living quarters, and all associated sitework.

B. Type of Contract:
   1. Project will be constructed under a single prime contract.

1.5 WORK BY OWNER

A. General: 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.

1.6 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

B. Owner-Furnished Products:
   1. SCBA air compressor and fill station.
   2. Alerting System.
   3. Refrigerators.
   4. Washers and dryers.
   5. Z Rack.

1.7 ACCESS TO SITE

A. General: Contractor shall have limited use of Project site for construction operations during construction period. Contractor's use of Project site is limited by Owner’s use of existing facility which must remain in operation until new facility is completed.

B. 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. Driveways, Walkways and Entrances: Keep drivewaysand entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

a. Schedule deliveries to minimize use of driveways and entrances by construction operations.

b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

1.8 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

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

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. Specification requirements are to be performed by Contractor unless specifically stated otherwise.

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

C. 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 published as part of the U.S. National CAD Standard and scheduled on Drawings.

3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements governing allowances.

B. Related Requirements:
1. Section 012200 "Unit Prices" for procedures for using unit prices.
2. Section 014000 "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.

1.3 SELECTION AND PURCHASE

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

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

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

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

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

B. 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.

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

1.6 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.7 LUMP-SUM ALLOWANCES

A. Requirements in this Article coordinate with AIA Document A201. Revise to suit Project.

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

C. 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 selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.

D. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
   1) If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.

1.8 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: To adjust allowance amounts, prepare an Allowance Expenditure Authorization Form 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.
   1. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
   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.

B. 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.
   1. 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.
   2. 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

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 ALLOWANCES

A. Allow the lump sum of $1,500 for purchase and installation of cast bronze dedication plaque.
B. Allow the lump sum of $100,000 for Owner Betterment.

END OF SECTION 01 2100

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

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

1.2 SUMMARY
- A. Section includes administrative and procedural requirements for alternates.

1.3 DEFINITIONS
- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
  1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
  2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES
- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
  1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.
- B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.
- C. Execute accepted alternates under the same conditions as other work of the Contract.
- D. Schedule: A schedule of alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

1.3 DEDUCTIVE ALTERNATE 1
- A. Refer to Sheet A-10.10
- B. Refer to Sheet A-10.11
- C. Refer to Sheet A-10.12
- D. Refer to Sheet A-10.13
- E. Refer to Sheet A-10.14
- F. Refer to Sheet S-10.10
- G. Refer to Sheet S-10.11

1.4 DEDUCTIVE ALTERNATE 2
- A. Refer to Sheet A-10.20
- B. Refer to Sheet A-10.21
- C. Refer to Sheet S-10.20
- D. Refer to Sheet S-10.21
- E. Refer to Sheet E-10-20
- F. Refer to Sheet E-10-21
- G. Refer to Sheet E-10-22
- H. Refer to Sheet E-10-23
- I. Refer to Sheet E-10-24

1.5 DEDUCTIVE ALTERNATE 3
- A. Refer to Sheet A-10.30
- B. Refer to Sheet A-10.31
- C. Refer to Sheet A-10.32
- D. Refer to Sheet A-10.33
- E. Refer to Sheet A-10.34

1.6 DEDUCTIVE ALTERNATE 4
- A. Refer to Sheet A-10.40

B. Refer to Sheet A-10.41
C. Refer to Sheet S-10.40
D. Refer to Sheet E-10-40

END OF SECTION

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
   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 in order to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify 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 facsimile of 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 cannot be provided, if applicable.
      b. Coordination 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 substitution 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 and 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 or other agency approved by local authority .
      j. Detailed comparison of Contractor's construction schedule using proposed substitution 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 sevendays 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.

1.4 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.

1.5 PROCEDURES

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

PART 2 - PRODUCTS

2.1 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. Substitution request is fully documented and properly submitted.
        c. Requested substitution will not adversely affect Contractor's construction schedule.
        d. Requested substitution has received necessary approvals of authorities having jurisdiction.
        e. Requested substitution is compatible with other portions of the Work.
        f. Requested substitution has been coordinated with other portions of the Work.
        g. Requested substitution provides specified warranty.

B. Substitutions for Convenience: Architect will consider requests for substitution if received within the stated period during bidding phase or within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.
    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 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.
        b. Requested substitution is consistent with the Contract Documents and will produce indicated results.
        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.

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 012500.13

SUBSTITUTION REQUEST FORM

PROJECT: _____ **(After Contract Award)**

TO: _____

_____

NO. _____ DATE: _____

Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Division 01 Section "Substitution Procedures:"

1. SPECIFIED PRODUCT OR SYSTEM

Substitution request for: _____

Specification Section No.: _____ Article/ Paragraph: _____

2. REASON FOR SUBSTITUTION REQUEST

SPECIFIED PRODUCT . . .

- ☐ Is no longer available.
- ☐ Is unable to meet project schedule.
- ☐ Is unsuitable for the designated application.
- ☐ Cannot interface with adjacent materials.
- ☐ Is not compatible with adjacent materials.
- ☐ Cannot provide the specified warranty.
- ☐ Cannot be constructed as indicated
- ☐ Cannot be obtained due to one or more of the following:
  - ☐ Strike
  - ☐ Lockout
  - ☐ Bankruptcy of manufacturer or supplier
  - ☐ Similar occurrence (explain below)

PROPOSED PRODUCT . . .

- ☐ Will reduce construction time
- ☐ Will result in cost savings of $ _____ to Project
- ☐ Is for supplier's convenience
- ☐ Is for subcontractor's convenience
- ☐ Other:_____ _____

3. SUPPORTING DATA

- ☐ Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request are attached.
- ☐ Sample is attached.
- ☐ Sample will be sent if requested.

4. QUALITY COMPARISON

Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

SPECIFIED PRODUCT PROPOSED PRODUCT

Manufacturer: _____

Name / Brand: _____

Catalog No.: _____

Vendor: _____

Variations: _____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: _____

Maintenance Service Available: ☐ Yes ☐ No

Spare Parts Source: _____

Warranty: ☐ Yes ☐ No _____ Years

5. PREVIOUS INSTALLATIONS

Identification of at least three similar projects on which proposed substitution was used:

PROJECT #1:

Project: _____

Address: _____

_____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

PROJECT #2:

Project: _____

Address: _____

_____

Architect: _____

Owner: _____

Contractor: _____

Date Installed: _____

6. EFFECT OF SUBSTITUTION

Proposed substitution affects other work or trades: ☐ No ☐ Yes (if Yes, explain)

_____

_____

Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:

☐ No ☐ Yes (if Yes, attach data explaining revisions)

7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

A. They have personally investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated above;

B. The proposed substitution is in compliance with applicable codes and ordinances;

C. The proposed substitution will provide same warranty as specified for specified product;

D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;

E. They have included complete cost data and implications of the substitution (attached);

F. They will pay any redesign fees incurred by the Architect or any of the Architect's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;

G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.

H. The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Contractor:_____
(Name of Contractor)

Date:_____ By: _____

Subcontractor:_____
(Name of Subcontractor)

Date:_____ By: _____

Note: Unresponsive or incomplete requests will be rejected and returned without review.

8. ARCHITECT'S REVIEW AND ACTION

☐ Substitution is accepted.

☐ Substitution is accepted, with the following comments:_____

_____

_____

☐ Resubmit Substitution Request:

☐ Provide more information in the following areas: _____

_____

_____

☐ Provide proposal indicating amount of savings / credit to Owner

☐ Bidding Contractor shall sign Bidder's Statement of Conformance

☐ Bidding Subcontractor shall sign Bidder's Statement of Conformance

☐ Substitution is not accepted:

☐ Substitution Request received too late.

☐ Substitution Request received directly from subcontractor or supplier.

☐ Substitution Request not submitted in accordance with requirements.

☐ Substitution Request Form is not properly executed.

☐ Substitution Request does not indicate what item is being proposed.

☐ Insufficient information submitted to facilitate proper evaluation.

☐ Proposed product does not appear to comply with specified requirements.

☐ Proposed product will require substantial revisions to Contract Documents.

By: _____

Date:_____

Architect has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

9. OWNER'S REVIEW AND ACTION

☐ Substitution is accepted; Architect to prepare Change Order.

☐ Substitution is not accepted.

☐ Owner will pay Architect directly for redesign fees.

☐ Include Architect's Additional Service fee for implementing the substitution in the Change Order.

By: _____
(Owner/Owner's Representative)

Date:_____

END OF FORM

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 MINOR CHANGES IN THE WORK

A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 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 CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail." or other 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 CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail." or other form acceptable to Architect**.**

1.4 ADMINISTRATIVE CHANGE ORDERS

A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701 or other form acceptable to Architect.

1.6 CONSTRUCTION CHANGE DIRECTIVE

A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. ConstructionChange Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
   1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

B. Documentation: Maintain detailed records on a time and material basis of work required by the ConstructionChange Directive.
   1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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 other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

A. 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.

1.3 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
   1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
      a. Application for Payment forms with continuation sheets.
      b. Submittal schedule.
      c. Items required to be indicated as separate activities in Contractor's construction schedule.
   2. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract as described in Section 011000 "Summary."

B. 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.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Name of Architect.
      c. Architect's project number.
      d. Contractor's name and address.
      e. Date of submittal.
   2. Arrange schedule of values consistent with format of AIA Document G703 .
   3. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
      a. Related Specification Section or Division.
      b. Description of the Work.
      c. Name of subcontractor.
      d. Name of manufacturer or fabricator.
      e. Name of supplier.
      f. Change Orders (numbers) that affect value.
      g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
         1) Labor.
         2) Materials.
         3) Equipment.
   4. 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.
      a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

7. 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.
    a. 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.
8. Schedule Updating: Update and resubmit the schedule of values prior to the next Applications.

1.4 APPLICATIONS FOR PAYMENT

A. 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.
    1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
B. 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.
C. Payment Application Times: Submit Application for Payment to Architect by the last day of the month. The period covered by each Application for Payment is one month, ending on the 25 day of the month, but project through the end of the month.
    1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
D. Application for Payment Forms: Use forms provided by Owner for Applications for Payment.
E. 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.
F. 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.
    1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
    2. 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.
    3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
    4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
G. 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.
    1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
    2. 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.
    3. Provide summary documentation for stored materials indicating the following:
        a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
        b. 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.
        c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
H. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
    1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
I. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
    1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
    2. When an application shows completion of an item, submit conditional final or full waivers.
    3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
    4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

J. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit conditional final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
   5. Waiver Forms: Submit executed waivers of lien on forms, acceptable to Owner.

K. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. Schedule of values.
   2. Schedule of unit prices.
   3. Submittal schedule (preliminary if not final).
   4. List of Contractor's staff assignments.
   5. List of Contractor's principal consultants.
   6. Copies of building permits.
   7. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
   8. Initial progress report.
   9. Report of preconstruction conference.
   10. Certificates of insurance and insurance policies.
   11. Performance and payment bonds.
   12. Data needed to acquire Owner's insurance.

L. 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.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

M. 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:
   1. Evidence of completion of Project closeout requirements.
   2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
   3. Updated final statement, accounting for final changes to the Contract Sum.
   4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
   5. AIA Document G707, "Consent of Surety to Final Payment."
   6. 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.
   7. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 013100 - 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 other 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. Requests for Information (RFIs).

1.3 DEFINITIONS

A. RFI: 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, and telephone number 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 and telephone numbers, including home, office, and 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, on Project Web site, and by each temporary telephone. 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.

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.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities 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. 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.

1.6 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown 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. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
      b. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
      c. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
      d. Indicate required installation sequences.
      e. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
   2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
   4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   6. Mechanical and Plumbing Work: Show the following:
      a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
      b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
      c. Fire-rated enclosures around ductwork.
   7. Electrical Work: Show the following:
      a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
      b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
      c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
      d. Location of pull boxes and junction boxes, dimensioned from column center lines.
   8. Fire-Protection System: Show the following:
      a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
   9. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
   10. Refer to individual Sections for additional requirements.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: 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. Digital Data Software Program: Refer to Section 011000 "Summary" for digital data software program.
      c. Contractor shall execute a data licensing agreement in the form of Agreement acceptable to Owner and Architect.

1.7 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
   1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
   2. Coordinate and submit RFIs in a prompt manner so as 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. Project number.
   3. Date.
   4. Name of Contractor.
   5. Name of Architect.
   6. RFI number, numbered sequentially.
   7. RFI subject.
   8. Specification Section number and title and related paragraphs, as appropriate.
   9. Drawing number and detail references, as appropriate.
   10. Field dimensions and conditions, as appropriate.
   11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   12. Contractor's signature.
   13. 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 Adobe Acrobat PDF format.

D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working 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 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.

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. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.8 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.
   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. Conduct the conference to review responsibilities and personnel assignments.
   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 conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
   3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

C. Sustainability Coordination Conference: Owner will schedule and conduct a LEED coordination conference before starting construction, at a time convenient to Owner Architect, and Contractor.
   1. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent and Sustainability coordinator; 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 meeting requirements for Sustainability certification, including the following:
      a. Sustainability Project Checklist.
      b. General requirements for Sustainability-related procurement and documentation.
      c. Project closeout requirements and Sustainability certification procedures.
      d. Role of Sustainability coordinator.
      e. Construction waste management.
      f. Construction operations and Sustainability requirements and restrictions.
   3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires 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. Options.
      b. Related RFIs.
      c. Related Change Orders.
      d. Purchases.
      e. Deliveries.
      f. Submittals.

g. Sustainable design requirements.
h. Review of mockups.
i. Possible conflicts.
j. Compatibility requirements.
k. Time schedules.
l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. 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.
6. Coordinate Pre-Installation conferences with Owner and Architect. Conferences to include, but not limited to:
   a. Sub-Structures / vehicle bay drawing.
   b. Sub-Structure / Division 26 and 28.
   c. Masonry Structure / vehicle doors.
   d. Slab finish.

E. 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. Submittal of written warranties.
   d. Requirements for completing sustainable design documentation.
   e. Requirements for preparing operations and maintenance data.
   f. Requirements for delivery of material samples, attic stock, and spare parts.
   g. Requirements for demonstration and training.
   h. Preparation of Contractor's punch list.
   i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
   j. Coordination of separate contracts.
   k. Owner's partial occupancy requirements.
   l. Installation of Owner's furniture, fixtures, and equipment.
   m. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.

F. Progress Meetings: Conduct progress meetings at weekly intervals.
1. Coordinate dates of meetings with preparation of payment requests.
2. Attendees: In addition to representatives of Owner 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) Status of submittals.
        3) Status of sustainable design documentation, including review of action plans.
        4) Deliveries.
        5) Off-site fabrication.
        6) Access.
        7) Site utilization.
        8) Temporary facilities and controls.
        9) Progress cleaning.
        10) Quality and work standards.
        11) Status of correction of deficient items.
        12) Field observations.
        13) Status of RFIs.
        14) Status of proposal requests.
        15) Pending changes.
        16) Status of Change Orders.
        17) Pending claims and disputes.
        18) 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.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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. Construction schedule updating reports.
   3. Daily construction reports.
   4. Material location reports.
   5. Site condition reports.

B. Related Requirements:
   1. Section 014000 "Quality Requirements" for submitting a 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 the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by Architect.

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 when activities can be performed and the critical path of Project.

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 is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
   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 manpower and equipment necessary for the completion of 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, where indicated.

B. Startup construction schedule.
   1. Approval 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.

D. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall 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 all 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 all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
3. Total Float Report: List of all activities sorted in ascending order of total float.

E. Construction Schedule Updating Reports: Submit with Applications for Payment.
F. Special Reports: Submit at time of unusual event.
G. 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. May be an employee of the Contractor.
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 phasing work stages and partial Owner occupancy.
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.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
B. Activities: Treat each story 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. Procurement Activities: Include procurement process activities for the following long lead 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.
3. 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.
4. Startup and Testing Time: Include no fewer than 7 days for startup and testing.
5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.

C. 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 under More Than One Contract: Include a separate activity for each contract.
   2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
   4. 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.
   5. Work Restrictions: Show the effect of the following items on the schedule:
      a. Provisions for future construction.
      b. Seasonal variations.
      c. Environmental control.
   6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
      a. Subcontract awards.
      b. Submittals.
      c. Purchases.
      d. Mockups.
      e. Fabrication.
      f. Sample testing.
      g. Deliveries.
      h. Installation.
      i. Tests and inspections.
      j. Adjusting.
      k. Curing.
      l. Building flush-out.
      m. Startup and placement into final use and operation.
   7. 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.
D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion, and the following interim milestones:
   1. Temporary enclosure and space conditioning.
E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
   1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
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 Contract Time.
G. 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, and equipment required to achieve compliance, and date by which recovery will be accomplished.
H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

A. General: Prepare network diagrams using AON (activity-on-node) format.

B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

C. CPM Schedule: Prepare Contractor's construction schedule using a cost- and resource-loaded, time-scaled CPM network analysis diagram for the Work.

1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
    a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.

D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    a. Preparation and processing of submittals.
    b. Mobilization and demobilization.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and commissioning.
    j. Punch list and final completion.
    k. Activities occurring following final completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
4. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, and demonstration and training (if applicable), in the amount of 5 percent of the Contract Sum.
    a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
    b. Total cost assigned to activities shall equal the total Contract Sum.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.

F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Main events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.
9. Average size of workforce.

10. Dollar value of activity (coordinated with the schedule of values).

G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
   1. Identification of activities that have changed.
   2. Changes in early and late start dates.
   3. Changes in early and late finish dates.
   4. Changes in activity durations in workdays.
   5. Changes in the critical path.
   6. Changes in total float or slack time.
   7. Changes in the Contract Time.

H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
   1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
   2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
   3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
   4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
      a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
      b. Submit value summary printouts one week before each regularly scheduled progress meeting.

2.3 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of separate contractors at Project site.
   2. Approximate count of personnel at Project site.
   3. Equipment at Project site.
   4. Material deliveries.
   5. High and low temperatures and general weather conditions, including presence of rain or snow.
   6. Accidents.
   7. Meetings and significant decisions.
   8. Unusual events (see special reports).
   9. Stoppages, delays, shortages, and losses.
   10. Meter readings and similar recordings.
   11. Emergency procedures.
   12. Orders and requests of authorities having jurisdiction.
   13. Change Orders received and implemented.
   14. Construction Change Directives received and implemented.
   15. Services connected and disconnected.
   16. Partial completions and occupancies.
   17. 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 shall 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.

2.4 SPECIAL REPORTS

A. General: Submit special reports directly to Owner within one day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: 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, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.

1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.

B. 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.

C. 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.

END OF SECTION

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for the following:
   1. Preconstruction photographs.
   2. Periodic construction photographs.
   3. Final completion construction photographs.
   4. Preconstruction video recordings.
   5. Periodic construction video recordings.

1.3 UNIT PRICES

A. Basis for Bids: Base number of construction photographs on average of 20 photographs per week over the duration of Project.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For photographer.

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

C. Digital Photographs: Submit image files within three days of taking photographs.
   1. Digital Camera: Minimum sensor resolution of 8 megapixels.
   2. Format: Minimum 3200 by 2400 pixels, in unaltered original files, with same aspect ratio as the sensor, uncropped, date and time stamped, in folder named by date of photograph, accompanied by key plan file.
   3. 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 vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      g. Unique sequential identifier keyed to accompanying key plan.
   4. Provide photographs to Architect and Owner.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels. Mount camera on a fixed pole at a location and height as approved by Architect.

B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to Architect.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
   1. Maintain key plan with each set of construction photographs that identifies each photographic location.

B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
   1. Date and Time: Include date and time in file name for each image.
   2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.

C. Preconstruction Photographs: Before starting construction, take photographs and video of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   1. Flag excavation areas 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 20 photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

E. Time-Lapse Sequence Construction Photographs: Take photographs with web cam mounted on pole and connected to internet via IP address.
   1. Frequency: Take photographs at 1 minute intervals each day construction activities occur.
   2. Vantage Points: Confirm location with Architect.

F. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. will inform photographer of desired vantage points.
   1. Do not include date stamp.

G. 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. Immediate follow-up when on-site events result in construction damage or losses.
      b. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
      c. Substantial Completion of a major phase or component of the Work.
      d. Extra record photographs at time of final acceptance.

END OF SECTION

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

A. 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."

B. 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."

C. 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.

D. 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

A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule prior to initial Owner, Architect, Consultant meeting. 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.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. 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.
3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
    a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
    a. Scheduled date for first submittal.
    b. Specification Section number and title.
    c. Submittal category: Action; informational.
    d. Name of subcontractor.
    e. Description of the Work covered.
    f. Scheduled date for Architect's final release or approval.
    g. Scheduled date of fabrication.
    h. Scheduled dates for purchasing.
    i. Scheduled dates for installation.
    j. Activity or event number.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

A. 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.
   1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
      a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
      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:
         1) Floor plans.
         2) Reflected ceiling plans.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
   1. 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.
      a. The right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on 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.
   1. Initial Review: Allow 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Will advise Contractor when a submittal being processed must be delayed for coordination.
   2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
   3. Resubmittal Review: Allow 21 days for review of each resubmittal.
   4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
   5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow 28 days for review of each submittal. Submittal will be returned to before being returned to Contractor.

D. Electronic Submittals: Identify and incorporate information in each electronic submittal file 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.
      a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
   3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
   4. Transmittal Form for Electronic Submittals: Use electronic form acceptable to Owner**,** containing the following information:
      a. Project name.
      b. Date.
      c. Name and address of Architect.
      d. Name of Contractor.
      e. Name of firm or entity that prepared submittal.
      f. Names of subcontractor, manufacturer, and supplier.
      g. Category and type of submittal.
      h. Submittal purpose and description.
      i. Specification Section number and title.

j. Specification paragraph number or drawing designation and generic name for each of multiple items.
k. Drawing number and detail references, as appropriate.
l. Location(s) where product is to be installed, as appropriate.
m. Related physical samples submitted directly.
n. Indication of full or partial submittal.
o. Transmittal number, numbered consecutively.
p. Submittal and transmittal distribution record.
q. Other necessary identification.
r. Remarks.

5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
a. Project name.
b. Number and title of appropriate Specification Section.
c. Manufacturer name.
d. Product name.
e. .

E. Options: Identify options requiring selection by Architect.

F. 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.

G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
2. Note date and content of revision in label or title block and clearly indicate extent of revision.
3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.

H. 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.

I. 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

A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Send electronic submittals as PDF electronic files to Architect.
a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
2. Submit electronic submittals via email as PDF electronic files.
a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
5. 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.
a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
1. 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.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:
a. Manufacturer's catalog cuts.
b. Manufacturer's product specifications.

c. Color charts for full available range of colors.
d. Statement of compliance with specified referenced standards.
e. Testing by recognized testing agency.
f. Application of testing agency labels and seals.
g. Notation of coordination requirements.
h. Availability and delivery time information.

4. For equipment, include the following in addition to the above, as applicable:
   a. Wiring diagrams showing factory-installed wiring.
   b. Printed performance curves.
   c. Operational range diagrams.
   d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
5. Submit Product Data before or concurrent with Samples.
6. Submit Product Data in the following format:
   a. PDF electronic file.

C. Shop Drawings: 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.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
   a. 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.
2. 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.
3. Submit Shop Drawings in the following format:
   a. PDF electronic file.

D. Samples: 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.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
   a. Generic description of Sample.
   b. Product name and name of manufacturer.
   c. Sample source.
   d. Number and title of applicable Specification Section.
   e. Specification paragraph number and generic name of each item.
3. 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.
4. 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.
   a. 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.
   b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. 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.
   a. 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.
6. 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.

a. 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.

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

2) 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.

E. Product Schedule: 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:

1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
2. Manufacturer and product name, and model number if applicable.
3. Number and name of room or space.
4. Location within room or space.
5. Submit product schedule in the following format:
   a. PDF electronic file.

F. Coordination Drawing Submittals: Comply with requirements specified in Section 013100 "Project Management and Coordination."

G. Contractor's Construction Schedule: Comply with requirements specified in Section 013200 "Construction Progress Documentation."

H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 012900 "Payment Procedures."

I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 014000 "Quality Requirements."

J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 017700 "Closeout Procedures."

K. Maintenance Data: Comply with requirements specified in Section 017823 "Operation and Maintenance Data."

L. Qualification Data: 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.

M. Welding Certificates: 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.

N. Installer Certificates: 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.

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

P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

R. 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.

S. Product Test Reports: 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.

T. Research Reports: 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:

1. Name of evaluation organization.
2. Date of evaluation.
3. Time period when report is in effect.
4. Product and manufacturers' names.

5. Description of product.
6. Test procedures and results.
7. Limitations of use.

U. Preconstruction Test Reports: 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.

V. Compatibility Test Reports: 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.

W. Field Test Reports: 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.

X. 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

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 Certification: 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.
1. 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

A. 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.

B. Project Closeout and Maintenance Material Submittals: See requirements in Section 017700 "Closeout Procedures."

C. 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

A. 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.

B. 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.

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

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

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

END OF SECTION

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

B. Testing and inspecting 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 -control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
4. Specific test and inspection requirements are not specified in this Section.

1.3 DEFINITIONS

A. 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.

B. 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. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.

D. 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.

E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

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

H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

I. 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, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

J. Experienced: When used with an entity or individual, "experienced" 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.

1.4 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be 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.

1.5 ACTION SUBMITTALS

A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
   1. Indicate manufacturer and model number of individual components.
   2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

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 sent to authorities having jurisdiction before starting work on the following systems:
   1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
   2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.

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.

1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

A. Quality-Control Plan, General: Submit quality-control plan within 10 days of commencement of construction , 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. Coordinate with Contractor's construction schedule.

B. Quality-Control Personnel Qualifications: Engage qualified full-time 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.
   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 the 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 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, and telephone number 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 inspecting.
   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, and telephone number 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 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, and telephone number 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 whether conditions, products, and installation will affect warranty.
   5. Other required items indicated in individual Specification Sections.

D. Permits, Licenses, and Certificates: For Owner's records, 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.

1.9 QUALITY ASSURANCE

A. General: 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.

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, 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 are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
   1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: 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 329; 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.

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 installation 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 responsibilities include the following:
      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, 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, 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: Refer to Section 014339.

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 inspecting 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, and the Contract Sum will be adjusted by Change Order.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
   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. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
      a. Contractor shall 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 inspecting 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 inspecting 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. 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."

D. 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.

E. 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.

F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location 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 any duties of Contractor.

G. Associated Services: Cooperate with agencies 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 inspecting. 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 inspecting equipment at Project site.

H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.
1. Distribution: Distribute schedule to Owner, Architect, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

1.11 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Conducted by a qualified testing agency and special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect 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 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 reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, 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

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

1.4 ABBREVIATIONS AND ACRONYMS

A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall 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."

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 014339 - MOCK-UP WALL CONSTRUCTION

PART 1 – GENERAL

1.1 DESCRIPTION

A An Envelope Pre-construction meeting shall be held with all of the subcontractors responsible for erecting the envelope related materials.

B. Work includes: Constructing mock-up, including all reviewed submittals required by the Contract Documents, to establish compliance with the design intent as well as the specified requirements to provide a complete and watertight facility.

C. Providing a photo manifest of as-built conditions as the mock-up is being constructed. Photos shall be kept at the job site during construction for reference.

D. Mock-up fabrication must be completed and reviewed and approved by the Owner and Architect prior to starting installation of envelope material.

1.2 QUALITY ASSURANCE

A. Coordination of product submittals and construction installation:

1. Prior to each submittal, carefully review and coordinate all aspects of each item being submitted.
2. Verify that each item being submitted is in conformance in all respects with the specified requirements.
3. By affixing the Contractor's signature to each submittal for the mock-up, the contractor certifies that this coordination has been performed.
4. Contractor shall construct the site built mock-up with the same manner of specified construction as the new construction.
5. Contractor shall construct the site built mock-up with the same workmanship and quality as being implemented on the new construction.
6. All material to be installed shall be reviewed by architect and consultants for conformance.

PART 2 – PRODUCTS

2.1 MOCK-UP REQUIREMENTS

A. Build mock-ups to verify selections made under sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Mock-ups construction shall be coordinated by the General Contractor and constructed by the subcontractor responsible for the actual construction work. All conditions and materials to be used on the job shall be included in the mock-up. Build mock-ups to comply with the following requirements, using materials indicated for the completed Work. Refer to Sheet A.9.01 for additional mockup requiremements.

B. Contractor shall start the construction of the mock-up based on, but not limited to, the following list:

1. Waterproofing membrane
2. Damproofing material
3. Flexible Through-Wall Flashing Membrane
4. Metal Through-Wall Flashing
5. Preformed Flashing Pieces
6. Face Brick with Mortar and Weeps
7. Wall Ties
8. Weather Barrier
9. Weeps
10. Window Unit.
11. Cast Stone.

C. Samples and Manufacturer's Submittals: Submit prior to delivery or installation.

1. Samples of all building system components including all specified accessories.
2. Submit samples of proposed warranties complete with any addenda necessary to meet the warranty requirements as specified.
3. Submit latest edition of manufacturer's specifications and installation procedures. Submit only those items applicable to this project.
4. A written statement from the materials manufacturer approving the installer, specifications and drawings as described and/or shown for this project and stating the intent to guarantee the completed project.
5. Follow submitted shop drawings, product data of all sheet metal.

D. Scale and Measurements: Make Shop Drawings accurately to a scale sufficiently large enough to show all pertinent aspects of the item and its method of connection to the work.
E. Shop Drawings and Product Data: Provide manufacturer's approved details of all conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.
   1. Manufacturer's Details: All termination details and other details normally required by the manufacturer's Technical Specifications, including both standard details and special details, shall be furnished by the Contractor and shall be approved in writing by the manufacturer, the company project manager, and the Owner's representative prior to final installation.
F. Provide manufacturer's approved details, of all perimeter conditions, project conditions, and any additional special job conditions which require details other than indicated in the drawings.

2.2 MANUFACTURER'S LITERATURE
A. Work provided on the mock-up shall follow all of the submitted literature from manufacturers.
B. Manufacturer's literature shall be the minimum for basis of design and shall be in conjunction with construction documents. All manufacturers' warranties shall remain in effect as specified.

2.3 SAMPLES
A. Provide sample or samples identical to the precise article proposed to be provided.

2.4 COLORS AND PATTERNS
A. Unless the precise color and pattern are specifically called out in the Contract Documents, and whenever a choice of color or pattern is available in the specified products, submit accurate color and pattern charts to the Architect/Project Manager for selection.
B. Contractor shall coordinate with Architect for exact layout or design of patterns and textures and how they are to be installed on the mock-up.

PART 3 – EXECUTION

3.1 INSTALLATION OF MATERIALS
A. Contractor shall install all materials on mock-up in same manner required for the main structure. Refer to specification sections for basis of design of all material being installed on this mock-up.
B. Contractor shall maintain a photo manifest of mock-up construction for Architect and Owner to review.
C. Quality of installation is of utmost importance and shall be monitored for completeness and conformance.
D. Once mock-up is complete, it shall be reviewed by the Architect and Owner's Representative for conformance to construction documents.
E. Contractor shall install material in same sequencing as required by industry standards.

3.2 INSTALLATION OF WINDOWS AND ASSOCIATED FLASHING
A. Installer shall coordinate the installation of the window with associated trades to maintain proper compatibility of material.
B. Installation shall be in accordance with referencing specifications.
C. Install all perimeters flashing as detailed to create a sealed and watertight condition.
D. Once window and flashing has been installed, Contractor shall notify Architect, Owner and Consultants for review for conformance and shall provide a water test of all wall flashing. Contractor shall notify Architect, Owner and Consultants to observe the testing. All tests shall be in accordance with referencing specifications.

3.3 INSTALLATION OF FLASHING AT THROUGH-WALL LOCATION
A. Installer shall coordinate the installation of the wall flashing with associated trades to maintain proper compatibility of material.
B. Installation shall be in accordance with referencing specifications.
C. Once flashing has been installed, Contractor shall notify Architect, Owner and Consultants for review for conformance and shall provide a water test of all wall flashing. Contractor shall notify Architect, Owner and Consultants to observe the testing. All tests shall be in accordance with referencing specifications.

END OF SECTION

SECTION 015000 - 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 other 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.

1.3 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, 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 Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.

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

D. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
3. 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.

E. 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. Identify further options if proposed measures are later determined to be inadequate. 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.

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 U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines.

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 per ASTM E 84 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.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: 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. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
3. Drinking water and private toilet.
4. Coffee machine and supplies.
5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
7. WiFi connection.

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. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
2. Heating 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.
3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 017700 "Closeout Procedures".

C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 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.

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.

3.2 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 to municipal system 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, 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. 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.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
   1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.

G. 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 overhead unless otherwise indicated.
   2. Connect temporary service to Owner's existing power source, as directed by Owner.

H. 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.
   2. Install lighting for Project identification sign.

I. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line(s) for each field office.
   1. Provide additional telephone lines for the following:
      a. Provide a dedicated telephone line for each facsimile machine in each field office.
      b. Provide one telephone line(s) for Owner's use.
   2. At each telephone, post a list of important telephone numbers.
      a. Police and fire departments.
      b. Ambulance service.
      c. Contractor's home office.
      d. Contractor's emergency after-hours telephone number.
      e. Architect's office.
      f. Engineers' offices.
      g. Owner's office.
      h. Principal subcontractors' field and home offices.
   3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

J. Electronic Communication Service: Provide a desktop computer in the primary field to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
   1. Processor: Intel Pentium D or Intel CoreDuo, 3.0 GHz processing speed.
   2. Memory: 4 gigabyte.
   3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
   4. Display: 22-inch LCD monitor with 256-Mb dedicated video RAM.

5. Full-size keyboard and mouse.
6. Network Connectivity: 02/110BaseT Ethernet.
7. Operating System: Microsoft Windows XP Professional or Microsoft Windows Vista Business.
8. Productivity Software:
    a. Microsoft Office 2010 or higher, including Word, Excel, and Outlook.
    b. Adobe Reader 7.0 or higher.
    c. WinZip 7.0 or higher.
9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
12. Backup: External hard drive, minimum 40 gigabyte, with automated backup software providing daily backups.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
    1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
    2. 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 Use of 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 according to Section 312000 "Earth Moving."
    3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
C. 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.
D. Parking: Provide temporary parking areas for construction personnel.
E. 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.
F. 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 touchup signs so they are legible at all times.
G. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
H. 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.

3.4 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.
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. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings.
   1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant- protection zones.
   2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
   3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
   4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

D. 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.

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 environmentally safe materials.

G. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals 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.
   2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.

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 work day.

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: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.

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 Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
   1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
   2. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
   3. Insulate partitions to control noise transmission to occupied areas.
   4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.
   5. Protect air-handling equipment.
   6. Provide walk-off mats at each entrance through temporary partition.

M. 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.
   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to 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.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: 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 Phase: 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, replace, or clean stored or installed material that begins to grow mold.
   7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: 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 permanent HVAC system to control humidity.
   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.
      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 materials that can not be completely restored to their manufactured moisture level within 48 hours.

3.6 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. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.

D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

E. 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. 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

SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches above the ground for trees up to, and including, 4-inch size; and 12 inches above the ground for trees larger than 4-inch size.

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

C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and [defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

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

1.4 ACTION SUBMITTALS

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

B. Samples for Verification: For each type of the following:

1. Organic Mulch: 1-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.
3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.

C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.

1. Species and size of tree.
2. Location on site plan. Include unique identifier for each.
3. Reason for pruning.
4. Description of pruning to be performed.
5. Description of maintenance following pruning.

1.5 INFORMATIONAL SUBMITTALS

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

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

C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or videotape.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.6 QUALITY ASSURANCE

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

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

C. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
   a. Construction schedule. Verify availability of materials, personnel, and equipment needed to

make progress and avoid delays.
b. Enforcing requirements for protection zones.
c. Arborist's responsibilities.
d. Field quality control.

1.7 PROJECT CONDITIONS

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

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

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; 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 more than 1 inch in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
1. Obtain topsoil only from well-drained sites where topsoil is 4 inchesdeep or more; do not obtain from bogs or marshes.

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: Ground or shredded bark.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

C. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Architect.
1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2-inch opening, 0.148-inch- diameter wire chain-link fabric; with 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 and 0.177-inch-diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
a. Height: 6 feet.
2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.
3. Protection-Zone Fencing to comply with, and be approved by authority having jurisdiction.

D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size and Text: As shown on Drawings.
2. Lettering: 3-inch- high minimum, white characters on red background.

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. For the record, 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 or to be relocated. 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.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
   1. Apply 4-inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

D. Cut underbrush under all trees throughout the entire site.

3.3 TREE- AND PLANT-PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area 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.
   1. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
   2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
   3. Access Gates: Install where indicated; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 20 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

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

E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. 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."

B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

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

3.5 ROOT PRUNING

A. Prune roots that are affected by temporary and permanent construction. Prune roots 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."

B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches as shown on Drawings and as follows:
1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
2. Pruning Standards: Prune trees according to ANSI A300 (Part 1) and the following:
a. Type of Pruning: Cleaning.
b. Specialty Pruning: Restoration.
3. Cut branches with sharp pruning instruments; do not break or chop.
4. Do not apply pruning paint to wounds.

B. Chip removed branches and dispose of off-site.

3.7 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. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. 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.

D. Minor Fill within Protection Zone: Where existing grade is 2 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.8 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.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
1. Submit details of proposed root cutting and tree and shrub repairs.
2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
4. Perform repairs within 24 hours.
5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern. Confirm with Architect that intent of Tree Preservation Plans are being met.
1. Provide new trees of same size and species as those being replaced for each tree that measures 6 inches or smaller in caliper size. For trees over 6 inches, provide twice the caliper size.
2. Plant and maintain new trees as specified in Section 329300 "Plants."

C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk. Drill 2-inch- diameter holes a minimum of 12 inchesdeep at 24 inches o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 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

SECTION 015713 - EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes providing temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction. Temporary measures include the following.
   1. Silt fences.
   2. Sediment barriers and check dams.
   3. Stabilized construction entrance.
   4. Construction of temporary swales and sedimentation basins as required.
   5. Seeding, sodding, and hydromulching.
   6. Dust control.
   7. Slope protection.

B. Comply with all local, state, and federal regulations regarding erosion control including the applicable provisions of the National Pollution Discharge Elimination System (NPDES) regulations from the Federal Clean Water Act.

C. Should any provisions of this section be at variance with erosion control plan prepared by the civil engineer, the civil engineer's directive shall take precedence.

1.2 NOTICE OF INTENT

A. Contractor and Owner shall jointly submit an EPA Notice of Intent (NOI) prior to construction.

B. Contractor shall prepare the report, coordinate with Owner, and file in accordance with regulations.

PART 2 - PRODUCTS

2.1 SILT FENCE

A. Filter Fabric: Non-woven polypropylene, polyethylene or polyamide thermoplastic fibers with non-raveling edges. The fabric shall be non-biodegradable, inert to most soil chemicals, ultraviolet resistant, unaffected by moisture or other weather conditions, and permeable to water while retaining sediment. The filter fabric shall be supplied in rolls a minimum of 36 inches wide.
   1. Acceptable Products: Lundin "Silt Buster", Mirafi "Envirofence" or acceptable substitution.

B. Wire Fence Support: Welded wire fabric 2 x 4 - W1.0 x W1.0.

C. Fence Posts: Painted or galvanized steel Tee or Y-posts with anchor plates, not less than 5 feet in length with a minimum weight of 1.3 pounds per foot . Hangers shall be adequate to secure fence and fabric to posts. Posts and anchor plates shall conform to ASTM A-702.

D. Dust Retardent: Equal to one of the following:
   1. Coherex by Golden Bear Div of Witco Corp, Chandler, AZ.
   2. Soil-Sement by Midwarst Insustrial Supply, Canton, OH.
   3. Soil Seal Concentrate by Soil Seakl Corp., Los Angeles, CA.

2.2 SEDIMENT TRAPS

A. Standard manufacture designed to fit the intended inlet.

2.3 STABILIZED CONSTRUCTION ENTRANCE

A. Aggregate: Graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448 and TEX 401-A coarse-aggregate; with 0 percent being retained by a 5-inch sieve and 100 percent being retained by a 3-inch sieve.

2.4 GRASS

A. Materials and seeding and sodding shall conform to applicable Division 32 section.

2.5 FERTILIZER

A. Use commercial grade fertilizers to insure germination and growth. Analysis by weight shall be 16-4-8 or 15-5-10 for Nitrogen, Phosphoric Acid and Potash.

2.6 WATER

A. Use clean potable water for maintaining the grass.

PART 3 - EXECUTION

3.1 GENERAL

A. Keep disturbed areas to a minimum required to adequately perform the work. At all times maintain the site in such a manner that minimizes erosion of the site. The execution of work under this section shall be in conformance with the NPDES rulings and the site Storm Water Pollution Prevention Plan.

3.2 SILT FENCES

A. Silt fence shall be a minimum of 24 inches (0.6 meter) high. Posts shall be embedded a minimum of 12 inches in the ground, placed a maximum of 8 feet apart and set on a slight angle toward the anticipated runoff source.
   1. When directed by the Engineer or designated representative, posts shall be set at specified intervals to support concentrated loads.

B. Securely attach filter fabric to posts and wire support fence, with the bottom 12 inches of filter fabric buried in a trench a minimum of 6 inches deep and 6 inches (150 mm) wide to prevent sediment from passing under the fence.
   1. When silt fence is constructed on impervious material, a 12-inch flap of fabric shall be extended upstream from the bottom of the silt fence and weighted to limit particulate loss.
   2. No horizontal joints will be allowed in the filter fabric.
   3. Vertical joints shall be overlapped a minimum of 12 inches with the ends sewn or otherwise securely tied.

C. Silt fence shall be maintained for the duration of the project, and repaired, replaced, and/or relocated when necessary or as directed by the Engineer or designated representative. Accumulated silt shall be removed when it reaches a depth of 6 inches.

3.3 EROSION CONTROL BARRIERS

A. Provide erosion control barriers at intervals along swales and ditches as shown on the Drawings or as necessary to meet the requirements of the Storm Water Pollution Prevention Plan.

B. Barriers: Silt fence or hay bales placed as indicated on the Drawings.

C. Maintain barriers in good working condition and replace when damaged.

3.4 STABILIZED CONSTRUCTION ENTRANCE

A. Remove trees, brush, stumps, obstructions, and other objectionable material and disposed of in a manner that will not interfere with the excavation, grading, and construction of the entrance as indicated on the Drawings.
   1. Stabilized construction entrance shall not drain onto the public right-of-way and shall not allow surface water runoff to exit the construction site.
   2. When necessary, vehicle wheels shall be cleaned to remove sediment prior to entrance onto public right of way.
      a. When vehicle washing is required, it shall be done on an area stabilized with crushed stone, which drains into an approved sediment trap or sediment basin.
   3. Sediment shall be prevented from entering any storm drain, ditch or watercourse through use of sand bags, gravel, boards, silt fence or other methods approved by the Engineer or designated representative.

B. The entrance shall be maintained in a condition that will prevent tracking or disposition of sediment onto public right of way. Provide periodic top dressing with additional stone as conditions demand, as well as the repair and/or cleanout of any measures used to trap sediment. Sediment that is spilled, dropped, washed, or tracked onto public right-of-way shall be removed immediately.

3.5 TEMPORARY AND PERMANENT SWALES

A. Description:
   1. Provide temporary and permanent drainage swales as required to carry drainage away from the work area to an approved outfall point.
   2. Unless otherwise shown on the drawings, swales shall be earthen "V" shaped channels graded to a sufficient depth and slope to carry the anticipated runoff, but at least 2 feet deep with a slope of 0.1 percent.
   3. Swales not designated to remain in place at the completion of the contract shall be cleaned of any muck, debris and other unsuitable material and filled with approved fill before final grading operations begin.
   4. Swales shall have erosion control barriers as required.
   5. All permanent swales shall be sodded to a minimum width of 10 feet on either side of the centerline of the swale.

B. Maintenance:
   1. During the course of construction maintain temporary swales constructed for this contract so as to allow proper drainage from the construction area. Before Contractor leaves the site at the end of construction, place temporary swales to remain in good working condition.
   2. Work with other contractors at the site in maintaining existing swales and ditches.
   3. Where necessary for access to the work areas, install adequately sized culverts and maintain to provide the access without disturbing the site drainage.
   4. Take care not to rut and damage sodded swales. Immediately repair damaged swales.
   5. Keep sodded swales mowed.

3.6 DRAINAGE DITCHES

A. Immediately hydromulch drainage ditches upon final grading.
B. Repair erosion of the banks of the drainage ditches immediately and re-stabilize.
C. Place sediment barriers at intervals along the ditch as shown on the plans or as necessary to help trap sediment on the site. Daily remove sediment and other debris trapped by the barriers.
D. Maximum Ditch Side Slopes: 3 feet horizontal to 1 foot vertical.
E. Maintenance of the ditches during construction shall include but not be limited to mowing, re-grading, sediment removal, re-hydromulching, bank repair and debris removal.
F. Sediment removed from the ditches may be respread on the site as directed by the Owner.

3.7 FILL AND CUT SLOPES

A. Fill slopes in all cases shall be no steeper than 3:1 unless specifically stated on the plans or approved by the Owner's soils engineer.
B. When cut slopes exceed 2:1 for depths over 3 feet, proper bracing and shoring per OSHA requirements shall be used and maintained.
C. For permanent slopes, cut or fill, between 2:1 and 10:1, erosion protection shall be provided with hydromulching, sodding, seeding, or other method as approved.

3.8 SEDIMENTATION BASINS

A. Description:
   1. Provide sedimentation ponds where indicated.
   2. Route drainage from cleared areas through the sedimentation basin.
   3. Operate and maintain the pond during construction.

B. Maintenance:
   1. Maintain the pond and the outfall and sediment retarding structure in good working condition throughout the time the pond is to be in operation.
   2. When sediment and debris fill the pond to over one third (1/3) its designed capacity, clean out the pond.
   3. Stockpile, in its' own separate area, the sediment from the clearing operation, or remove from the site, as required. Make adequate drainage provisions such that drainage from the sediment stockpile drains back into the sediment pond. When approved by the Owner, sediment removed from the pond may be spread over the site.

3.9 SEEDING

A. Seed disturbed portions of the site and stockpile areas within 14 days if the phasing of the construction operations are anticipated to leave those portions of the areas unworked for 21 days or more.
B. Maintain seeded areas until the project is accepted by the Owner. Maintain by watering, fertilizing, reseeding, mowing and erosion repair as may be required. Cut grass when the average height of the grass reaches 6 inches. Clippings may be mulched back into the seeded areas.

3.10 DUST RETARDENT

A. Apply with mobile pressure type distributor truck at 300 gallons per acre. Initiate dust retardent treatment once site grading has been initiated and during windy conditions (forcasted or actual 20 mph or greater). Perform not less than 3 times per day during the months of May-Sept and once per day the remaining months or whenever dryness of the soil warrants.

END OF SECTION

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

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. Products salvaged or recycled from other projects are not considered new products.
   3. Comparable Product: Product that is demonstrated and approved through submittal process 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 specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 ACTION SUBMITTALS

A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
   2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
      a. Form of Approval: As specified in Section 013300 "Submittal Procedures."
      b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Section 013300 "Submittal Procedures." Show compliance with requirements.

1.5 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.

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 to determine that products are undamaged and properly protected.

C. Storage:
1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
6. Protect stored products from damage and liquids from freezing.
7. 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 warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for 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 with the Specifications, 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 not in conflict with 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 "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's

convenience will not be considered.

2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
3. Products:
   a. Restricted List: 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 be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
4. Manufacturers:
   a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
   b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. 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 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.

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
   1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Section 012500 "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or 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.

2.2 COMPARABLE PRODUCTS

A. Conditions for Consideration: 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 these requirements:
   1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
   2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
   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.

PART 3 - EXECUTION (Not Used)

END OF SECTION

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SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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 and surveying.
   3. Installation of the Work.
   4. Cutting and patching.
   5. Coordination of Owner-installed products.
   6. Progress cleaning.
   7. Starting and adjusting.
   8. Protection of installed construction.

1.3 DEFINITIONS

A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.

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

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.

B. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
   1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
   2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
   3. Products: List products to be used for patching and firms or entities that will perform patching work.
   4. Dates: Indicate when cutting and patching will be performed.
   5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
      a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.

C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

D. Certified Surveys: Submit two copies signed by .

E. Final Property Survey: Submit 10 copies showing the Work performed and record survey data.

1.5 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. 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, 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. Fire separation assemblies.
c. Air or smoke barriers.
d. Fire-suppression systems.
e. Mechanical systems piping and ducts.
f. Control systems.
g. Communication systems.
h. Fire-detection and -alarm systems.
i. Conveying systems.
j. Electrical wiring systems.
k. 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. Exterior curtain-wall construction.
d. Sprayed fire-resistive material.
e. Equipment supports.
f. Piping, ductwork, vessels, and equipment.
g. 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.

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

D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.
1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with requirements in Section 013520.

B. 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.

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, 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.
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. 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.

B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.

C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 013100 "Project Management and Coordination."

3.3 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. If discrepancies are discovered, notify Architect promptly.

B. General: Engage a licensed surveyor to lay out the Work using 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.

3.4 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. 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."

3.5 INSTALLATION

A. General: 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.

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 the best possible results. 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.

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: Do not use tools or equipment that produce harmful 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 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.
   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. Fit exposed connections together to form hairline joints.

J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.6 CUTTING AND PATCHING

A. Cutting and Patching, 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 according to 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. Concreteand 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. 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 minimize 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. 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 OWNER-INSTALLED PRODUCTS

A. Site Access: Provide access to Project site for Owner's construction personnel.

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. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully. Comply with Indoor Air Quality Plan During Construction (Section 015720).
   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, according to 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 according to 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 in Finished Areas: 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 015000 "Temporary Facilities and Controls."

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 assure 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. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION

SECTION 017419 - 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 other 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 waste.
   2. Recycling nonhazardous demolition and construction waste.
   3. Disposing of nonhazardous demolition and construction waste.

1.3 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
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 PERFORMANCE REQUIREMENTS

A. General: Achieve end-of-Project rates for salvage/recycling of 75 percent by weight of total non-hazardous solid waste generated by the Work. Practice efficient waste management in the use of materials in the course of the Work. Use all reasonable means to divert construction and demolition waste from landfills and incinerators. Facilitate recycling and salvage of materials, including the following:
   1. Demolition Waste:
      a. Asphalt paving.
      b. Concrete.
      c. Concrete reinforcing steel.
      d. Brick.
      e. Concrete masonry units.
      f. Rough hardware.
      g. Roofing.
      h. Insulation.
      i. Doors and frames.
      j. Door hardware.
      k. Windows.
      l. Glazing.
      m. Metal studs.
      n. Gypsum board.
      o. Acoustical tile and panels.
      p. Carpet.
      q. Carpet pad.
      r. Equipment.
      s. Cabinets.
      t. Plumbing fixtures.
      u. Piping.
      v. Supports and hangers.
      w. Valves.
      x. Sprinklers.
      y. Mechanical equipment.
      z. Refrigerants.
      aa. Electrical conduit.

bb. Copper wiring.
cc. Lighting fixtures.
dd. Lamps.
ee. Ballasts.
ff. Electrical devices.
gg. Switchgear and panelboards.
hh. Transformers.

2. Construction Waste:
   a. Masonry and CMU.
   b. Lumber.
   c. Wood sheet materials.
   d. Wood trim.
   e. Metals.
   f. Roofing.
   g. Insulation.
   h. Carpet and pad.
   i. Gypsum board.
   j. Piping.
   k. Electrical conduit.
   l. Packaging: Regardless of salvage/recycle goal indicated in "General" Paragraph above, salvage or recycle 100 percent of the following uncontaminated packaging materials:
      1) Paper.
      2) Cardboard.
      3) Boxes.
      4) Plastic sheet and film.
      5) Polystyrene packaging.
      6) Wood crates.
      7) Plastic pails.

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. 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.

1.7 QUALITY ASSURANCE

A. Waste Management Coordinator Qualifications: Experienced firm, with a record of successful waste management coordination of projects with similar requirements.

B. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.

C. Waste Management Conference: Conduct conference 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 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 ASTM E 1609 and 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 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. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
   2. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
   3. 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 was 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 hauling and tipping fees and cost of collection containers 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 hauling and tipping fees by donating materials.
   7. Savings in hauling 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 (Not Used)

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. This can be an employee of the Contactor.

C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work. Representatives of each subcontractor shall sign a form confirming they have been trained.

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, recycled, reused, donated, and sold.
2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

E. Recycling Receivers and Processors area limited to list below:
1. City of Denton Solid Waste and Recycling, 1527 South Mayhill Road, Denton, Texas 76208. (940) 349-8700.

3.2 SALVAGING DEMOLITION WASTE

A. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

B. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

C. Plumbing Fixtures: Separate by type and size.

D. Lighting Fixtures: Separate lamps by type and protect from breakage.

E. 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 accrue to Owner.

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.

3.4 RECYCLING DEMOLITION WASTE

A. Asphalt Paving: Grind asphalt to maximum 1-1/2-inch size.
1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.

B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.

C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
1. Pulverize concrete to maximum 1-1/2-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.

D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
1. Pulverize masonry to maximum 1-inch size.
a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.
b. Crush masonry and screen to comply with requirements in Section 329300 "Plants" for use as mineral mulch.
2. Clean and stack undamaged, whole masonry units on wood pallets.

E. Metals: Separate metals by type.
1. 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. 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.

J. 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.

K. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

L. Conduit: Reduce conduit to straight lengths and store by type and size.

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.
      a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

C. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
      a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, 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. Burning: Do not burn waste materials.

C. Disposal: Remove waste materials and dispose of at designated spoil areas on Owner's property.

D. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION

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SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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. Warranties.
   4. Final cleaning.
   5. Repair of the Work.

1.3 ACTION SUBMITTALS

A. Product Data: For cleaning agents.
B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

A. Certificates of Release: From authorities having jurisdiction.
B. Certificate of Insurance: For continuing coverage.
C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

1.6 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, final completion construction photographic documentation, 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 where applicable.
      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 Architect's signature for receipt of submittals.
   5. Submit test/adjust/balance records.
   6. Submit sustainable design submittals required in Section 013520 and in individual Sections.
   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 heat and other utilities.
   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, including touchup painting.
   10. Touch up 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 7 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 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. Reinspection: 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.

1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
   1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
   2. 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 shall state that each item has been completed or otherwise resolved for acceptance.
   3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
   4. Submit pest-control final inspection report.

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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

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 [and proceeding from lowest floor to highest floor].
   2. Organize items applying to each space by major element, including categories for ceiling, 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.

1.9 SUBMITTAL OF PROJECT WARRANTIES

A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.

B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
   1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
   4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.

C. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

A. 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.
   1. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

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, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, 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 neither planted nor 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. Sweep concrete floors broom clean in unoccupied spaces.
      i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
      j. 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.
      k. Remove labels that are not permanent.

l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
q. 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 015000 "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.
a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION

SECTION 017823 - 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 other 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.
   2. Emergency manuals.
   3. Operation manuals for systems, subsystems, and equipment.
   4. Product maintenance manuals.
   5. Systems and equipment 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. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed 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 operations and maintenance submittals are acceptable.
   2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:
   1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
      a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
      b. Enable inserted reviewer comments on draft submittals.
   2. Also provide two hard copies of the O&M Manual.

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.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. Include a section in the directory for each of the following:
   1. List of documents.
   2. List of systems.
   3. List of equipment.
   4. Table of contents.

B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
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."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Organization: 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 Architect.
7. Name and contact information for Commissioning Authority.
8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
9. 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.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.

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. 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: Enable bookmarking of 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.

2.3 OPERATION MANUALS

A. 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.

B. 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.

C. 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.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. 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.

B. 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.

C. 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.

D. 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.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. 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.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. 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 warranty and bond information, as described below.

B. 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.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.

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.

D. 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.

E. 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.

F. 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.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. 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 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.

B. 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.

C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
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.

E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, 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.
1. 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.

F. 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 operation and maintenance manuals.
2. Comply with requirements of newly prepared record Drawings in Section 017839 "Project Record Documents."

G. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION

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SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 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.

1.3 CLOSEOUT SUBMITTALS

A. Record Drawings: Comply with the following:
   1. Number of Copies: Submit one set 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 one paper-copy set(s) of marked-up record prints.
         2) Submit record digital data files and three set(s) of record digital data file plots.
         3) Plot each drawing file, whether or not changes and additional information were recorded.

B. Record Specifications: Submit of Project's Specifications, including addenda and contract modifications.

C. Record Product Data: Submit 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 of each submittal.

E. Reports: Submit written report]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.

PART 2 - PRODUCTS

2.1 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 archive 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 below first floor.
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 by Change Order or Construction Change Directive.
k. Changes made following Architect's written orders.
l. Details not on the original Contract Drawings.
m. Field records for variable and concealed conditions.
n. 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 sets 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: Same digital data software program, version, and operating system as the original Contract Drawings.
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 one set of digital data files of the Contract Drawings for use in recording information.
a. See Section 013300 "Submittal Procedures" 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. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
2. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
3. Identification: As follows:
a. Project name.
b. Date.
c. Designation "PROJECT RECORD DRAWINGS."
d. Name of Architect.
e. Name of Contractor.

2.2 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 .

2.3 RECORD PRODUCT DATA

A. 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.

B. Format: Submit record Product Data as .
   1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

2.4 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 .
   1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

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. Maintenance of Record Documents and Samples: Store record documents and Samples 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.

END OF SECTION

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SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
   1. Demonstration of operation of systems, subsystems, and equipment.
   2. Training in operation and maintenance of systems, subsystems, and equipment.

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. Attendance Record: For each training module, submit list of participants and length of instruction time.

C. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

A. 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.

1.5 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 has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 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. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. 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.

PART 3 - EXECUTION

3.1 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.

C. Training for mechanical systems and emergency generator shall be provided by the manufacturer.

3.2 INSTRUCTION

A. 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.

B. 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.

C. 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.

END OF SECTION

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SECTION 017900: COMMISSIONING DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.1 SUMMARY

A. Demonstration of products and systems to be commissioned and where indicated in specific specification sections.

B. Training of Owner personnel in operation and maintenance is required for:

1. All software-operated systems.

2. HVAC systems and equipment.

3. Plumbing equipment.

4. Electrical systems and equipment.

5. Landscape irrigation.

6. Items specified in individual product Sections.

1.2 RELATED REQUIREMENTS

A. Section 019113 – General Commissioning Requirements

B. Section 220800 – Commissioning of Plumbing Systems

C. Section 230800 – Commissioning of HVAC Systems

D. Section 260800 – Commissioning of Electrical Systems

E. Other

1.3 GENERAL

A. The GC shall coordinate the operator training. Training requirements are shown in each Section specifying commissioning and in Sections specifying items or systems to be commissioned. GC shall video all training of personnel.

1.4 SUBMITTALS

A. Draft Training Plans: At least 30 days prior to the start of training, the GC shall provide draft training plans to the Architect, Owner, and Commissioning Agent. The GC shall revise and resubmit until acceptable. The GC shall provide the following:

1. Overall schedule showing all training sessions.

2. Include at least the following for each training session:

a. Identification, date, time, and duration.

b. Description of products and/or systems to be covered.

c. Name of firm and person conducting training; include qualifications.

d. Intended audience, such as job description.

e. Objectives of training and suggested methods of ensuring adequate training.

f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.

g. Media to be used, such as slides, hand-outs, etc.

h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

B. Training Manuals: The GC shall provide a training manual for each attendee; allow for minimum of two attendees per training session.

1. Include applicable portion of O&M manuals.

2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.

3. Provide one extra copy of each training manual to be included with operation and maintenance data.

C. Training – The GC shall coordinate with the Owner and CxA on the date(s) of training and shall provide at least 14 days' notice prior to training.

D. Training Reports:

1. Identification of each training session, date, time, and duration.

2. Sign-in sheet showing names and job titles of attendees.

3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.

E. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.

1. Format: DVD Disc and Electronic Format

2. Label each disc and container with session identification and date.

3. Training video shall be broken up, edited, and labeled for each piece of equipment and/or training session.

4. Electronic Copies shall be included in the Close-Out documentation.

1.5 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.

1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.

2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 DEMONSTRATION - GENERAL

A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.

B. Demonstrations conducted during Functional Testing need not be repeated unless Owner personnel training is specified.

C. Demonstration may be combined with Owner personnel training if applicable.

D. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

E. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.

1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.2 TRAINING - GENERAL

A. GC will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:

1. The location of the O&M manuals and procedures for use and preservation; backup copies.

2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.

3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:

1. Review the applicable O&M manuals.

2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.

3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.

4. Provide hands-on training on all operational modes possible and preventive maintenance.

5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.

6. Discuss thermostat setpoints, setback schedules, thermostat overrides.

7. Discuss simple trouble shooting tree.

8. Discuss common troubleshooting problems and solutions.

9. Discuss any peculiarities of equipment installation or operation.

10. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.

END OF SECTION

SECTION 019113: GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY: This section includes general requirements that apply to the implementation of the commissioning process without regard to specific systems, assemblies, and components.

1.2 RELATED REQUIREMENTS

A. Section 017900 - Commissioning Training Requirements

B. Section 220800 – Commissioning of Plumbing Systems

C. Section 230800 – Commissioning of HVAC Systems

D. Section 260800 – Commissioning of Electrical Systems

E. Other

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

ACG Commissioning Guideline	(2005) Commissioning Guideline

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Commissioning Standard	(2009) Procedural Standards for Whole Building Systems Commissioning of New Construction; 3rd Edition

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1429	(1994) HVAC Systems Commissioning Manual, 1st Edition

1.4 DEFINITIONS

A. Acceptance Phase: Phase of construction after startup and initial checkout when functional performance tests, O&M documentation review and training occurs.

B. Commissioning Agent (CxA): An independent party, not otherwise associated with the A/E team members or the Contractor, oversees, though he/she may be hired as a subcontractor to them. The CxA directs the day-to-day commissioning activities.

C. Commissioning Plan: An overall plan that provides the structure, schedule, and coordination planning for the commissioning process.

D. Construction Phase: Phase of construction at the beginning of construction when submittal review , commissioning plan, documentation of system verification checks of commissioned systems are completed, and TAB and Controls completes work.

E. Data Logging: Monitoring flows, currents, status, pressures, etc. of equipment using stand-alone data loggers separate from the control system.

F. Deferred Functional Tests: FPT's that are performed later, after substantial completion, due to partial occupancy, equipment, seasonal requirements, design or other site conditions that disallow the test from being performed.

G. Deficiency: A condition in the installation or function of a component, piece of equipment or system that is not in compliance with the Contract Documents (that is, does not perform properly or is not complying with the design intent).

H. Functional Completion: All TAB and commissioning responsibilities of the Contractor, (except for seasonal or approved deferred testing and controls training), must be completed.

I. Functional Performance Test (FPT): Test of the dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is the dynamic testing of systems. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc. The systems are run through all the control system's sequences of operation and components are verified to be responding as the sequences state. Traditional air or water test and balancing (TAB) is not functional testing. TAB's primary work is setting up the system flows and pressures as specified, while functional testing is verifying that which has already been set up. The CxA develops the functional test procedures in a sequential written form, coordinates, oversees, and documents the actual testing, which is usually performed by the installing contractor or vendor. FPT's are performed after prefunctional checklists, startup, T&B, controls are complete. The subcontractor is responsible for reviewing, understanding, and performing the FPT's.

J. Indirect Indicators: Indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100% closed.

K. Issues log: A formal and ongoing record of problems or concerns and their resolution that have been raised by members of the Commissioning Team during the course of the commissioning Process.

L. Manual Test: Using hand-held instruments, immediate control system readouts or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”).

M. Monitoring: The recording of parameters (flow, current, status, pressure, etc.) of equipment operation using data loggers or the trending capabilities of control systems.

N. Over-written Value: Writing over a sensor value in the control system to see the response of a system (e.g., changing the outside air temperature value from 50 F to 75 F to verify economizer operation). See also “Simulated Signal”.

O. Phased Commissioning: Commissioning that is completed in phases due to the size of the structure or other scheduling issues, in order to minimize the total construction time.

P. Post-Acceptance Phase: Phase of the project after the Acceptance Phase. During this phase, commissioning requirements are to correct any deficiencies, carry out any required re-testing and off-season testing, O&M and close-out documentation review.

Q. Prefunctional Checklist (PFC): A list of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided and completed by the CxA. Prefunctional checklists are primarily static inspections and procedures to prepare the equipment or system for initial operations (e.g., belt tension, oil levels OK, labels affixed, gages in place, sensors calibrated, etc.).

R. Sampling: Functionally testing only a fraction of the total number of identical or near identical pieces of equipment.

S. Seasonal Performance Tests: FPT that are deferred until the system(s) will experience conditions closer to their design conditions.

T. Simulated Condition: Condition that is created for the purpose of testing the response of a system.

U. Simulated Signal: Disconnecting a sensor and using a signal generator to send an amperage, resistance or pressure to the transducer and DDC system to simulate a sensor value.

V. Startup: The initial starting or activating of dynamic equipment, including executing prefunctional checklists.

W. Test Procedures: The step-by-step process which must be executed to fulfill the test requirements. The test procedures are developed by the CxA with assistance and coordination from GC and subcontractors.

X. Test Requirements: Requirements specifying what modes and functions, etc. shall be tested. The test procedures are not the detailed test procedures. The test requirements are specified in the Contract Documents.

Y. Trending: Monitoring using the building control system.

1.5 ABBREVIATIONS:

A. The following are common abbreviations used in the Specifications and in the Commissioning Plan.

1. A/E - Architect and Design Engineers
2. CxA - Commissioning Agent
3. CC - Controls Contractor
4. EC - Electrical Contractor
5. ES - Electronic Security Contractor
6. FPT - Functional Performance Test
7. GC - General Contractor (prime)
8. MC - Mechanical Contractor
9. PFC – Pre-functional Checklist
10. PM - Project Manager (of the Owner)
11. Subs - Subcontractors to General
12. TAB - Test and Balance Contractor

1.6 SYSTEM DESCRIPTION

A. Commissioning

1. Perform Commissioning in accordance with the requirements of the standard under which the Commissioning Firm's qualifications are approved, i.e., ACG Commissioning Guideline, NEBB Commissioning Standard, or SMACNA 1429 unless otherwise stated herein. Use the Commissioning Standard for all aspects of Commissioning, including qualifications for the Commissioning Firm and Commissioning Agent. All quality assurance provisions of the Commissioning Standard such as performance guarantees shall be part of this contract. Commissioning procedures shall be developed by the Commissioning Agent and be in accordance with Commissioning Scope of Work provided by Lawrence Public Schools. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the Commissioning Standard used (ACG, NEBB, or TABB), the requirements and recommendations in these procedures and requirements shall be considered mandatory.

2. This project will have the following selected building systems commissioned:

   i. HVAC Systems

   ii. Domestic Water Heating Systems (where applicable)

   iii. Lighting Control Systems

3. The commissioning process encompasses and coordinates the functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing and training. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents

   i. Verify that applicable equipment and systems are installed according to the contract specifications, manufacturer's recommendations and to industry accepted minimum standards and that they receive adequate operational checkout by installing contractors.

   ii. Verify and document proper performance of equipment and systems.

   iii. Provide a Commissioning Final Report.

   iv. Verify that the Owner's operating personnel are adequately trained.

   v. Set-up and review trending on all commissioned systems.

B. The commissioning process does not reduce the responsibility of the system designers or installing contractors to provide a finished and fully functioning product in accordance with the Contract Documents.

1.7 COMMISSIONING TEAM

A. Members appointed by Owner:

1. CxA - An entity identified by the owner who leads, plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the contracted commissioning agents under a separate contract.

2. Representatives of the facility user and operation and maintenance personnel.

B. Assistance/Documentation may be requested from the following team members:

1. General Contractor Superintendent

2. General Contractor Project Manager

3. Contractor Quality Control Manager

4. Mechanical Subcontractor Representative

5. Electrical Subcontractor Representative

6. Testing, Balancing, and Adjusting Subcontractor Representative

7. Instrumentation and Controls Subcontractor Representative

8. Owner Furnished Equipment Manufacturer's Representatives

9. Owner's Representative

C. Provision of a fully commissioned system of all materials required under the construction contract is the responsibility of the General Contractor. Therefore, Contractor Group members of the Systems Commissioning Team, through participation in the planning, management, and oversight of all construction activities related to equipment approvals, performance testing, and commissioning of the systems identified herein must be able to assure the Owner that all systems have been properly tested and commissioned. The Owner is intended to participate fully as adjuncts to the Contractor Group Team members. It is intended that through this participation, the Contractor Group Team members will be provided timely access to all design information necessary to resolve questions as to intended performance of the systems specified. In addition, the Owner will be sufficiently involved in the development of commissioning and performance testing programs to assure timely review of plans and procedures submitted by the Contractor. The purpose of this process will be to provide fully functional systems which interact to meet all contract performance requirements. The participation of the Commissioning Team members shall not relieve the General Contractor of any responsibility for compliance with the requirements of the contract.

1.8 SCHEDULING

A. The CxA will work with GC according to established protocols to schedule the commissioning activities. The CxA will review the Construction Schedule and verify that prefunctional and functional testing is properly scheduled. The GC will integrate all commissioning activities into the master schedule.

B. Commissioning inspections and testing will be accomplished in the presence of a representative of the General Contractor, and the Owner with the CxA overseeing the process.

1.9 OVERVIEW OF THE COMMISSIONING PROCESS

A. Commissioning Plan: The CxA will develop the commissioning plan which shall be included in the project schedule. The commissioning plan provides guidance and further details the requirements in the execution of the commissioning process. The Specifications take precedence over the Commissioning Plan in the event of a conflict.

B. Commissioning Process: The following narrative provides a brief overview of the typical commissioning tasks during construction and the general order in which they occur.

1. Commissioning during construction begins with a meeting conducted by the CxA where the commissioning process is reviewed with the commissioning team members during a scheduled monthly/biweekly contractors' meeting. This meeting will occur prior to the completion of the first Prefunctional Checklist.

2. Additional meetings will be required throughout construction, scheduled by the CxA with

necessary parties attending, to plan, scope, coordinate, schedule future commissioning related activities, and resolve problems.

3. Equipment documentation, including: Shop Drawings, installation instructions, detailed start up procedures are submitted to the CxA during the normal submittals process.

4. In general, performance verification proceeds from component level to systems and intersystem levels with pre-functional checklists being completed before functional testing.

5. The Subs, under their own direction, execute and document the pre-functional checklists before and during the start up process with the GC and the CxA monitoring conformance.

6. Prior to commencement of functional testing, the Commissioning Team shall perform a systems activation inspection to ensure the systems are ready to be functionally tested.

   a. The GC will ensure all Pre-functional Checklists are completed. The contractor shall identify any missing checklists and provide as necessary.

   b. The CxA will verify all Pre-functional Checklists, TAB and startup are complete for systems to be Functionally Tested.

7. The CxA will prepare the Functional Testing protocols for execution by the GC and Subs.

8. The GC will schedule the Functional Testing after the Pre-Functional Checklists, TAB and startup are complete and the Functional Testing protocols have been reviewed by the GC and Subs.

9. The CxA will witness and document the Functional Testing process.

10. The GC will witness the Functional Testing process to insure completed by the Subs.

11. Items of non-compliance in material, installation or setup are noted for the Contractor to correct. Non-complying systems will then be retested and functional performance verified by the GC and the CxA.

12. All functional performance tests are completed before Substantial Completion Date.

13. If applicable, the CxA will review the Closeout and O&M documentation for completeness.

14. The GC will review the training plan provided by the Subs. The GC and CxA will witness training session(s) to verify that acceptable training was provided. The GC shall video all training for the Owner.

1.10 RESPONSIBILITIES

A. The general responsibilities of various parties in the commissioning process are provided in this subsection. The specific responsibilities will be included in the commissioning plan.

B. Owner's Responsibilities:

1. Provide the OPR documentation to the CxA for information and use.

2. Attend initial commissioning meeting and additional meetings as necessary.

3. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

4. Assist the GC in coordinating the training of owner's personnel.

C. Architect/Engineer Responsibilities:

1. Provide the Basis of Design documents approved by the Owner to the CxA for use in developing the commissioning plan, operating and maintenance training plan, and final commissioning report.

2. Attend commissioning team meetings as needed.

3. Provide copies of all project documents including plans, specifications, addenda, ASI, PR's, etc.

4. Provide any design narrative and sequences documentation requested by the CxA. The designers shall assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

5. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.

6. Participate in the resolution of system deficiencies identified during commissioning, according to the contract documents.

7. Provide required Closeout documentation for the Systems Manual.

D. Contractors Responsibilities:

1. Facilitate the coordination of the commissioning and incorporate commissioning activities into the Master Project Schedule (MPS).

2. Ensure that all subcontractors and vendors execute their commissioning responsibilities according the contract documents and the MPS.

3. Incorporate Cx Milestones into the Construction Schedule.

4. Provide copies of all submittals including all changes thereto to the CxA.

5. Attend and participate in commissioning team meetings.

6. Cooperate with the CxA for timely resolution of issues recorded in the issues log.

7. Complete Prefunctional Checklist as work is completed and provide to the CxA for review and verification.

8. Schedule and conduct Owners Training**.**

E. Commissioning Authority (CxA) Responsibilities:

In general, the Commissioning Authority shall:

1. Organize and lead the commissioning team.

2. Coordinate the commissioning work and with the GC and owner, help integrate commissioning activities into the Master Project Schedule.

Specifically, the CxA shall complete all of these responsibilities during the following phases of construction:

1. Pre-Construction Phase

    i. Attend Pre-Construction Meeting

    ii. Develop Commissioning Activities Schedule and Incorporate Into Construction Schedule

    iii. Lead Commissioning Kick-Off Meeting

2. Construction Phase

    i. Develop Pre-Functional Checklists

    ii. Perform Ongoing Construction Observations

    iii. Coordinate Completion of Pre-Functional Checklists

    iv. Conduct Site Tours for Owner Staff

    v. Pre-Functional Checklist Verification

    vi. Maintain Commissioning Issues Log

    vii. Verify Start-Up

    viii. Develop Functional Performance Tests

    ix. Lead Controls Coordination Meeting

    x. Review Test and Balance Report

    xi. Participate in MEP Above-Ceiling Inspections

    xii. Complete Functional Testing

    xiii. Complete TAB Verification

    xiv. Attend and Verify Owner Training

    xv. Ensure Recording of Owner Training

    xvi. Ensure Delivery of Training Materials

3. Occupancy Phase

    i. Ensure Delivery of O&M Manuals

    ii. Ensure Deliver of Close-Out Documentation

iii. Publish Initial Commissioning Report

iv. Review Commissioning Report with Owner Staff

v. Review and Approve Systems Manual

4. Post-Occupancy Phase

i. Perform Seasonal/Defferred Commissioning

ii. Update Commissioning Issues Log

iii. Publish Final Commissioning Report

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. All testing equipment required to perform startup and initial checkout and required functional performance testing shall be provided by the construction contractor for the equipment being tested.

B. Special equipment, tools, and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and shall be left on site for use by the Owner.

C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerance specified in the Specifications.

2.2 UTILITIES AND ACCESSORIES

A. Provide utilities necessary to execute testing and commissioning, including water, fuels, chemicals, batteries, and other similar expendable items.

B. Provide any equipment or device required for access, such as ladders, and platforms.

PART 3 EXECUTION

3.1 SUBMITTALS

A. Pre-Construction Phase

i. Commissioning Activities Schedule

B. Construction Phase

i. Commissioning Plan

ii. Prefunctional Checklists

iii. Functional Performance Test Procedures

C. Occupancy Phase

i. Initial Commissioning Report

D. Post-Occupancy Phase

i. Final Commissioning Report

3.2 START-UP AND PREFUNCTIONAL CHECKLISTS

A. General: Pre-Functional checklists ensure that the equipment and systems are properly installed and operational. They ensure that functional performance testing (in-depth system checkout) may proceed without unnecessary delays. Each piece of equipment receives full pre-functional checkout. The pre-functional testing for a given system must be successfully completed prior to formal functional performance testing of equipment of subsystems of the given system.

i. Execution of Start-Up and Pre-Functional Checklists

1. The Subs and vendors shall execute startup and provide the GC with the signed and dated copy of the completed start-up documentation and prefunctional checklist. The CxA will verify 10 percent of the pre-function checklist.

2. Only individuals that have direct knowledge and witnessed that a line item task on the pre-functional checklist was actually performed shall initial or check that item off.

3. The GC and CxA shall witness the Start-up.

B. Deficiencies: The subcontractor shall list any outstanding items of the initial start-up and pre-functional procedures that were not completed successfully, at the bottom of the procedures form or on an attached sheet. The procedures form and any outstanding deficiencies shall be provided to the GC and the CxA within 2 days of test completion. The GC and CxA will review and monitor outstanding deficiencies. The GC and the subcontractor shall correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner.

C. PHASED COMMISSIONING: When startup and initial checkout are required to be executed in phases, this phasing will be planned and scheduled in a coordination meeting of the CxA, mechanical, plumbing, TAB, and controls contractor, and the GC. The GC shall modify the construction schedule as needed, to reflect phased commissioning.

3.3 FUNCTIONAL TESTING

A. Objectives and Scope

1. The objective of functional testing is to demonstrate that each system is operating according to the Contract Documents. Functional testing facilitates bringing the systems to full dynamic operation. During the testing process, areas of deficient performance are identified and corrected, improving the operation and functioning of the systems.

2. In general, each system should be operated through all modes of operation (seasonal, occupied, unoccupied, warm-up, cool-down, part- and full-load) where there is a specified system response. Verifying each sequence in the sequences of operation is required. Proper responses to such modes and conditions as power failure, freeze conditions, low oil pressure, no flow, equipment failure, etc. shall also be tested.

3. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and GC. Beginning system testing before full completion does not relieve the Contractor from

fully completing the system, including all prefunctional checklists as soon as possible.

B. Documentation and Non-Conformance

1. Documentation: The GC and CxA will witness and the CxA will document the results of all functional performance tests using the specific procedural forms developed for that purpose.

2. Non-Conformance

a. The CxA will record the results of the functional test on the procedure or test form. All deficiencies or non-conformance issues shall be noted.

b. Corrections of minor deficiencies identified may be made during the tests. In such cases, the deficiency and resolution will be documented on the procedure form.

c. Every effort will be made to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

d. All deficiencies or non-conformance issues identified during the functional testing shall be corrected and retested at no additional cost to the owner.

3.4 CLOSEOUT DOCUMENTATION AND OPERATION AND MAINTENANCE MANUALS

A. Closeout Documentation and O&M Manuals

1. The contractor shall compile closeout documentation for all required equipment according to the specification equipment and building operating or electrical system being commissioned.

2. Contractor shall submit 1 draft copy of the completed operating and maintenance manual to the architect/engineer and CxA for review within 60 calendar days after review of equipment shop drawings.

3. Contractor shall provide approved O&M manuals prior to Owner training sessions.

B. Commissioning Records

1. The Commissioning Agent shall provide a Final Commissioning Report. The report shall include an executive summary, list of participants and roles, brief building description, overview of commissioning and testing activities and a general description of testing and verification methods. All outstanding non-compliance items shall be specifically listed. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. shall be listed. Each non-compliance issue shall be referenced to the specific functional test, inspection, trend log, etc. where the deficiency is documented. The functional performance and efficiency section for each piece of equipment shall include brief description of the verification method used (manual testing, BAS trend logs, data loggers, etc.) and include observations and conclusions from the testing

2. The Commissioning Agent shall provide the General Contractor the following documentation:

i. OPR

ii. Basis of Design

iii. Commissioning Plan

iv. Initial Commissioning Report

v. Final Commissioning Report

vi. Commissioning Reviews and Field Reports

vii. Completed Prefunctional Checklists

viii. Completed Functional Testing Procedures

ix. Schematics for Each Commissioned Component

x. Start-Up Reports

xi. Functional Test Reports

3.5 DEFERRED TESTING

A. Unforeseen Deferred Tests: If any check or test cannot be completed due to the building structure, required occupancy condition or other deficiency, execution of checklists and functional testing may be delayed upon approval of the CxA.

3.6 PREREQUISITES TO SUBSTANTIAL COMPLETION: The commissioning must be completed, except for training, prior to Beneficial Occupancy Date, unless scheduled and approved by the Owner.

END OF DOCUMENT

SECTION 024100 - DEMOLITION

PART 1 -GENERAL

1.01 WORK INCLUDED

A. Furnish labor, materials, equipment and incidentals necessary for every type of required demolition.
B. Furnish equipment of every type required to demolish and transport construction debris away from the site.

1.02 QUALITY ASSURANCE [Not Used]

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01 33 23 – Shop Drawings, Product Data, and Samples.

1.04 STANDARDS

Work shall be performed in accordance with the codes and ordinances of the agency having jurisdiction over the Place of Record.

1.05 DELIVERY AND STORAGE

Stockpile construction debris at the site only as long as necessary to arrange hauling to a disposal site. Stack materials neatly and handle in an orderly manner until removed from site. Construction debris shall be placed in trash containers. Do not allow trash to blow around the construction site.

1.06 JOB CONDITIONS

A. Contractor shall visit the site and determine the extent of demolition required and the site conditions that might affect his proposal. Include costs of covering all aspects of the demolition as part of the proposal.
B. The drawings shall be carefully reviewed to determine the extent of necessary demolition. Property lines and limits of demolition shall be accurately located prior to beginning site demolition. Demolition outside the limits indicated on the plans, or outside the property lines shall not be performed.
C. Material removed from the construction site during demolition, and any equipment not otherwise designated to remain the property of the Owner shall become the property of the Contractor and shall be promptly removed from the construction site.
D. Remove and dispose of off-site all drilled pier spoils.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.01 PREPARATION

A. Mark areas to be cleared and grubbed prior to commencing clearing additional requirements. Program Manager shall approve clearing and grubbing limits prior to commencement of clearing operations.
B. The clearing limits shall not extend beyond the project limits, plus adequate distance as approved by the Program Manager to allow for construction procedures.

3.02 BACKFILLING

A. Backfill cavities resulting from demolition. Fill cavities occurring within the limits of building, structures, or pavements in accordance with the requirements of other sections of the specifications. Backfill and compact cavities outside the construction limits to the same density as the surrounding earth.

B. Except where further excavation extends beyond the cavities resulting from work performed under this section, fill holes with appropriate backfill material and compact to the density of the surrounding undisturbed soil. Finish the site by blading or other methods to smooth the area, remove ditches, mounds, or other natural or manmade irregular features. Blend grades together in a smooth uniform manner.

3.03 EXISTING LANDSCAPING

A. Remove trees and brush of all sizes and description within the limits of construction. Cut trees approximately 12" above ground line and grub out and remove the remaining stumps and roots. Remove root systems larger than one (1) inch to 12" below the lowest foundation line.

B. Protect trees and landscaping not designated to be removed from damage. Contractor and Program Manager shall visit the site and mark trees that are to remain. In the event that these trees are in close proximity to the construction, wrap trunks with 2” x 4” timber and take precautions to prevent damage to limbs and root systems.

C. Scrape the entire site within the limits of construction, including structures, building, streets, parking lots or other pavements clear of brush, under-growth, or other vegetation.

D. Felled trees, brush, lumber, concrete, and other debris shall become the property of the Contractor, and shall be promptly removed from the site.

E. Areas that have gravel parking or areas that are HMAC surfaces shown to be removed will be excavated down to natural soil. All gravel will be stockpiled on site as per Engineer. Gravel may be used in other areas requiring gravel if approved by Engineer. All HMAC surfaces shall be disposed of legally off site.

3.04 EXISTING STRUCTURES

Remove any concrete or masonry structures within the limits of the construction, or as otherwise indicated, including concrete slabs, foundations, brick or other masonry work, concrete steps, septic tanks, sidewalks, pavements, curbs and gutters or other components.

3.05 BURIED STRUCTURES

Remove underground structures such as abandoned manholes, vaults, septic tanks and distribution field piping, inlets, buried trash, or debris.

3.06 UNDERGROUND UTILITIES

Take precautions during excavation procedures to guard against damage to active underground piping. In the event that inactive or abandoned pipelines are uncovered, determine that the lines are inactive, then remove buried piping within the limits of construction, or 4'-0" beyond the limits of buildings or other structures, or as needed to clear excavations. Plug both ends of such abandoned piping with concrete plugs.

3.07 FIELD QUALITY CONTROL

No burning will be permitted on the site.

3.08 CLEAN AND ADJUST

At conclusion of demolition, remove all remaining trash and debris from the construction site. Clean site to remove wind-blown paper, trash or other debris.

END OF SECTION 024100

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SECTION 024113

SELECTIVE SITE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following:
   1. Demolition and removal of selected site elements and building remnants.
   2. Demolition and removal of existing paving, curbs, sidewalks, and adjacent landscape work to limits indicated on Drawings.

B. Items of interest or value to Owner that may be encountered during selective demolition shall remain Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to Owner.

1.2 REFERENCES

A. American National Standard Institute (ANSI):
   1. ANSI A 10.6 “Demolition, Safety Requirements”

B. National Fire Protection Association (NFPA)
   1. NFPA 241 “Standard for Safeguarding Construction, Alteration, and Demolition Operations”

1.3 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.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.4 INFORMATIONAL SUBMITTALS

A. General: Submit the following under provisions of Section 013300.

B. Schedule of Selective Demolition Activities: Indicate the following:
   1. Interruption of utility services. Indicate how long utility services will be interrupted.
   2. Coordination for shut-off, capping, and continuation of utility services as required.
   3. Owner’s On-Site Operations: Provide a detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's off-site operations.
   4. Means of protection for items to remain and items in path of waste removal from site.

C. Qualification Data: Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project name, addresses, names of Architects and Owners, and other information specified.

D. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations. Comply with Division 01 Section "Photographic Documentation." Submit before Work begins.

E. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

F. Closeout Submittals: Record documents, indicating locations of encountered items, whether currently in use or abandoned in place.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Contractor: Contractor is responsible for quality control of the Work.
   2. Demolition Firm: A firm experienced in successfully demolition and removal of work similar to that indicated for this Project, with a record of successful performance, and with sufficient capacity to provide demolition, removal, and legal disposal of debris without causing delay in the Work.

B. Regulatory Requirements: Comply with all applicable requirements of the laws, codes, ordinances and regulations of Federal, State and Municipal authorities having jurisdiction. Obtain necessary approvals from all such authorities.
   1. Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

2. Comply with ANSI A 10.6 and NFPA 241.

C. Pre-demolition Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to selective demolition.

1.6 PROJECT CONDITIONS OR SITE CONDITIONS

A. Environmental Requirements: Proceed with the Work in accordance with governmental requirements.

B. Condition of Site Elements: Owner assumes no responsibility for actual condition of site elements to be demolished.
   1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner insofar as practicable. However, variations may occur by Owner's removal and salvage operations prior to start of demolition work.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Recycled Materials: Items of recycled value to Contractor may be removed from structure as work progresses. Recycled items shall be transported from site as they are removed. Comply with governing regulations pertaining to environmental protection.

E. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous Materials: If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

F. Explosives: Use of explosives will not be permitted.

G. Traffic: Conduct demolition operations and removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

H. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

I. Protections: Ensure safe passage of persons around areas of demolition. Conduct operations to prevent injury to adjacent buildings, structures, other facilities, and persons.
   1. Erect temporary covered passageways as required by authorities having jurisdiction.
   2. Provide shoring, bracing, or support to prevent movement, settlement or collapse of structures to be demolished and adjacent facilities to remain.

J. Damages: Promptly repair damages caused to adjacent facilities by demolition operations at no cost to Owner.

K. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.
   1. Do not interrupt existing utilities serving adjacent facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

L. Utility Services: Refer to applicable Sections for disconnecting, removal, and capping of utility services. Do not start demolition work until utility disconnections have been completed and verified in writing.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. 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.

E. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs and preconstruction videotapes.
   1. Comply with requirements specified in Division 01 Section "Photographic Documentation.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary of Work."

B. Service/System Requirements: 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.
2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

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 Division 01 Section "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.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of existing adjacent buildings.

C. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.

D. Pollution Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.
1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.

3.4 DEMOLITION

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. Proceed with demolition in systematic manner, from top of structure to ground. Complete demolition work above each floor or tier before disturbing supporting members on lower levels.
2. Demolish concrete and masonry in small sections.
3. Break up and remove concrete slabs-on-grade, unless otherwise shown to remain.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition.

C. Below-Grade Construction:
1. Demolish and remove below-grade construction and concrete slabs on grade.
2. Filling Basements and Voids: Completely fill below-grade areas and voids resulting from demolition of structures.
3. Use satisfactory soil materials consisting of stone, gravel, and sand, free from debris, trash, frozen materials, roots and other organic matter.
4. Prior to placement of fill materials, ensure that areas to be filled are free of standing water, frost, frozen material, trash and debris.
5. Place fill materials in horizontal layers not exceeding 6" in loose depth. Compact each layer at optimum moisture content of fill material to a density equal to original adjacent ground, unless subsequent excavation for new work is required.
6. After fill placement and compaction, grade surface to meet adjacent contours and to provide flow to surface drainage structures.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be 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.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. At the end of each workday, remove unused materials, debris and containers from the site.

C. Burning of removed materials from demolished structures will not be permitted on site.

D. Disposal: Transport demolished materials off Owner's property and legally dispose of them.
E. 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

SECTION 024116 - STRUCTURE DEMOLITION

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. Demolition and removal of buildings and site improvements.
   2. Removing below-grade construction.
   3. Disconnecting, capping or sealing, and abandoning in-place removing site utilities.
   4. Salvaging items for reuse by Owner.

1.3 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged.

B. Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

1.4 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition 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 INFORMATIONAL SUBMITTALS

A. Predemolition Photographs: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the Work begins.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

C. Predemolition Conference: Conduct conference at Project site.
   1. Inspect and discuss condition of construction to be demolished.
   2. Review structural load limitations of existing structures.
   3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
   4. Review and finalize protection requirements.
   5. Review procedures for noise controland dust control.
   6. Review procedures for protection of adjacent buildings.
   7. Review items to be salvaged and returned to Owner.

1.7 PROJECT CONDITIONS

A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.

B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
   1. Provide not less than 72 hours' notice of activities that will affect operations of adjacent occupied buildings.

2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
    a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.

C. Owner assumes no responsibility for buildings and structures to be demolished.
1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
2. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

E. On-site storage or sale of removed items or materials is not permitted.

1.8 COORDINATION

A. Arrange demolition schedule so as not to interfere with or.

PART 2 - PRODUCTS - (Not Used)

2.1 SOIL MATERIALS

A. Satisfactory Soils: Comply with requirements in Section 312000 "Earth Moving."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting demolition operations.

B. Review Project Record Documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.

C. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 PREPARATION

A. Existing Utilities: Locate, identify, disconnect, and seal or cap off indicated utilities serving buildings and structures to be demolished.
1. Arrange to shut off indicated utilities with utility companies.
2. If removal, relocation, or abandonment of utility services will affect adjacent occupied buildings, then provide temporary utilities that bypass buildings and structures to be demolished and that maintain continuity of service to other buildings and structures.
3. Cut off pipe or conduit a minimum of 24 inches below grade. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing according to requirements of authorities having jurisdiction.

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of demolition.

C. Salvaged Items: Comply with the following:
1. Clean salvaged items of dirt and demolition debris.
2. Transport items to storage area designated by Owner.

3.3 PROTECTION

A. Existing Facilities: Protect adjacent walkways, loading docks, building entries, and other building facilities during demolition operations. Maintain exits from existing buildings.

B. Existing Utilities: Maintain utility services to remain and protect from damage during demolition operations.
1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
    a. Provide at least 72 hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

C. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered

passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

D. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.4 DEMOLITION, GENERAL

A. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
   2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

3.5 DEMOLITION BY MECHANICAL MEANS

A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.

B. Remove debris from elevated portions of the building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
   1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.

C. Salvage: Items to be removed and salvaged are indicated.
   1. 240 s.f. of brick is to be salvaged and reused. Provide temporary weather barrier on existing facility. Owner will remove personal items, fire related equipment, and appliances.

D. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending 5 feetoutside footprint indicated for new construction. Abandon below-grade construction outside this area.
   1. Remove below-grade construction, including basements, foundation walls, and footings, completely.

E. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within 5 feet outside footprint indicated for new construction. Abandon utilities outside this area.
   1. Fill abandoned utility structures with according to backfill requirements in Section 312000 "Earth Moving."

3.6 SITE RESTORATION

A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.

B. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.7 REPAIRS

A. Promptly repair damage to adjacent buildings caused by demolition operations.

3.8 DISPOSAL OF DEMOLISHED MATERIALS

A. Remove demolition waste materials from Project site and legally dispose of them in an EPA-approved landfill acceptable to authorities having jurisdiction.
   1. Do not allow demolished materials to accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn demolished materials.

3.9 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by building demolition operations. Return adjacent areas to condition existing before building demolition operations began.
   1. Clean roadways of debris caused by debris transport.

END OF SECTION

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SECTION 031100 - CONCRETE FORMING FOR CIVIL WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish material and labor to form, tie, brace and support wet concrete, reinforcing steel and embedded items until the concrete has developed sufficient strength to remove forms.

1.02 QUALITY ASSURANCE

A. DESIGN CRITERIA
Forms shall be designed for the pressure exerted by a liquid weighing 150 pounds per cubic foot. The rate of placing the concrete, the temperature of the concrete, and all other pertinent factors shall be taken into consideration when determining the depth of the equivalent liquid. An additional design live load of 50 pounds per square foot shall be used on horizontal surfaces.

B. ALIGNMENT CONTROL
True alignment of walls and other vertical surfaces having straight lines or rectangular shapes shall be controlled and checked by the following procedures:

1. Forming shall be arranged with provisions for adjusting the horizontal alignment of a form, after the form has been filled with concrete to grade, using wedges, turn-buckles, or other adjustment methods. Establish a transit line or other reference so that adjustments can be made to an established line while the concrete in the top of the form is still plastic.
2. Adjusting facilities shall be at intervals which permit adjustments to a straight line. Concrete shall not be placed until adequate adjusting facilities are in place.

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01 33 00, SUBMITTAL PROCEDURES and shall include drawings or descriptions of construction joint locations.

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

A. American Concrete Institute (ACI) specifications:
ACI 361 Specifications for Structural Concrete for Buildings
ACI 318 Building Code Requirements for Reinforced Concrete

B. American Institute of Steel Construction (AISC) publication:
AISC Manual of Steel Construction

C. American Iron and Steel Institute (AISI) publication:

D. American Plywood Association (APA) standards

1.05 DELIVERY AND STORAGE

Lumber for forms shall be stacked neatly on platforms raised above ground.

1.06 JOB CONDITIONS

A. The Contractor shall notify the Engineer upon completion of various portions of the work required for placing concrete so that compliance with the plans and specifications may be monitored. The Engineer will authorize the Contractor to proceed with the placement after this has been completed and corrections, if required, have been made.

B. In hot weather, both sides of the face forms may be required to be treated with oil to prevent warping and to secure tight joints.

PART 2 - PRODUCTS

2.01 MATERIALS

A. LUMBER: Properly seasoned and of good quality; free from loose or unsound knots, knot holes, twists, shakes, decay, splits, and other imperfections which would affect its strength or impair the finished surface of the concrete.

B. FIBER BOARD FORM LINING: Hardboard finished smooth on one (1) side; minimum thickness of 3/16"*;* thoroughly wet with water at least 12 hours before using.

C. PLYWOOD FORM LINING: Conforming to APA HDO; exterior exposure waterproof adhesive, 3/8" thick.

D. FORM OIL: Light, clear oil; shall not discolor or injuriously affect the concrete surface, subsequent coatings, or delay or impair curing operations

2.02 FABRICATIONS

A. LUMBER: Lumber for facing or sheathing shall be surfaced on at least one (1) side and two (2) edges, and sized to uniform thickness. Lumber of nominal 1" thickness or plywood of 3/4" thickness shall be permitted for general use on structures, if backed by a sufficient number of studs and wales.

B. SPECIAL FORM LUMBER

1. Molding for chamfer strips or other uses shall be made of redwood, cypress, or pine materials of a grade that will not split when nailed, and which can be maintained to a true line without warping. The form shall be mill cut and dressed on all faces. Fillet forms at sharp corners, both inside and outside and at edges, with triangular chamfer strips at all non-contiguous edges exposed to view. Thoroughly oil chamfer strips before installation on forms.
2. Construct forms for railings and ornamental work to standards equivalent to first class mill work.
3. All moldings, panel work, and bevel strips shall be straight and true with neatly mitered joints, and designed so that the finished work shall be true, sharp and clean-cut.

C. FORMS

1. Forms shall be built mortar-tight and of material sufficient in strength to prevent bulging between supports.
2. Reused forms or form lumber shall be maintained clean and in good condition as to accuracy, shape, strength, rigidity, tightness, and smoothness of surface.
3. All forms shall be so constructed as to permit removal without damage to the concrete. Exercise special care in framing forms for copings, offsets, railing and ornamental work, so that there will be no damage to the concrete when the forms are removed.

D. METAL FORMS

1. The specifications for "Forms" regarding design, mortar tightness, filleted corners, beveled projections, bracing, alignment, removal, re-use, oiling, and wetting shall apply equally to metal forms.
2. The metal used for forms shall be of such thickness that the forms will remain true to shape. Bolt and rivet heads on the facing sides shall be countersunk. Clamps, pins, or other connecting devices shall be designed to hold the forms rigidly together and to allow removal without injury to the concrete.
3. Metal forms which do not present a smooth surface or line up properly shall not be used. Exercise special care to keep metal free from rust, grease, or other foreign material that discolors the concrete.

E. FORM LININGS

1. Timber forms for exposed concrete surfaces which are to be given a rubbed finish shall be facelined with an approved type of form lining material.
2. If plywood is used for form lining, it shall be made with waterproof adhesive and have a minimum thickness of 3/4". It shall preferably be oiled at the mill and then be oiled or lacquered on the job before using.
3. If fiber beard is used, apply water to the screen side on the board. Stack the boards screen side to screen side. Use the smooth hard face as the contact surface of the form. Such surfaces may be formed with 3/4" thick plywood made with waterproof adhesive if backed with adequate studs and wales. The greatest strength of the outer plies should be at right angles to the studding. In this case, form lining will not be required.

4. Carefully align edges and faces of adjacent panels and fill the joints between panels with patching plaster or cold water putty to prevent leakage. Lightly sand with No.0 sandpaper to make the joints smooth.
5. Forms which are reused shall have all unused form tie holes filled and smoothed as specified above.

F. FORM TIES
1. Metal form ties shall be used to hold forms in place and to provide easy metal removal. The use of wire for ties shall not be permitted.
2. Remove metal appliances which are used inside the forms to hold the forms in correct alignment to a depth of at least 1-1/2" from the surface of the concrete, without undue injury to the surface from chipping or spalling. Such devices, when removed, shall leave a smooth opening in the concrete surface no larger than 1" in diameter.
3. Burning off rods, bolts, or ties shall not be permitted.
4. Metal ties shall be held in place by devices attached to wales. Each device shall be capable of developing the strength of the tie.
5. Metal and wooden spreaders which are separate from the forms shall be wired from the top of form and shall be entirely removed as the concrete is placed.
6. The use of metal form ties which are encased in paper or other material to allow the removal of complete tie, and which leave a hole through the concrete structure, shall not be permitted in the construction of basement or water bearing walls.

G. FALSEWORK
1. Falsework shall be designed and constructed so that no excessive settlement or deformation occurs. Falsework shall provide necessary rigidity.
2. Timber used in falsework centering shall be sound, in good condition and free from defects which impair its strength.
3. Steel members shall be of adequate strength and shape for the intended purpose.
4 Timber piling used in falsework may be of any wood species which satisfactorily withstands driving and which adequately supports the superimposed load.
5. When sills or timber grillages are used to support falsework Columns, unless founded on solid rock, shale or other hard materials, place them in excavated pits. Backfill to prevent the softening of the supporting material from form drip or from rains that may occur during the construction process. Sills or grillages shall be of ample size to support the superimposed load without settlement.
6. Falsework not founded on a satisfactory spread footing shall be supported on piling, which shall be driven to a bearing capacity to support the superimposed load without settlement.

PART 3 - EXECUTION

3.01 PREPARATION

Before placing concrete, insure that embedded items are correctly, firmly and securely fastened into place. Embedded items shall be thoroughly clean and free of oil and other foreign material. Anchor bolts shall be set to exact locations by the use of suitable anchor bolt templates.

3.02 INSTALLATION

A. Pre-placement
1. During the elapsed time between building the forms and placing the concrete, maintain the forms to eliminate warping and shrinking.
2. Treat the facing of forms with suitable form oil before concrete is placed. Apply oil before the reinforcement is placed. Wet form surfaces which will come in contact with the concrete immediately before the concrete is placed.
3. At the time of placing concrete, the forms shall be clean and entirely free from all chips, dirt, sawdust, and other extraneous matter at the time. Forms for slab, beam and birder construction shall not have tie wire cuttings, nails, matches or any other matter which would mar the appearance of the finished construction. Clean forms and keep them free of foreign matter during concrete placement.

B. PLACEMENT
1. Set and maintain forms to the lines designated, until the concrete is sufficiently hardened to permit form removal. If, at any stage of the work, the forms show signs of bulging or sagging, immediately remove that portion of the concrete causing this condition. If necessary, reset the forms and securely brace against further movement.

2. Provide adequate cleanout openings where access to the bottom of the forms is not otherwise readily attainable.
3. Carefully and accurately place and support reinforcement in concrete structures.

C. REMOVAL

Remove forms so that the underlying concrete surface is not marred or damaged in any way. Forms shall not be removed until the concrete has attained sufficient strength (minimum of 28-day compressive strength) to safely carry the dead load, but in no case less than the number of curing days set forth in the following table.

Forms for concrete paving.	7 day min. OR 75%design strength

END OF SECTION 031100

SECTION 03 20 00 - CONCRETE REINFORCING FOR CIVIL WORK

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor and reinforcing materials required to cut, bend, tie, splice, place and support the reinforcement in the material grades, sizes, quantities and locations specified.

1.02 QUALITY ASSURANCE

TOLERANCES

Reinforcement shall be placed where specified, with the following maximum tolerances, plus or minus:

A. Cover 1/4"
B. Spacings 1/4" in 12"

1.03 SUBMITTALS

Submittals shall be in accordance with Section 01 33 00, SUBMITTALS and shall include:

A. Record data for layouts (shop drawings with bar lists clearly marked with reference to plans.
B. Certifications of steel quality, size, grade and manufacturers origin.

1.04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety:

A. American Society for Testing and Materials (ASTM) standards:
ASTM A615 "Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement"
B. American Concrete Institute (ACI) publications:
ACI 301 "Specification for Structural Concrete for Buildings"
ACI 315 "Details and Detailing of Concrete Reinforcement"
ACI 318 "Building Code Requirements for Reinforced Concrete"
C. Concrete Reinforcing Steel Institute (CRSI) publication:
CRSI Manual of Standard Practice

1.05 DELIVERY AND STORAGE

Store steel reinforcement above the surface of the ground upon platform skids or other supports. Protect from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, steel reinforcement shall be free from dirt, scale, dust, paint, oil and other foreign material. Tag and store steel reinforcement for ease of correlation with shop drawings.

1.06 JOB CONDITIONS

A. Proposed deviations from reinforcing indicated on the plans or specifications shall be approved in writing by the Engineer prior to fabrication.
B. Bar lengths shall be of the length shown on the plans or tables, not the minimum code length.
C. Specified cover for reinforcing shall be maintained throughout construction. Bars shall be cut to lengths necessary to allow for proper clearances.
D. Stirrups shall be hooked.
E. Steel reinforcing bars shall be produced in the United States of America.
F. Cover of concrete shall be measured from face of forms to outside face of reinforcement bar, stirrup or tie.

PART 2 - PRODUCTS

2.01 MATERIALS

A. STEEL REINFORCING BARS: Billet-Steel bars for concrete reinforcement conforming to ASTM A615; Grade 60 with minimum yield strength of 60,000 psi.
B. SUPPORTS: Bar supports shall be of the proper type for the intended use. Bar supports shall be uniform high density polyethylene (plastic) or fiberglass reinforced plastic (FRP) conforming to CRSI Class 1, Maximum Protection.
C. SPACERS: Pre-cast mortar or concrete blocks.
D. MECHANICAL BAR SPLICES: Cadweld splices as manufactured by Erico Products, Inc., or equal, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical devices shall develop at least 125% of the specified yield of the spliced bars.
E. MECHANICAL THREADED SPLICES: Mechanical threaded connections shall utilize a metal coupling sleeve with internal threads which engage threaded ends of the bars to be spliced and shall develop in tension or compression 125% of the specified yield strength of the bar.

2.02 FABRICATIONS

BENDING: Reinforcement shall be bent cold by machine to shapes indicated on the plans; true to shapes indicated; irregularities in bending shall be cause for rejection. Unless otherwise noted, all hook and bend details and tolerances shall conform to the requirements of ACI 315 and ACI 318.

PART 3 - EXECUTION

3.01 PREPARATION

The reinforcing steel in all concrete walls shall be spaced its proper distance from the face of the forms using chairs.

3.02 INSTALLATION

A. GENERAL: Place the reinforcement carefully and accurately in the concrete structures. Rigidly tie and support the reinforcement. Welding of any type of reinforcement shall not be permitted.
B. SPLICES
    1. Splicing of bars, except where indicated on the plans, shall not be permitted. Lap splices which are permitted shall have a lap in accordance with ACI 318. Rigidly clamp or wire the bars at all splices, in accordance with ACI. Welding of reinforcing steel splices shall not be permitted.
    2. Make mechanical splices using "Cadweld" reinforcing bar connectors, installed in strict accordance with the manufacturer's instructions and recommendations. The mechanical device shall develop at least 125% of the specified yield strength of the bar.
    3. Lap splice locations not shown on the plans shall be approved by the Engineer prior to fabrication. Splices shall be kept to a minimum. Splices shall occur only at points of minimum stress. Stagger splices in adjacent bars.
C. PLACEMENT
    1. Place steel reinforcement, as indicated on the plans, with the specified tolerances. Hold securely in place during the placing of the concrete. The minimum clear distance between bars shall be per ACI 318. Always pass vertical stirrups around the main tension members and securely attach thereto. Wire reinforcing together at a sufficient number of intersections to produce a sound, sturdy mat or cage of reinforcement that will maintain the reinforcement in correct positions when the concrete is placed.
    2. Hold the reinforcing steel in concrete slabs firmly in place with wire supports or "chairs". Sizing and spacing of the chairs shall be sufficient to properly support the steel, and shall be in accordance with CRSI Publications "Manual of Standard Practice".
    3. Space the reinforcing steel in concrete walls the proper distance from the face of the forms, as indicted on the drawings, using galvanized metal spacers.
    4. Where reinforcing conflicts with location of anchor bolts, inserts, etc., required to be cast in concrete, submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing shall be permitted without the prior approval of the Engineer.

3.03 FIELD QUALITY CONTROL

Concrete shall not be deposited until the Engineer has observed the final placing of the reinforcing steel, and has given permission to place concrete.

END OF SECTION 032000

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SECTION 033000 - CAST-IN-PLACE CONCRETE FOR CIVIL WORK

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. Codes and Standards: Comply with the applicable provisions of the following codes, specifications, and standards:
   ACI 301 "Specifications for Structural Concrete for Buildings."
   ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
   ACI 311 "Recommended Practice for Concrete Inspection."
   ACI 318 "Building Code Requirements for Reinforced Concrete."
   ACI 347 "Recommended Practice for Concrete Formwork." Concrete Reinforcing Steel Institute, "Manual for Standard Practice."

B. Workmanship: Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerance, and finishes. Correct deficient unsatisfactory concrete as directed by Engineer.

C. Provide testing and inspection service for quality control testing during concrete operations in accordance with General Conditions.

1.02 SUBMITTALS

A. Shop Drawings: Concrete Reinforcement: Submit in accordance with General Conditions. Include drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete structures"; shows bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood-faced or other acceptable panel-type materials to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable size to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection. Use plywood complying with U.S. Product Standards PS-1 "B-B High Density Overlaid Concrete Form," Class 1.

B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

2.02 REINFORCING MATERIALS

A. Reinforcing Bars: ASTM A 615, Grade 60.

B. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs and spacers, supporting, and fastening reinforcing bars in place. Use wire bar type supports complying with CRSI recommendations. Wood, brick, plastic, and other devices will not be acceptable

2.03 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I, domestic manufacture. Use only one brand of cement throughout the project.
   1. Regional Materials: Provide product that are a "regional material" as defined in Section 013520.

B. Normal Weight Aggregates: ASTM C 33.
   1. Regional Materials: Provide product that are a "regional material" as defined in Section 013520.
   2. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
   3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:
      a. Crushed stone, processed from natural rock or stone.

b. Washed gravel, either natural or crushed. Use of pit or bankrun gravel is not permitted.
c. Maximum Aggregate Size: 1½".

C. Water: Clean, fresh, free from oil, acid, organic matter or other deleterious substances.
D. Air-Entraining Admixture: ASTM C 260.
E. Fly ash and calcium chloride or admixture containing more than 0.1% chloride ions are not permitted.

2.04 RELATED MATERIAL

A. Membrane-Forming Curing Compound: ASTM C309, Type I.
B. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
Product/manufacturer; one of the following:
Weldcrete; Larsen Products
EucoWeld; Euclid Chemical Co.
Sonocrete; Sonneborn-Contech
Acrylic Bondcrete; The Burke Co.

2.05 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mix for concrete, to produce a minimum 28 day compressive strength of 3,500 psi, as indicated on Contract Documents. Use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs.
B. Proportion mixes by laboratory trial batch, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1.
C. Submit written reports to the Architect of each proposed mix for each class concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Architect/Engineer.
D. Admixtures:
1. Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content of 5% (±1%) with a maximum water cement ratio of 0.50.
E. Slump Limits: Proportion and design mixes to result in concrete slump at the point of placement of not less than 3" and not more than 5".

2.06 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with the requirements of ASTM C94, and as herein specified. No additional water to be added to the batch for material with insufficient slump with approval of Architect/Engineer.
B. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When the air temperature is between 85° F and 90° F, reduce the mixing and delivery time from 1-2 hours to 75 minutes, and when the air temperature is above 90° F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 FORMS

A. Design, erect, support, brace, and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by the concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
B. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
C. Construct forms complying with ACI 347, to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
D. Fabricate forms for easy removal without hammering or prying against the concrete surfaces.
E. Chamfer exposed corners and edges as shown, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniforms smooth lines and tight edge joints.
F. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed

to prevent form deflection, and to prevent spalling concrete surfaces upon removal. Provide ties so portion remaining within concrete after removal is at least 1½" inside concrete and which will not leave holes larger than 1" diameter in concrete surface.

G. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and locations of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms.

H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms after concrete placement if required to eliminate leaks.

I. Forms which are destroyed or damaged and are not capable of supporting the design load shall be replaced with new forms prior to placing concrete.

3.02 PLACING REINFORCEMENT

A. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

C. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers.

D. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

3.03 JOINTS

A. Construction Joints: Locate and install construction joints, which are not shown on the drawings, so as not to impair the strength and appearance of the structure, as acceptable to the Engineer.

B. Provide keyways at least 1½" deep in all construction joints in grade beams.

C. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.

D. Control Joints per details.

3.04 INSTALLATION OF EMBEDDED ITEMS

A. General: Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain the required elevations and contours in the finished slab surface. Provide and secure units sufficiently strong to support the types of screeds required. Align the concrete surface to the elevation of the screed strips by the use of strike-off templates.

3.05 PREPARATION OF FORM SURFACES

A. Coat the contact surfaces of forms with a form-coating compound before reinforcement is placed.

B. Do not allow excess form-coating material to accumulate in the forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

3.06 CONCRETE PLACEMENT

A. Pre-Placement Inspection: Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit the installation of their work; cooperate with other trades in setting such work. Thoroughly wet wood forms immediately before placing concrete, where form-coatings are not used. Notify the Architect/Engineer at least one (2) working days prior to concrete placement.

B. Coordinate the installation of joint materials and moisture barrier with placement of forms and reinforcing steel.

C. General: Comply with ACI 304, and as herein specified.

D. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.

E. Placing Concrete in Forms: Deposit concrete in grade beam forms in horizontal layers not deeper than 48" and in a manner to avoid inclined construction joints. Place continuously where possible. Start placing at ends of section and progress toward the center. Do not place concrete in beams supported on piers until the concrete in the piers is no longer plastic.

F. Consolidate place concrete by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping. Use vibrators designed to operate with vibratory element submerged in concrete, maintaining a speed of not less than 6000 impulses per minute.

G. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion, limit the duration of vibration to the time necessary to consolidate the concrete and complete embedment of reinforcement and other embedded items without causing segregation of the mix.

H. Placing Concrete: Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

I. Consolidate concrete during placing operation so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

J. Bring surfaces to the correct level with a straight-edge and strikeoff. Use bull floats and darbies to smooth the surface, leaving it free of humps or hollow. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations or while seep water is present on slab surface.

K. Maintain reinforcing in the proper position during concrete placement operations.

L. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliances with ACI 306.

M. Hot Weather Placing: When hot weather conditions exist that would seriously impair the quality and strength of concrete, place concrete in compliance with ACI 305.

3.07 FINISH OR FORMED SURFACES

A. Related Unformed Surfaces: At horizontal offset and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces.

3.08 PAVING FINISHES

A. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps. Immediately after trowel finishing, slightly roughen surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.09 CONCRETE CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively proper hardening. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Keep continuously moist for not less than 72 hours. Begin Final curing procedures immediately following initial curing and before concrete has dried. Continue final curing for at least 168 cumulative hours (not necessarily consecutive) during which concrete has been exposed to air temperatures above 50° F. Avoid rapid drying at end of final curing period.

B. Concrete surfaces shall be cured by application of curing compound. Provide membrane curing by applying membrane-forming curing compound to damp concrete surfaces as soon as water film has disappeared. Apply uniformly in 2-coat continuous operation by power-spray equipment in accordance with manufacturer's directions. Apply second coat at right angle to first coat.

3.10 REMOVAL OF FORMS

A. Formwork not supporting weight of concrete, such as sides of beams, walls, and similar parts of the work, may be removed 48 hours after placing concrete, provide concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

3.11 RE-USE OF FORMS

A. Clean and repair surfaces of forms to be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound materials to concrete contact form surfaces as specified for new formwork.

B. When forms are extended for successive concrete placement thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

3.12 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill-in holes and openings left in concrete structures for passage of work by other trades, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete the work.

3.13 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to the Architect/Engineer. Remove and replace damaged concrete as directed by Engineer.

B. Cut out honeycomb, rock pockets, voids over ½" diameter, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edge of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Architect/Engineer.

3.14 QUALITY CONTROL TESTING DURING CONSTRUCTION

A. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:

1. Slump: ASTM C 143: One test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.

2. Compression Test Specimens: ASTM C 31; one set of 4 standard cylinders for each compressive strength test. Mold and store cylinders for laboratory cured test specimens.

3. Compressive Strength Tests: ASTM C 39; one set for each 100 cu. Yds. or fraction thereof, of each concrete class placed in any day or for each 5,000 sq. Ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days and the remaining specimen held for future testing, if required. Report test results in writing to the Architect and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day test and 28-day tests.

B. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained. Test to determine adequacy of concrete will be by cored cylinders complying with ASTM C 42. Contractor shall pay for such test conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

C. Concrete shall meet the compressive strength as shown on the plans and specifications regardless of ACI 318. ACI 318 shall have no bearing on pass/fail of all site concrete.

END OF SECTION 033000

SECTION 033000 - 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

B. Related Requirements:

1. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
2. Section 321313 "Concrete Paving" for concrete pavement and walks.
3. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.
4. Section 033543 " Polished Concrete Finish" for polished concrete.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

a. Contractor's superintendent.
b. Independent testing agency responsible for concrete design mixtures.
c. Ready-mix concrete manufacturer.
d. Concrete Subcontractor.
e. Special concrete finish Subcontractor.
f. Concrete Polisher.

2. Review items shall include but not be limited to:
    a. special inspection and testing and inspecting agency procedures for field quality control
    b. concrete finishes and finishing
    c. cold- and hot-weather concreting procedures
    d. curing procedures
    e. construction contraction and isolation joints
    f. joint-filler strips
    g. semirigid joint fillers
    h. forms and form removal limitations
    i. vapor-retarder installation
    j. anchor rod and anchorage device installation tolerances
    k. steel reinforcement installation
    l. methods for achieving specified floor and slab flatness and levelness floor and slab flatness and levelness measurement
    m. concrete repair procedures
    n. concrete protection

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

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.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. 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. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

E. Samples: For vapor retarder.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, manufacturer and testing agency.

B. Welding certificates.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.

2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Floor and slab treatments.
7. Bonding agents.
8. Adhesives.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.
12. Repair materials.

D. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates.

E. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer, detailing fabrication, assembly, and support of formwork.

F. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. 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.

C. Testing Agency Qualifications: Owner shall engage an Independent Testing Agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner shall engage an Independent Testing Agency to perform preconstruction testing on concrete mixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage**.**

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: 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.

1. When average high and low 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.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. 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 to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

1. ACI 301.
2. ACI 117.

2.2 FORM-FACING MATERIALS

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

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
    a. Structural 1, B-B or better; mill oiled and edge sealed.
    b. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

D. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut 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 where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
2. Fly Ash: ASTM C 618, Class F or C.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Water: ASTM C 94/C 94M and potable.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: 15-MIL, ASTM E 1745, Class A**,** except with maximum water-vapor permeance of 0.01 perms. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.7 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork, as noted by the Architect.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 according to ASTM D 2240.

C. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

2.9 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C 150/C 150M, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.10 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.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Use fly ash as needed to reduce the total amount of portland cement, which would otherwise be used. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:]

1. Fly Ash: 15 percent, maximum, coordinate with finishing contractor and Polished Concrete Finish, Section 035360.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing 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 and concrete with a w/c ratio below 0.50.

2.11 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Piers: Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

B. Grade Beams: Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Slump Limit: 3 to 5 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
4. Air Content: 3 to 6 percent, plus or minus 1.5 percent at point of delivery for 3/4 -inch nominal maximum aggregate size.

C. Slabs-on-Grade (Exterior Exposed Concrete): Normal-weight concrete.

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum W/C Ratio: 0.50.
3. Minimum Cementitious Materials Content: 540 lb/cu. yd..
4. Slump Limit: 5 inches, plus or minus 1 inch.
5. Air Content: Air Content: 3 to 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

D. Suspended Slabs (Structural Slabs on Void Forms): Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi at 28 days.

2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 2 to 4 inches, plus or minus 1 inch.
4. Air Content: 3 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.12 FABRICATING REINFORCEMENT

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

2.13 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

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

I. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

- EMBEDDED ITEM INSTALLATION

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

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.2 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.3 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that 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. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect / Engineer.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. 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.
4. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Structural Slabs: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints in Structural Slabs: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints in Structural Slabs: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete

when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated by Architect.
2. 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: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

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

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and the withheld water indicated on the batch ticket from the concrete supplier.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. 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.

D. 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.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.

5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

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

3.8 FINISHING FLOORS AND SLABS

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

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

1. Apply scratch finish to surfaces indicated by Architect to receive concrete floor toppings and mortar setting beds for bonded cementitious floor finishes.

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

1. Apply float finish to surfaces indicated by Architect to receive trowel finish.

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

1. Apply a trowel finish to surfaces indicated by Architect that is exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

    a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15, at carpeted floor areas.
    b. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for other non-sloped suspended slabs floor surfaces.
    c. Specified overall values of flatness, F(F) 50; and of levelness, F(L) 35; at polished concrete areas and bays. Measure in accordance with ASTM E1155 and ACI 117. Provide testing at 1 test per 100 sf of floor surface area, evenly distributed over the test surface area, tests shall not be closer than 5'-0" on center.

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

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

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

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

G. Slip-Resistive Finish: Before final floating, where indicated by Architect, apply slip-resistive aggregate or aluminum granule finish, and where indicated to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:

1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate or aluminum granules over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
2. After broadcasting and tamping, apply float finish.
3. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive aggregate or aluminum granules.

H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces according to manufacturer's written instructions and as follows, where indicated by Architect: (Reference "Polished Concrete Finish", Section 035360)

1. Uniformly apply dry-shake floor hardener at a rate of 100 lb/100 sq. ft. unless greater amount is recommended by manufacturer.
2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.

3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. 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: 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. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 6 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated.
3. Minimum Compressive Strength: 3000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 12-inch centers around the full perimeter of concrete base.
5. For supported equipment, install anchor rods that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-rod insert into bases. Install anchor rods to elevations required for proper attachment to supported equipment.

3.10 CONCRETE PROTECTING AND CURING

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

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

C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days 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 for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.11 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions, where indicated by Architect. (Reference “Polished Concrete Finish”, section 035360)

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days' old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.12 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. 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 patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without

coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a Special Inspector and an Independent Testing Agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: Owner shall engage an Independent Testing Agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. 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.

    a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231/C 231M, 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.

4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of four standard cylinder specimens (6”x12” cylinders) for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of one laboratory-cured specimens at 7 days and one set of two specimens at 28 days, hold fourth cylinder to be tested at a later date if required by Architect / Engineer.
    a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at 28-days.
7. 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.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
9. 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.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. 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 Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. Measure floor and slab flatness and levelness according to ASTM E 1155 within 48 hours of finishing.

3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer. (Refer to Section 035360)

END OF SECTION 033000

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SECTION 033543 - POLISHED CONCRETE

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 SECTION INCLUDES

A. Polished concrete floor finish consisting of thorough cleaning of new concrete slab, dry grinding to remove surface imperfections and irregularities, application of dye hardener, and polishing.

1.3 REFERENCES

A. NFSI - National Floor Safety Institute; Test Method 101A; current edition.

1.4 SYSTEM DESCRIPTION

A. Polished Concrete Floor Finish: A multi-step finishing process on concrete floor surfaces consisting of dry grinding and polishing to the scheduled reflective sheen.

1.5 PERFORMANCE REQUIREMENTS

A. Completed polished concrete floor surface shall have a static Coefficient of Friction or Slip Coefficient of 0.6, minimum, when tested in accordance with NFSI Test Method 101A.

1.6 SUBMITTALS

A. Product Data: Provide manufacturer's product data sheets on densifier, sealer, and joint filler materials. Provide manufacturer's product data on polishing equipment, including grinding machine, grinding heads, grinding pads and dust extraction system.

B. Samples: Submit two polished concrete finish samples, 6 x 6 inch in size, illustrating sheen level of polished concrete.

C. Test Reports: Submit test reports or certification from NFSI confirming that polished concrete floor finish has been tested in accordance with Method 101A and has passed phase 2 level of certification.

D. Manufacturer's Instructions: Indicate complete preparation and finishing instructions for each level of sheen.

E. Maintenance Data: Indicate manufacturer's recommended cleaning and maintenance instructions for polished concrete floor finish.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing the work of this Section and trained by equipment manufacturer in proper operation of equipment; successfully completed not less than 3 previous projects of similar scope.

B. Pre-Installation Conference:

1. Prior to application of polished concrete floor finish, conduct a pre-installation conference at the project site.
2. Attendance: Contractor, job superintendent, and suppliers of hardeners and sealers related to polished concrete floor finish work.
3. Agenda: Finish criteria, mock-ups, preparation, application process and protection of completed floors.

C. Provide list of not less than 5 successful projects, complete with name and contact information of owner, documenting past performance.

1.8 MOCK-UP

A. Aggregate mock-up:

1. Location: pour temporary slab.
2. Size: minimum 6' x 6'.

B. Finish mock-up:

1. Location: Day Room.
2. Size: minimum 6' x 6'.
3. Show colorant, polished finish and selected sheen level.

C. Accepted mock-up will serve as a standard to judge quality and workmanship of completed polished concrete floor finish

1.9 PROJECT CONDITIONS

A. Take precautions to prevent staining of concrete prior to application of concrete floor polishing:
B. Prohibit parking of vehicles on concrete slab.
C. If construction equipment must be used for application, diaper components that might drip oil, hydraulic fluid, or other liquids.
D. Prohibit acids and acidic detergents from contacting concrete surfaces.
E. Sequence application of concrete polishing after completion of other construction activities that would be damaging to completed polished finish.
F. Concrete Substrate
    1. Minimum Ff/Fl rating: 35/30, tested to ASTM E1155.
    2. 28 day compressive strength 4500 to 5000 PSI.
    3. Cured minimum 14 days using methods indicated in Section 033000. If curing compound is used, it shall be natural dissipating type.
    4. Power troweled, without burning and without hand finishing.
    5. If fine aggregate concrete mix with minimal aggregate is specified, concrete must be thoroughly floated and tamped.
    6. Acceptable ph ASTM F710, consult with manufacturer with results.
    7. Relative Humidity performed ASTM F2170, consult with manufacturer with results.
    8. Maximum fly ash content to be 15%.
G. Protect concrete surfaces scheduled to receive dyed and polished finish prior to finishing; prevent damage and staining:
    1. Provide fluid containment for equipment working on floors before and after polishing.
    2. Do not allow vehicular traffic on floors before or after polishing.
    3. Do not allow acids to contact surfaces.
    4. Close areas to traffic during finishing and for minimum time period after finishing as recommended by concrete treatment manufacturer.

1.10 SCHEDULING

A. Erect exterior walls prior to beginning work (including all grinding, application of densifier, application of color, and polishing) of this section. Complete all work of this section prior to erecting any interior partitions and load bearing walls.

PART 2 - PRODUCTS

2.1 ACCEPTABLE HARDENING/SEALING MANUFACTURERS

A. RetroPlate Concrete Polishing System, by Advanced Floor Products
    1. Hardener: RetroPlate 99
    2. Sealer: RetroGuard (living quarters), RetroPel (apparatus bays)
    3. Dye: To be provided by manufacturer of hardener/sealer from their full range of products and colors.
B. Consolideck, By Prosoco
    1. Hardener: LS
    2. Sealer: PolishGuard (living quarters), Consolideck SLX 100 Water and Oil Repellent (apparatus bays)
    3. Dye: To be provided by manufacturer of hardener/sealer from their full range of products and colors.
C. Armour Products, by Silex Custom Concrete Solutions
    1. Hardener: Armour Hard
    2. Sealer: Armour Renew Stain Guard (living quarters), Armour Seal (apparatus bays)
    3. Dye: To be provided by manufacturer of hardener/sealer from their full range of products and colors.
D. Each manufacturer must provide a:
    1. Hardener
    2. Stain sealer
    3. Dye: To be provided by manufacturer of hardener/sealer from their full range of products and colors.

2.2 EQUIPMENT

A. Grinding Machine: Counter rotating head floor grinding machine and edge grinder.
B. Dust Extraction System: Provide complete with squeegee attachment.
C. Grinding Heads:

1. Metal Bonded SF-80, SF-150 or SF-300 diamonds depending on application.
2. Resin Bonded: HTC phenolic resin diamonds in 400, 800, 1500, and 3000 grits.

D. Grinding Pads for Edges:
1. Swiflex Telum grits 40 or 60 and 120, depending upon application.
2. KGS Speedline grits 200, 400, 800, 1500, and 3000.

2.3 ACCESSORY MATERIALS

A. Acceptable Control Joint Filler:
1. Metzger McGuire MM 80 epoxy joint filler.
2. Hi-Tech Structural Systems Polyurea Joint Filler HT-PE85.

B. Self-Leveling Underlayment: As recommended by system manufacturer for use in areas requiring deep grinding to remove deep surface imperfections.

C. Dye: To be provided by manufacturer of hardener/sealer from their full range of products and colors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine concrete floors for defects and conditions that cannot be corrected by preparatory work.

B. Do not proceed until defects are corrected.

3.2 PREPARATION

A. Clean concrete surfaces free of dirt, debris, paint/oil splatters and other residue.

B. Remove curing compounds and sealers from concrete surfaces.

C. Leave concrete surfaces clean and dry, ready for polishing process.

D. Protect adjacent surfaces and finishes from damage by concrete polishing procedures.

E. Fill control joints with joint filler and shave prior to the grinding and polishing process.

3.3 APPLICATION

A. Apply concrete polishing in accordance with manufacturer's instructions to the selected sheen level.

B. Finish to be:
1. Class B Fine Aggregate
2. Surface Texture Grade B-1 (CSDA ST-115).

C. Grind concrete floor to within 5 inches of walls and partitions using SF-40 grit, removing construction debris and floor slab imperfections and imparting a uniform scratch pattern in concrete surfaces. Thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris.

D. Apply liquid densifier, undiluted, at approximate rate of 200 s.f. per gal (or as otherwise recommended by manufacturer) in accordance with manufacturer's instructions. Remove excess material from surfaces. Allow to cure for 1 to 2 hours before proceeding with grinding and polishing.

E. Grind concrete floor to within 5 inches of walls and partitions using metal bonded diamond grits, SF-80, SF-150 and SF-300 in succession, grinding 90 degrees from each previous grind and removing scratches from each previous grind. After each grind, thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris.

F. Any additional grinding required to meet Surface Texture Grade B-1 (CSDA ST-115) shall be included.

G. Grind edges of floor using KGS 60, 120 and 220-grit grinding pads, completely removing scratches from each previous grind. After each grind, thoroughly vacuum floor using a squeegee vacuum attachment to completely remove dust and debris.

H. Polish concrete floor, to sheen level indicated, with resin bonded diamond grit of 800 as applicable, first polishing floor edges with pads of same grit and then polishing field of floor, completely removing scratches from each previous grit.

I. Apply dye to polished concrete after 400 grit polishing has occurred.

J. Completed polished concrete floor shall have uniform sheen level and shall match accepted mock-up.

K. Stain sealer to be applied per manufacturer's recommendation.

3.4 FIELD QUALITY CONTROL

A. Measure with profilometer in accordance with ST-115.

B. Measure gloss rating using Horbia 320 gloss meter; re-polish if required to achieve specified gloss rating.

C. Measure slip resistance using BOT-3000 slip-tester by Universal Walkway Testing; ensure compliance with specified slip resistance rating

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SECTION 042000 - UNIT MASONRY

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. Concrete masonry units.
   2. Decorative concrete masonry units.
   3. Acoustical concrete masonry units.
   4. Face brick.
   5. Mortar and grout.
   6. Steel reinforcing bars.
   7. Masonry joint reinforcement.
   8. Ties and anchors.
   9. Embedded flashing.
   10. Miscellaneous masonry accessories.
   11. Cavity-wall insulation.

B. Items installed but not furnished under this section:
   1. Cast Stone Trim in Unit Masonry.
   2. Steel lintels in Unit Masonry.
   3. Steel shelf angles for supporting Unit Masonry.
   4. Cavity Wall Insulation.

C. Related Requirements:
   1. Section 051200 “Structural Steel Framing” for installing anchor sections of adjustable masonry anchors for connecting to structural steel frame.
   2. Section 071900 “Water Repellents” for Water Repellents applied to unit masonry assemblies.
   3. Section 072100 “Thermal Insulation” for cavity wall insulation.
   4. Section 076200 “Sheet Metal Flashing and Trim” for exposed sheet metal flashing and for furnishing manufactured reglets installed in masonry joints.
   5. Section 089516 “Wall Vents” for wall vents (Brick Vents).

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.
   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.5 ACTION SUBMITTALS

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

B. Samples for Initial Selection:
   1. Decorative CMUs, in the form of small-scale units.
   2. Face brick**,** in the form of straps of five or more bricks.
   3. Weep holes/vents.
   4. Pigmented Mortar.
   5. Accessories embedded in masonry.

C. Shop Drawings:
   1. Masonry Units: Show sizes profiles, covering, and location of special shape.
   2. Stone Trim Units: Show sizes, profiles, and locations of each stone trim unit required.
   3. Reinforcement Steel: Detail bending, lap strengths and placement of unit masonry; reinforcing bars.

Comply with ACI 315. Show elevations of reinforced walls.
4. Fabricated Flashing: Detail corner units and other special applications.
5. Indicate location of other work integrated into system.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:
1. Masonry units.
a. Include data on material properties and material test reports substantiating compliance with requirements.
b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.
8. Integral water repellents used in CMUs.
9. Mortar admixtures.

B. Mix Designs: For each type of mortar and grout include description of types and proportions of ingredients.
1. Include Test Reports for mortar mixes required to comply with property specifications. Test according to ASTM C109 / C 109Mfor compressive strength, ASTM C1506 for water retention, and ASTM C91 / C91M for air content.
2. Include test reports, according to ASTM C1019 for grout mixes required to comply with compressive strength requirement.

C. Statement of Compressive Strength of Unit Masonry: For each combination of masonry unit type and mortar type, product statements of average net-area compressive strength of masonry Units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 602 / ACI 530-1 / ASCEG.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.
1. Recycled material data. Provide for any material with recycled content:
a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
b. Material costs for each product having recycled content.
2. Regional material data. Provide for each product manufactured within 500 miles:
a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
c. Material cost for product.

1.7 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

D. 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 typical wall area as shown on Drawings.
2. Build mockups foreach type of exposed unit masonry construction in size as indicated on Drawings.
a. Include a sealant-filled joint at least 16 inches long in each exterior wall mockup.
b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.

c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include studs, sheathing, and , veneer anchors, flashing**,** cavity drainage material, and weep holes in exterior masonry-veneer wall mockup.

3. Clean one-half of exposed faces of mockups with masonry cleaner as indicated.
4. Protect accepted mockups from the elements with weather-resistant membrane.
5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units 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. If units become wet, do not install until they are dry.
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. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.
E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.9 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
   2. Where one the of the multi he masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain

chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

C. Source Limitations for Masonry Units: Obtain exposed masonry units of uniform texture and color, or a uniform blood within the ranges accepted for those characteristics, from single source from single manufacturer for each product required.

D. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for expected masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

E. Masonry Standard: Comply with TMS 602 / ACI 530.1 / ASCE 6, except as modified by requirements in the contract documents.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
   1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
   2. Provide square-edged units for outside corners unless otherwise indicated.
   3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
      a. Widths: 6 and 8 inches nominal.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.
   1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
      a. Products: Subject to compliance with requirements, provide one of the following following]:
         1) ACM Chemistries; RainBloc.
         2) BASF Aktiengesellschaft; Rheopel Plus.
         3) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.

C. CMUs: ASTM C 90.
   1. Density Classification: Lightweight.
   2. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

D. Decorative CMUs: ASTM C 90.
   1. Density Classification: Lightweight.
   2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
   3. Pattern and Texture: Ground face.
   4. Colors: As selected by Architect from manufacturer's full range.
   5. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.
   6. Colors and Patterns: Trenwyth Trenstone ground faced units, color group E, “Mission White”.
   7. Provide in the following shapes: 8F, 8FE, 8FEBN, 8FT, and KOBB (open bottom).
   8. Provide raked mortar joints at interior.
   9. Decorative CMU location.

E. Sound Absorbing Concrete Masonry Units: Hollow units with solid closed tops, fabricated from Portland cement and lightweight mineral aggregate, Soundblox Type 12RSC/RF-4 as manufactured by Proudfoot Company, Inc., Greenwich, Connecticut, providing an NRC of 0.80.
   1. All units shall be from the same manufacturing plant, shall have the same surface texture and shall meet the requirements of ASTM C 90, Grade N lightweight for load-bearing units. Units shall have a linear shrinkage not to exceed 0.065% by test.
   2. Size: 8" x 16" face.
   3. Sound Absorption: Two cavities with two funnel-shaped slots in each block. Each cavity shall have incombustible fibrous fillers with metal septa factory installed.
   4. Provide left and right sound blocks as required for reinforced masonry construction.
   5. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1900 psi.
   6. Provide "equivalent concrete masonry thickness" required for fire-rated assemblies where indicated or required by code.

2.3 CONCRETE LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

C. Concrete Lintels: Precast or foamed-in-place concrete lintels complying with requirements in Section 033000 “Cast-In-Place Concrete” and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated as built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels unit cured.

2.4 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units:

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

B. Face Brick: Facing brick complying with ASTM C 216.

1. Products: Subject to compliance with requirements, provide the following:
   a. As scheduled below.
2. Grade: SW.
3. Type: FBS.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Size (Actual Dimensions): As scheduled.
7. Corners at soldier courses need to be solid.
8. Application: Use where brick is exposed unless otherwise indicated.
9. Color and Texture:
   a. Brick Type 1: Acme Brick Blend
      1) Plant DTP-673
      2) Product Code 29-888-01-21
      3) Bricks: 152-C08316 (60%), 156-C00117 (15%), 157-C10316 (15%), 601-C15817 (10%)
   b. Brick Type 2: Acme Brick Blend 601 Brookshire.

2.5 MORTAR AND GROUT MATERIALS

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

1. Alkali content shall not be more than 0.1 percent when tested according to ASTM C114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Capital Materials Corporation; Flamingo Color Masonry Cement.
   b. Cemex S.A.B. de C.V.; Brikset Type N.
   c. Essroc, Italcementi Group; Brixment.
   d. Holcim (US) Inc.; Mortamix Masonry Cement.
   e. Lafarge North America Inc.; Magnolia Masonry Cement.
   f. Lehigh Cement Company; Lehigh Masonry Cement.
   g. National Cement Company, Inc.; Coosa Masonry Cement.

E. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Davis Colors; True Tone Mortar Colors.
b. Solomon Colors, Inc.; SGS Mortar Colors.

F. Colored Cement Product: Packaged blend made from and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
2. Pigments shall not exceed 10 percent of portland cement by weight.
3. Pigments shall not exceed 5 percent of masonry cement by weight.

G. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

H. Aggregate for Grout: ASTM C 404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Euclid Chemical Company (The); Accelguard 80.
b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.

J. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent by same manufacturer.
1. Products: Subject to compliance with requirements, provide one of the following:
a. ACM Chemistries; RainBloc for Mortar.
b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

K. Water: Potable.

L. Masonry Cement: ASTM C91 / C91M.

M. Lafarge:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that maybe incorporate into the work included, but not limited to the following:
a. Cemex S.A.B. to C.V.
b. Lafarge North America, Inc.
c. Lehigh Hanson; Heidelberg Cement Group.

N. Mortar Cement: ASTM C1329 / C1329M.

2.6 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
1. Interior Walls:Hot-dip galvanized, carbon steel.
2. Exterior Walls:
a. Hot-dip galvanized, carbon steel in typical locations
b. Stainless Steel where reinforcing is used with veneer anchors.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet**,** with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
1. Ladder type with 1 side rod at each face shell of hollow masonry units more than 4 inches wide, plus 1 side rod at each wythe of masonry 4 inches wide or less.
2. Tab type, either ladder or truss design, with 1 side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe**.**
a. Acceptable Product: Hohmann & Barnard; 270-2X Ladder Eye Wire.

E. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single

0.187-inch- diameter, hot-dip galvanized, carbon-steel continuous wire.

F. Reinforcing Bar Positions: Wire Units disguised to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in the center of cells. Units are formed from 0-14 Celsius inch steel wire, hot dipped galvanized after fabrication. Provide units disguised for number of bars indicated.

2.7 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
   1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
   2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
   3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304].
   4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
   5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
   6. Stainless-Steel Sheet: ASTM A 666, Type 304.
   7. Steel plates, shapes, and bars: ASTM A36 / A36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
   1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units.
   2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.
   3. Wire: Fabricate from 3/16-inch- diameter, stainless steel.

D. Adjustable Anchors for Connecting to Concrete: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Connector Section: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.060-inch- thick, stainless steel sheet.
      a. 0.064-inch- thick, galvanized sheet may be used at interior walls unless otherwise indicated.
   2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.187-inch-diameter, stainless steel wire.

E. Adjustable Masonry-Veneer Anchors:
   1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   2. Fabricate sheet metal anchor sections and other sheet metal parts from .078-inch- thick stainless steel sheet, galvanized after fabrication.
   3. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- diameter, stainless steel wire unless otherwise indicated.
   4. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
      a. Products: Subject to compliance with requirements,provide one of the following:
         1) At Sheathing: Hohmann & Barnard, Inc.; HB-213-2X.
         2) At Steel Columns: Hohmann & Barnard,Inc; 359-FH with type 304 Stainless Steel Vee Byna-Tie.
   5. Polymer-Coated, Steel Drill Screws for Steel Studs: ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) ITW Buildex; Teks Maxiseal with Climaseal finish.
         2) Textron Inc., Textron Fastening Systems; Elco Dril-Flex with Stalgard finish.

F. Partition Top Anchors:
   1. 105-inch – thick metal plate with a 3/8 inch diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dipped galvanized after fabrication.

2.8 EMBEDDED FLASHING MATERIALS

A. The built-in flashing membrane shall be 40 mil flexible sheet material, consisting of a blend of elastomeric and thermal plastic polymers, incorporating DuPont Elvaloy®. The membrane shall be reinforced with synthetic fibers, calendered into sheet form, rolled and cut to width.

B. Cloaks shall be pre-formed, three dimensional flexible units used for detail corners, level changes, stop ends and special applications. Cloak color shall be as selected by Architect and/or shall match mortar color. Reference manufacturer's list of colors for selection.

C. Flashing Membrane Adhesive: Flashing adhesive exceeds the requirements of TTS00230C Type II, Class B, ASTM C 92094 and Canadian Spec CAN 19, 13M82. The product is terra cotta (dull red) in color.

D. Surface-adhered with drip membrane shall be a composite 40 mil membrane consisting of 25 mils of elastomeric/thermal plastic membrane incorporating DuPont Elvaloy® and 15 mils of SBS asphaltic adhesive. The membrane shall be reinforced with synthetic fibers, calendered into sheet form, rolled and cut to standard widths.
   1. Standard Sheet Dimensions: Thickness 40 mil
   2. Roll length 75 ft
   3. Roll widths 12, 18, 24, 36 in
   4. Cloaks shall be pre-formed, three dimensional flexible units used for detail corners, level changes, stop ends,

E. Asphalt Primer: Shall be a two-sided, self-adhering tape used to seal the top of cloaks against the back-up wythe. Adhesive may be used as an alternative.

F. Mastic: Shall be used at all laps and joints, and top terminations.

G. Substrate Primer: As recommended by flashing manufacturer.

H. Fabricate metal drip edges from stainless steel. Extend at least 3 inches into wall and ½ inch out of wall, with outer edge bent 30 degrees and hemmed.

I. Termination Bar: Use the following unless otherwise indicated:
   1. Products: Subject to compliance with requirements provide the following:
      a. Hohmann and Barnard, Inc; type T1, Stainless Steel.

J. Metal Flashing: Provide metal flashing complying with section 076200 “Sheet Metal Flashing and Trim” and as allows.

2.9 FLEXIBLE FLASHING

A. Flexible Flashing: Use the following unless otherwise indicated:
   1. Asphalt-Coated Copper Flashing: 5-oz./sq. ft. copper sheet coated with flexible asphalt. Use only where flashing is fully concealed in masonry.
      a. Manufacturers: Subject to compliance with requirements, provide the following:
         1) Hohmann & Barnard, Inc.; H & B C-Coat Flashing.
   2. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.030 inch.
      a. Manufacturers: Subject to compliance with requirements, provide the following:
         1) Illinois Product Corporation; Preformed IPCO Flashing.

B. Application: Unless otherwise indicated, use the following:
   1. Where flashing is indicated to receive counterflashing, use metal flashing.
   2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
   3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
   4. Where flashing is fully concealed, use flexible flashing.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated fromneoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from[styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805][or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:
   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
      a. Products: Subject to compliance with requirements,provide one of the following]:

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
3) Heckmann Building Products Inc.; No. 85 Cell Vent.
4) Hohmann & Barnard, Inc.; Quadro-Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Advanced Building Products Inc.; Mortar Break.
b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
c. Mortar Net USA, Ltd.; Mortar Net.
2. Provide one of the following configurations:
a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
b. Strips, not less than 2 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.
c. Sheets or strips full depth of cavity and installed to full height of cavity.
d. Sheets or strips not less than 2 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
1. Products: Subject to compliance with requirements, provide one of the following]:
a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
b. Heckmann Building Products Inc.; No. 376 Rebar Positioner.
c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.

2.11 CAVITY-WALL INSULATION

A. Refer to Section 072100.

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

2.12 MASONRY CLEANERS

A. Proprietary Non-Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Exterior Masonry Conditions: PROSOCO; Sure-Klean 600.
b. At Interior Masonry Conditions Over Polished Concrete Floors: SynPro Masonry Cleaner.
c. Prosoco Burnished Custom Masonry Cleaner (at burnished cmu block).

2.13 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, antifreeze compounds, or other admixtures, unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime mortar.
4. For reinforced masonry, use portland cement-lime mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

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

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N. Where exposed to the elements, provide water repellent admixture.

4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Pigmented Mortar: Use colored cement product or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
   1. Pigments shall not exceed 10 percent of portland cement by weight.
   2. Mix to match Architect's sample.
   3. Application: Use pigmented mortar for exposed mortar joints with the following units:
      a. Decorative CMUs.
      b. Face brick.
      c. Cast stone trim units.

E. Grout for Unit Masonry: Comply with ASTM C 476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
   4. Verify that substrates are free of substances that impair mortar bond.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.2 INSTALLATION, GENERAL

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

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

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

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

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

G. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
   1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
   2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
   3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:
   1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
   2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
   3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:
1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch**.**
5. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond or bond pattern indicated on Drawings if different; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

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

H. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
1. Install compressible filler in joint between top of partition and underside of structure above.
2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
3. Wedge non-load-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078446 "Fire-Resistive Joint Systems."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow brick CMUs as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill

head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
   1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
   2. Allow cleaned surfaces to dry before setting.
   3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
   1. For glazed masonry units, use a nonmetallic jointer 3/4 inch or more in width.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

F. Cut joints flush where indicated to receive waterproofing cavity wall insulation or air barriers unless noted otherwise.

3.6 MASONRY-CELL FILL

A. Loose-Fill Insulation: Perlite complying with ASTM C549, Type II (surface treated for water repellency and limited moisture absorption) or Type IV (surface treated for water repellency and to limit dust generation).

B. Lightweight-Aggregate Fill: ASTM C331/C331M.

3.7 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.8 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framingandconcrete and masonry backup with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through sheathing to wall framing and to concrete and masonry backup with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

3.9 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
   1. Provide an open space not less than 1 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
   2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
   3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry using one of the following methods:
   1. Install preformed control-joint gaskets designed to fit standard sash block.

2. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

C. Form expansion joints in brick as follows:
1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
2. Build flanges of factory-fabricated, expansion-joint units into masonry.
3. Build in compressible joint fillers where indicated.
4. Form open joint full depth of brick wythe and of width indicated, but not less than[3/8 inch1/2 inch for installation of sealant and backer rod specified in Section 079200 "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 079200 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.11 LINTELS

A. Install steel lintels where indicated.

B. Provide lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

1. Provide 7 by 4 by 3/8 inch lintels unless otherwise noted.

C. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.12 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated

B. Install flashing as follows unless otherwise indicated:
1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of wall in exposed masonry. Where interior face of wall is to receive furring or framing, carry flashing completely through inner wythe and turn flashing up approximately 2 inches on interior face.
3. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 4 inches and 1-1/2 inches into the inner wythe
4. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches, and terminated with a termination bar.
5. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches at end dams.
6. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
7. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
8. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
9. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.

D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

E. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

3. Space weep holes formed from 16 inches o.c.

F. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.13 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
   1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
   2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.14 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:
   1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 32 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.
      a. Where bed joints of wythes do not align, use adjustable (two-piece) type ties.
      b. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type ties to allow for differential movement regardless of whether bed joints align.
   2. Masonry Joint Reinforcement: Installed in horizontal mortar joints.
      a. Where bed joints of both wythes align, use ladder-type reinforcement extending across both wythes.
      b. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.
      c. Where one wythe is of clay masonry and the other of concrete masonry, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties to allow for differential movement regardless of whether bed joints align.
   3. Header Bonding: Provide masonry unit headers extending not less than 3 inches into each wythe. Space headers not over [8 inches] [12 inches] clear horizontally and 16 inches clear vertically.
   4. Masonry Veneer Anchors: Comply with requirements for anchoring masonry veneers.

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

3.15 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:
   1. Fasten screw-attached anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
   2. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
   3. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   4. Space anchors as indicated, but not more than 16 inches o.c. vertically and 24 inches o.c. horizontally (or 12 inches on center vertically and 32 inches on center horizontally) with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

3.16 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections.

Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
   2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
   3. Place grout only after inspectors have verified proportions of site-prepared grout.
C. Testing Prior to Construction: One set of tests.
D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.
F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
J. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.17 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in two uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat, and scarify first coat to ensure full bond to subsequent coat.
B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.
C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.18 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
   5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
   6. Clean concrete masonry and cast stone by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.19 MASONRY WASTE DISPOSAL

A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
B. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.
   1. Crush masonry waste to less than 4 inches in each dimension.
   2. Mix masonry waste with at least two parts of specified fill material for each part of masonry waste. Fill material is specified in Section 312000 "Earth Moving."
   3. Do not dispose of masonry waste as fill within 18 inches of finished grade.
C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION

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SECTION 047200 – PRECAST CONCRETE

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 trim units.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. For precast concrete units, include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
B. Shop Drawings: Show fabrication and installation details for precast concrete units. Include dimensions, details of reinforcement and anchorages if any, and indication of finished faces.
   1. Include building elevations showing layout of units and locations of joints and anchors.
C. Samples for Initial Selection: For colored mortar.
D. Samples for Verification:
   1. For each color and texture of precast concrete required, 10 inches square in size.
   2. For colored mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicated types and amounts of pigments used**.**

1.4 INFORMATION SUMITTALS

A. Sustainable Submittals:
   1. Recycled material data. Provide for any material with recycled content:
      a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
      b. Material costs for each product having recycled content.
   2. Regional material data. Provide for each product manufactured within 500 miles:
      a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
      b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
      c. Material cost for product.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of precast concrete units similar to those indicated for this Project, that has sufficient production capacity to manufacture required units, and is a plant certified by the Precast Concrete Institute.
B. Source Limitations for Precast concrete: Obtain precast concrete units through single source from single manufacturer.
C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
D. Mockups: Furnish precast concrete for installation in mockups specified in Section 042000 "Unit Masonry."
E. 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 typical wall area as shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Coordinate delivery of precast concrete with unit masonry work to avoid delaying the Work and to minimize the need for on-site storage.
B. Pack, handle, and ship precast concrete units in suitable packs or pallets.
   1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move precast

concrete units, if required, using dollies with wood supports.

2. Store precast concrete units on wood skids or pallets with nonstaining, waterproof covers, securely tied. Arrange to distribute weight evenly and to prevent damage to units. Ventilate under covers to prevent condensation.

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

D. Store mortar aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Comply with cold-weather construction requirements in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until precast concrete has dried, but no fewer than seven days after completing cleaning.

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

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MATERIALS

A. General: Comply with ASTM C 1364.

B. Portland Cement: ASTM C 150, Type I or Type III, containing not more than 0.60 percent total alkali when tested according to ASTM C 114. Provide natural color or white cement as required to produce precast concrete color indicated.

C. Coarse Aggregates: Granite, quartz, or limestone complying with ASTM C 33; gradation and colors as needed to produce required precast concrete color.

D. Fine Aggregates: Natural sand or crushed stone complying with ASTM C 33, gradation and colors as needed to produce required precast concrete textures and colors.

E. Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

F. Admixtures: Use only admixtures specified or approved in writing by Architect.

1. Do not use admixtures that contain more than 0.1 percent water-soluble chloride ions by mass of cementitious materials. Do not use admixtures containing calcium chloride.

2. Use only admixtures that are certified by manufacturer to be compatible with cement and other admixtures used.

3. Air-Entraining Admixture: ASTM C 260. Add to mixes for units exposed to the exterior at manufacturer's prescribed rate to result in an air content of 4 to 6 percent, except do not add to zero-slump concrete mixes.

G. Reinforcement: Deformed steel bars complying with ASTM A 615/A 615M, Grade 60. Use galvanized or epoxy-coated reinforcement when covered with less than 1-1/2 inches of precast concrete material.

1. Epoxy Coating: ASTM A 775/A 775M.

2. Galvanized Coating: ASTM A 767/A 767M.

H. Embedded Anchors and Other Inserts: Fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

2.2 PRECAST CONCRETE UNITS

A. Provide precast concrete units complying with ASTM C 1364 using either the vibrant dry tamp or wet-cast method.

1. Provide units that are resistant to freezing and thawing as determined by laboratory testing according to ASTM C 666/C 666M, Procedure A, as modified by ASTM C 1364.

B. Fabricate units with sharp arris and accurately reproduced details, with indicated texture on all exposed surfaces unless otherwise indicated.

1. Slope exposed horizontal surfaces 1:12 to drain unless otherwise indicated.

2. Provide drips on projecting elements unless otherwise indicated.

C. Fabrication Tolerances:

1. Variation in Cross Section: Do not vary from indicated dimensions by more than 1/8 inch.

2. Variation in Length: Do not vary from indicated dimensions by more than 1/360 of the length of unit or 1/8 inch, whichever is greater, but in no case by more than 1/4 inch.
3. Warp, Bow, and Twist: Not to exceed 1/360 of the length of unit or 1/8 inch, whichever is greater.
4. Location of Grooves, False Joints, Holes, Anchorages, and Similar Features: Do not vary from indicated position by more than 1/8 inch on formed surfaces of units and 3/8 inch on unformed surfaces.

D. Cure units as follows:
1. Cure units in enclosed moist curing room at 95 to 100 percent relative humidity and temperature of 100 deg F for 12 hours or 70 deg F for 16 hours.
2. Keep units damp and continue curing to comply with one of the following:
a. No fewer than six days at mean daily temperature of 60 deg For above.

E. Acid etch units after curing to remove cement film from surfaces to be exposed to view.

F. Colors and Textures: As selected by Architect from manufacturer's full available range.

2.3 MORTAR MATERIALS

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

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Products: Subject to compliance with requirements,provide one of the following:
a. Davis Colors; True Tone Mortar Colors.
b. Solomon Colors, Inc.; SGS Mortar Colors.

E. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

F. Water: Potable.

2.4 ACCESSORIES

A. Anchors: Type and size indicated, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

B. Dowels: 1/2-inch- diameter, round bars, fabricated from steel complying with ASTM A 36/A 36M, and hot-dip galvanized to comply with ASTM A 123/A 123M.

C. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by precast concrete manufacturer and expressly approved by cleaner manufacturer for use on precast concrete and adjacent masonry materials.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Diedrich Technologies, Inc.
b. ProSoCo, Inc.

2.5 MORTAR MIXES

A. Comply with requirements in Section 042000 "Unit Masonry" for mortar mixes.

B. Do not use admixtures including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime or mortar unless otherwise indicated.

C. Comply with ASTM C 270, Proportion Specification.
1. For setting mortar, use Type N.
2. For pointing mortar, use Type N.

D. Pigmented Mortar: Use colored cement produc or select and proportion pigments with other ingredients to produce color required. Do not add pigments to colored cement products.
1. Pigments shall not exceed 10 percent of portland cement by weight.
2. Pigments shall not exceed 5 percent of mortar cement by weight.
3. Mix to match Architect's sample.

4. Application: Use pigmented mortar for exposed mortar joints.

2.6 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to sample and test precast concrete units according to ASTM C 1364.
   1. Include one test for resistance to freezing and thawing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SETTING PRECAST CONCRETE IN MORTAR

A. Set precast concrete as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
   1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
   2. Coordinate installation of precast concrete with installation of flashing specified in other Sections.
B. Wet joint surfaces thoroughly before applying mortar or setting in mortar.
C. Set units in full bed of mortar with full head joints unless otherwise indicated.
   1. Set units with joints 3/8 or 1/4 inch wide unless otherwise indicated.
   2. Build anchors and ties into mortar joints as units are set.
   3. Fill dowel holes and anchor slots with mortar.
   4. Fill collar joints solid as units are set.
   5. Build concealed flashing into mortar joints as units are set.
   6. Keep head joints in coping and other units with exposed horizontal surfaces open to receive sealant.
   7. Keep joints at shelf angles open to receive sealant.
D. Rake out joints for pointing with mortar to depths of not less than 3/4 inch. Rake joints to uniform depths with square bottoms and clean sides. Scrub faces of units to remove excess mortar as joints are raked.
E. Point mortar joints by placing and compacting mortar in layers not greater than 3/8 inch. Compact each layer thoroughly and allow it to become thumbprint hard before applying next layer.
F. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
G. Provide sealant joints at copings and other horizontal surfaces, at expansion, control, and pressure-relieving joints, and at locations indicated.
   1. Keep joints free of mortar and other rigid materials.
   2. Build in compressible foam-plastic joint fillers where indicated.
   3. Form joint of width indicated, but not less than 3/8 inch.
   4. Prime precast concrete surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.
   5. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.3 SETTING ANCHORED PRECAST CONCRETE WITH SEALANT-FILLED JOINTS

A. Set precast concrete as indicated on Drawings. Set units accurately in locations indicated with edges and faces aligned according to established relationships and indicated tolerances.
   1. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure units in place.
   2. Shim and adjust anchors, supports, and accessories to set precast concrete in locations indicated with uniform joints.
B. Keep cavities open where unfilled space is indicated between back of precast concrete units and backup wall; do not fill cavities with mortar or grout.
C. Fill anchor holes with sealant.
   1. Where dowel holes occur at pressure-relieving joints, provide compressible material at ends of dowels.
D. Set precast concrete supported on clip or continuous angles on resilient setting shims. Use material of

thickness required to maintain uniform joint widths. Hold shims back from face of precast concrete a distance at least equal to width of joint.

E. Keep joints free of mortar and other rigid materials. Remove temporary shims and spacers from joints after anchors and supports are secured in place and precast concrete units are anchored. Do not begin sealant installation until temporary shims and spacers are removed.
   1. Form open joint of width indicated, but not less than 3/8 inch.

F. Prime precast concrete surfaces to receive sealant and install compressible backer rod in joints before applying sealant unless otherwise indicated.

G. Prepare and apply sealant of type and at locations indicated to comply with applicable requirements in Section 079200 "Joint Sealants."

3.4 INSTALLATION TOLERANCES

A. Variation from Plumb: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

B. Variation from Level: Do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

C. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.

D. Variation in Plane between Adjacent Surfaces (Lipping): Do not vary from flush alignment with adjacent units or adjacent surfaces indicated to be flush with units by more than 1/16 inch, except where variation is due to warpage of units within tolerances specified.

3.5 ADJUSTING AND CLEANING

A. Remove and replace stained and otherwise damaged units and units not matching approved Samples. Precast concrete may be repaired if methods and results are approved by Architect.

B. Replace units in a manner that results in precast concrete matching approved Samples, complying with other requirements, and showing no evidence of replacement.

C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed precast concrete as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample; leave one sample uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of precast concrete.
   3. Protect adjacent surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet surfaces with water before applying cleaners; remove cleaners promptly by rinsing thoroughly with clear water.
   5. Clean precast concrete by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
   6. Clean precast concrete with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION

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SECTION 051200 - STRUCTURAL STEEL FRAMING

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. Structural steel.
2. Grout.

B. Related Requirements:
1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
2. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and for surface-preparation and priming requirements.

1.3 DEFINITIONS

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

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.

C. Delegated-Design Submittal: For structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, fabricator, shop-painting applicators and testing agency.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength, bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

F. Survey of existing conditions.

G. Source quality-control reports.

H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use Allowable Stress Design; data are given at service-load level.

B. Construction: Combined system of braced frame and shear walls.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: As noted.
2. Finish: Black except where indicated to be galvanized.

F. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

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

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

C. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain, ASTM A 153/A 153M, Class C.

D. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM F 436, Type 1, hardened or ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

E. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

F. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

G. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

2.4 PRIMER

A. Primer: Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

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

2.5 GROUT

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

2.6 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches o.c. unless otherwise indicated.

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

2.8 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.
6. Surfaces enclosed in interior construction.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning." or SSPC-SP 3, "Power Tool Cleaning."

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

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to member where noted according to ASTM A 123/A 123M.
1. Galvanize lintels and shelf angles.

2.10 SOURCE QUALITY CONTROL

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

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

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

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

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

B. Baseplates Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.

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

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

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

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

1. Joint Type: Snug tightened.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

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

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

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165.
    b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
    c. Ultrasonic Inspection: ASTM E 164.
    d. Radiographic Inspection: ASTM E 94.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

    1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

D. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

END OF SECTION 051200

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SECTION 052100 - STEEL JOIST FRAMING

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. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. Joist accessories.

B. Related Requirements:
1. Section 042000 "Unit Masonry" for installing bearing plates in unit masonry.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:

1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications,

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Canam Steel Corporation; Canam Group, Inc.
2. CMC Joist & Deck.
3. New Millennium Building Systems, LLC.
4. Valley Joist.
5. Vulcraft; Nucor Vulcraft Group.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

1. Use ASD; data are given at service-load level.

2. Design special joists to withstand design loads with live-load deflections no greater than the following:
   a. Roof Joists: Vertical deflection of [1/360] [1/240] of the span.

2.3 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.

1. Joist Type: K-series steel joists and KCS-type K-series steel joists.

B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

D. Camber joists according to SJI's "Specifications.".

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

2.4 PRIMERS

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

2.5 JOIST ACCESSORIES

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

B. Steel bearing plates with integral anchorages are specified in Section 055000 "Metal Fabrications."

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

1. Finish: Plain, uncoated.

D. Welding Electrodes: Comply with AWS standards.

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

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Do not prime paint joists and accessories to receive sprayed fire-resistive materials.

C. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing 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 INSTALLATION

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

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Do not rigidly connecting bottom-chord extensions to columns or supports.

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

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

3.3 FIELD QUALITY CONTROL

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

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

1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:

    a. Liquid Penetrant Inspection: ASTM E 165/E 165M.
    b. Magnetic Particle Inspection: ASTM E 709.
    c. Ultrasonic Testing: ASTM E 164.
    d. Radiographic Testing: ASTM E 94.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

3.4 PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2 or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.

END OF SECTION 052100

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SECTION 053100 - STEEL DECKING

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. Roof deck.
2. Acoustical roof deck.

B. Related Requirements:
1. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

1. Power-actuated mechanical fasteners.
2. Acoustical roof deck.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

C. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials" for Class 1 fire rating and Class 1-90 windstorm ratings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

2.2 ROOF DECK

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. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corp.
4. Valley Joist.
5. Verco Decking, Inc., a Nucor company.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

a. Color: Manufacturer's standard.

2. Deck Profile: As indicated.
3. Profile Depth: As indicated.
4. Design Uncoated-Steel Thickness: As indicated.
5. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated].
6. Span Condition: Triple span or more.
7. Side Laps: Overlapped.

2.3 ACOUSTICAL ROOF DECK

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. Canam Steel Corporation; Canam Group, Inc.
2. New Millennium Building Systems, LLC.
3. Nucor Corp.

B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer.

    a. Color: Manufacturer's standard.
2. Deck Profile: As indicated.
3. Cellular Deck Profile: As indicated, with bottom plate.
4. Profile Depth: As indicated.
5. Design Uncoated-Steel Thickness: As indicated.
6. Design Uncoated-Steel Thicknesses; Deck Unit/Bottom Plate: As indicated.
7. Span Condition: Triple span or more.
8. Side Laps: Overlapped.
9. Acoustical Perforations: Deck units with manufacturer's standard perforated vertical webs.
10. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber.
    a. Installation of sound-absorbing insulation as specified by Architect.

11. Acoustical Performance: NRC 0.65, tested according to ASTM C 423.

2.4 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: As indicated.

C. Side-Lap Fasteners: As indicated.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

H. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch- wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions 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 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

3.3 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels to steel supporting members as indicated:

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

C. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Mechanically fasten to substrate to provide a complete deck installation.

1. Mechanically attach cover plates at changes in direction of roof-deck panels unless otherwise indicated.

E. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

F. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified by Architect.

3.4 FIELD QUALITY CONTROL

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

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on **both surfaces** of prime-painted deck immediately after installation, and apply repair paint.

1. Apply repair paint, of same color as adjacent shop-primed deck, to top and bottom surfaces of deck.

END OF SECTION 053100

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SECTION 054000 - COLD-FORMED METAL FRAMING

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. Exterior non-load-bearing wall framing.
   2. Interior non-load-bearing wall framing exceeding height limitations of standard, nonstructural metal framing.
   3. Ceiling joist framing.
   4. Soffit framing.

B. Related Requirements:

   1. Section 055000 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
   2. Section 092216 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing.
   1. All structural member shall be designed and submitted, sealed by a Structural Engineer as a deferred submittal in accordance with the AISI “Specifications for the Design of Cold-Formed Structural Members”, latest edition.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Welding certificates.

C. Product Certificates: For each type of code-compliance certification for studs and tracks.

D. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.

1. Steel sheet.
2. Expansion anchors.
3. Power-actuated anchors.
4. Mechanical fasteners.
5. Vertical deflection clips.
6. Horizontal drift deflection clips
7. Miscellaneous structural clips and accessories.

E. Evaluation Reports: For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

C. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Stud Manufacturers Association.

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. ClarkDietrich Building Systems.
2. MarinoWARE.

3. MBA Building Supplies.
4. Nuconsteel, A Nucor Company.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.

1. Design Loads: As indicated on Drawings.
2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
    a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
    b. Interior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height under a horizontal load of 5 lbf/sq. ft..
    c. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
    a. Upward and downward movement of L/360.
5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
1. Wall Studs: AISI S211.
2. Headers: AISI S212.
3. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:

1. Grade: ST50H (50 ksi steel).
2. Coating: G60.

B. Steel Sheet for Vertical Deflection and Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. Grade: 50, Class 1.
2. Coating: G60.

2.4 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing.
2. Bracing, bridging, and solid blocking.
3. Web stiffeners.
4. Anchor clips.
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Hole-reinforcing plates.
10. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Rods: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed rods, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C or mechanically deposition according to ASTM B 695, Class 50.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58 or ICC-ES AC308 as appropriate for the substrate.

1. Uses: Securing cold-formed steel framing to structure.
2. Type: Torque-controlled expansion anchor or Torque-controlled adhesive anchor.
3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5, unless otherwise indicated.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.

1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A 780/A 780M or SSPC-Paint 20.

B. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members as required.

2.7 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners and install according to Shop Drawings, with screws penetrating joined members by no fewer than three exposed screw threads.

B. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.

    a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
    b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Install insulation, specified in Section 072100 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

H. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install double deep-leg deflection tracks and anchor outer track to building structure.
2. Connect vertical deflection clips to infill studs and anchor to building structure.
3. Connect drift clips to cold-formed steel framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
1. Install double deep-leg deflection tracks and anchor outer track to building structure.
2. Connect vertical deflection clips to studs and anchor to building structure.
3. Connect drift clips to cold-formed steel metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.6 ERECTION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 054000

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SECTION 055000 - METAL FABRICATIONS

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. Steel framing and supports for overhead doors.
   2. Steel framing and supports for countertops.
   3. Steel tube reinforcement for low partitions.
   4. Steel framing and supports for mechanical and electrical equipment.
   5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   6. Shelf angles.
   7. Metal ladders.
   8. Metal bollards.
   9. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:
   1. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. 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.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
   1. Nonslip aggregates and nonslip-aggregate surface finishes.
   2. Paint products.
   3. Grout.

B. Shop Drawings: Show fabrication and installation details[Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items**.** Provide Shop Drawings for the following:
   1. Steel framing and supports for overhead doors.
   2. Steel framing and supports for countertops.
   3. Steel framing and supports for mechanical and electrical equipment.
   4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   5. Metal ships' ladders.
   6. Metal bollards.

C. For metal fabrications indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Provide shop drawings and calculations signed and sealed by a professional engineer licensed to practice in the State of Texas.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders and alternating tread devices.

B. Structural Performance of Alternating Tread Devices: Alternating tread devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Alternating Tread Device Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099000.

B. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

D. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.5 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 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 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 or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.
G. Fabricate seams and other connections that are 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.
J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 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.
C. Galvanize miscellaneous framing and supports where indicated.
D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES
A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.
B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
C. Galvanize shelf angles located in exterior walls.
D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS
A. Provide metal ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

2.9 MISCELLANEOUS STEEL TRIM
A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
   1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
C. Galvanizeexterior miscellaneous steel trim.

2.10 METAL BOLLARDS
A. Fabricate metal bollards from Schedule 80 steel pipe.
   1. Cap bollards with 1/4-inch- thick steel plate.

2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.
3. Where bollards are indicated to receive light fixtures, provide cutouts for fixtures and holes for wire.

B. Prime bollards with zinc-rich primer.

2.11 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
B. Galvanize plates.
C. Prime plates with zinc-rich primer.

2.12 FINISHES, GENERAL

A. Finish metal fabrications after assembly.
B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
1. Shop prime with primer as indicated in Section 099000. unless zinc-rich primer is indicated.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.
B. 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.
C. 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.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.
E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.
B. Anchor supports for and overhead grilles securely to, and rigidly brace from, building structure.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.
B. Anchor bollards in concrete . Fill annular space around bollard solidly with nonshrink grout; mixed and placed to comply with grout manufacturer's written instructions. Slope grout up approximately 1/8 inch toward bollard.
C. Place removable bollards over internal sleeves and secure with 3/4-inchmachine bolts and nuts. After tightening nuts, drill holes in bolts for inserting padlocks. Owner furnishes padlocks.

D. Fill bollards solidly with concrete, mounding top surface to shed water.
   1. Do not fill removable bollards with concrete.

3.4 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.5 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 dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000.

END OF SECTION

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SECTION 061053 - MISCELLANEOUS ROUGH 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:
   1. Rooftop equipment bases and support curbs.
   2. Wood blocking and nailers.
   3. Plywood backing panels.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
   1. NHLA: National Hardwood Lumber Association.

1.4 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 materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
   2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded 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. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 15 percentunless otherwise indicated.

C. No Added Urea-Formaldehyde data. Provide for any permanently installed composite wood used on the interior of the building.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2[for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground].
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or 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, 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 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, use materials complying 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 beyond the centerline of the burners at any time during the test.
1. Use treatment that does not promote corrosion of metal fasteners.
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 a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
E. Application: Treat all miscellaneous carpentry unless otherwise indicated.

2.4 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.
B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

2.5 PLYWOOD BACKING PANELS
A. Equipment Backing Panels: DOC PS 1, thickness indicated or, if not indicated, not less than 3/4-inchnominal thickness.
B. Roof Sheathing (over foam insulation board): DOC PS1, BDX, thickness as indicated, but not less than 5/8 inch.
C. Platform Subfloor: 1-1/8 inch thick tongue and groove plywood, ADX.

2.6 FASTENERS
A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fastenersof Type 304 stainless steel.
B. Nails, Brads, and Staples: ASTM F 1667.
C. Power-Driven Fasteners: NES NER-272.
D. Wood Screws: ASME B18.6.1.
E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
F. Lag Bolts: ASME B18.2.1.
G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry

assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Do not splice structural members between supports unless otherwise indicated.

F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. 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.

I. Use steel common 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 between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

C. Set wood blocking for support of woodwork, metal work, plumbing fixtures, electrical outlets, lighting fixtures, mirrors, toilet room accessories, etc., where indicated or normally required to support such items. Provide blocking and nailers to allow nailing of centers, ends and edges of wall boards where applied to wood frame construction. Provide nailers and blocking to receive all wood trim and mouldings.

D. Nailers shall be at least 2 x 4 material, except as may be detailed otherwise, and shall be securely bolted in place.

E. Where bolt sizes and spacing are no specifically noted, use not less than 3/8" bolts at 32" o.c. staggered. Furnish metal expansion shields for concrete.

F. Exterior wood nailers for roof curbs, flashings and the like shall be of preservative treated.

G. Blocking: Provide blocking to stiffen the structure and for the support of other work such as door stops,toilet accessories, railings, AV equipment, etc..

H. Roof Curbs: Provide wood curbs to frame openings and to support flashings as detailed. Use preservative treated lumber.

I. Nailers: Provide nailers of the required sizes where indicated on the Drawings.

1. Nailers shall be at least 2 x 4 material, except as may be detailed otherwise, and shall be securely bolted in place
2. Where bolt sizes and spacing are not specifically noted, use not less than 3/8" bolts and 32" o.c. staggered.

J. Grounds: Provide and install grounds where required for plaster, for casework and cabinets and for nailing trim. They shall be continuous, set back 1/2" from exposed edges of overlapping finish, straight, plumb or level, and in true alignment. Spot grounds set in plaster of Paris, not more than 12" apart, may be used

where continuous grounds are impractical.

3.3 PROTECTION

A. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061600 - SHEATHING

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. Wall sheathing.
  2. Sheathing joint and penetration treatment.

1.3 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.

1.4 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 WALL SHEATHING
- A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
  1. Products: Subject to compliance with requirements, provide one of the following:
     a. CertainTeed Corporation; GlasRoc.
     b. G-P Gypsum Corporation; Dens-Glass Gold.
     c. National Gypsum Company; Gold Bond e(2)XP.
     d. Temple-Inland Inc.; GreenGlass
     e. United States Gypsum Co.; Securock.
  2. Type and Thickness: Type X, 5/8 inch thick.

2.2 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS
- A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners. Confirm compatibility with air/moisture barrier.

2.3 MISCELLANEOUS MATERIALS
- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with [APA AFG-01] [ASTM D 3498] that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

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. NES NER-272 for power-driven fasteners.
  2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
  3. 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."
- D. Use screws purposely made for application. 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 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 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.
   1. Fasten gypsum sheathing to cold-formed metal framing with screws.
   2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
   2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
   1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
   2. For sheathing under stucco cladding, boards may be initially tacked in place with screws if overlying self-furring metal lath is screw-attached through sheathing to studs immediately after sheathing is installed.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.
   1. Apply silicone emulsion sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings. Allow first coat of sealant t dry before applying second coat.

END OF SECTION

SECTION 062023 - 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:
   1. Interior trim for base, chair rails, and other items indicated.

1.3 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. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
   2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
   3. Include copies of warranties from chemical-treatment manufacturers for each type of treatment.

1.4 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.

1.5 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.
   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.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and the following grading rules:
   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."

B. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
   1. For exposed lumber, mark grade stamp on end or back of each piece.

2.2 INTERIOR TRIM

A. Hardwood Lumber Trim:
   1. Species and Grade:
      a. Stain Grade: Match Finish Schedule on Drawings.
      b. Opaque Grade: Birch, Polar, or Luan, any cut.
   2. Maximum Moisture Content: 10 percent.
   3. Finger Jointing: Not allowed.
   4. Gluing for Width: Not allowed.
   5. Veneered Material: Allowed.
   6. Face Surface: Surfaced (smooth).
   7. Matching: Selected for compatible grain and color.

2.3 MISCELLANEOUS MATERIALS

A. 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.
B. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
C. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.
D. Installation Adhesive for Foam Plastic Moldings: Product recommended for indicated use by foam plastic molding manufacturer.
E. Multipurpose Construction Adhesive: Formulation complying with ASTM D 3498 that is recommended for indicated use by adhesive manufacturer.

2.4 FABRICATION

A. Back out or kerf backs of the following members except those with ends exposed in finished work:
   1. 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.
C. Grade: Provide all finish carpenty items in AWI Premium Grade.

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.
   1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
   2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
   3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inchmaximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
   4. 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 incheslong, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter 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.
   1. Match color and grain pattern of trim for transparent finish (stain or clear finish) across joints.
   2. Install trim after gypsum-board joint finishing operations are completed.
   3. 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 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.

3.6 CLEANING

A. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.

3.7 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.

3.8 WASTE MANAGEMENT

A. Separate wood waste in accordance with the Waste Management Plan.
B. Separate the following categories for salvage or reuse on site:
   1. Sheet materials larger than 2 sq. ft.
   2. Solid wood:
      a. Trim longer than 16"
      b. Multiple offcuts of any size larger than 12"
C. Recycle the following categories:
   1. Clean, unpainted engineered wood products
   2. Clean, unpainted dimensional lumber
D. Separate the following categories for disposal and place in designed areas for hazardous materials:

END OF SECTION

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SECTION 064116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

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. Plastic-laminate-faced architectural cabinets.
   2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products high-pressure decorative laminatecabinet hardware and accessories.
   1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for electrical switches and outletsand other items installed in architectural plastic-laminate cabinets.

C. Samples for Initial Selection:
   1. Plastic laminates.
   2. Thermoset decorative panels.

D. Samples for Verification:
   1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
   2. Wood-grain plastic laminates, 12 by 24 inches, for each type, pattern and surface finish.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of product.

1.5 QUALITY ASSURANCE

A. 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 mockups of typical plastic-laminate cabinets as shown on Drawings.
   2. 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. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install cabinets 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 cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
   1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

D. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.8 COORDINATION

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

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
   1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Premium

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

E. Reveal Dimension: 1/2 inch.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Abet Laminati, Inc.
      b. Formica Corporation.
      c. Lamin-Art, Inc.
      d. Panolam Industries International, Inc.
      e. Wilsonart International; Div. of Premark International, Inc.

G. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces: Grade HGS.
   2. Vertical Surfaces: Grade VGS.
   3. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
   4. Edgebanding for Plastic Laminate Clad Cabinets: Rigid PVC extrusions, through color with satin finish, 3 mm thick at counter tops, doors, drawer fronts, and exposed shelving on front and back edges (front edge only for fixed shelving); and 1 mm thick elsewhere, including edges of shelving within cabinets

H. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS.
      a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inchminimum thickness, matching laminate in color, pattern, and finish.
      b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
      c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
   2. Drawer Sides and Backs: Solid-hardwood lumber.
   3. Drawer Bottoms: Hardwood plywood

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
   1. Join subfronts, backs, and sides with glue and dovetail construction.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. As indicated by laminate manufacturer's designations.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.
   1. Wood Moisture Content: 5 to 10 percent.
B. Plywood: AWI Economy grade Fir, grade A-B, as substrate for surfaces to receive plastic laminate.
C. Medium-Density Fiberboard: ANSI A208.2, Grade MD
   1. Acceptable manufacturers:
      a. SierraPine
      b. Plum Creek
      c. Flakeboard American Limited
D. Cores of sink tops must be water resistant material.
   1. Acceptable Products:
      a. Medex moisture resistant MDF.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."
B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 135 degrees of opening, self-closing.
   1. Basis of Design Product: Blum; CLIP top BLUMOTION.
C. Wire Pulls: Back mounted, solid[metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter
D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
E. Shelf Rests: BHMA A156.9, B04013; metal.
F. Drawer Slides: BHMA A156.9.
   1. All slides to be self-closing:
      a. Basis of Design: Accuride; 3600 Heavy Duty.
   2. Grade 1 and Grade 2: Bottom mounted full-extension type; zinc-plated steel with polymer rollers.
   3. Grade 1HD-100 : Bottom mounted; full-extension type; zinc-plated-steel ball-bearing slides.
   4. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
   5. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
   6. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
   7. For computer keyboard shelves, provide Grade 1
   8. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.
G. Door Locks: BHMA A156.11, E07121.
H. Drawer Locks: BHMA A156.11, E07041.
I. Door and Drawer Silencers: BHMA A156.16, L03011.
J. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Stainless Steel: BHMA 630.
K. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
L. Built-In Bed Pull: Mockett Company model DP-137.
M. Under Counter Support Bracket: Speed Brace 21x24C. Finish color: Black.
N. Kitchen Island Towel Bar and Trim Rings: Mockett Company model RCK4.
O. Kitchen Island Trash Grommet: Mockett Company model TM12B.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
C. Adhesives: Do not use adhesives that contain urea formaldehyde.
D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement].
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.5 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
   1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 066400 - PLASTIC PANELING

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. Plastic sheet paneling (indicated at FRP on Drawings).

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE
- A. Testing Agency: Acceptable to authorities having jurisdiction.

1.5 PROJECT CONDITIONS
- A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
- A. Source Limitations: Obtain plastic paneling and trim accessories from single manufacturer.

2.2 PLASTIC SHEET PANELING
- A. Glass-Fiber-Reinforced Plastic Paneling: Gelcoat-finished, glass-fiber-reinforced plastic panels complying with ASTM D 5319. Panels shall be USDA accepted for incidental food contact.
  1. Manufacturers: Subject to compliance with requirements,provide products by one of the following:
     a. Crane Composites, Inc.
     b. Marlite.
     c. Nudo Products, Inc.
  2. Low-Emitting Materials: Paneling shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  3. Surface-Burning Characteristics: As follows when tested by a qualified testing agency according to ASTM E 84. Identify products with appropriate markings of applicable testing agency.
     a. Flame-Spread Index: 25 or less.
     b. Smoke-Developed Index: 450 or less.
  4. Nominal Thickness: Not less than 0.09 inch.
  5. Surface Finish: Molded pebble texture.
  6. Color: To be selected from manufacturer’s full range.

2.3 ACCESSORIES
- A. Trim Accessories: Manufacturer's standard two-piece, snap-on vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.
  1. Color: Match panels.
- B. Exposed Fasteners: Nylon drive rivets recommended by panel manufacturer.
- C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, 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. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints to provide equal panels at ends of walls not less than half the width of full panels.

1. Mark plumb lines on substrate at trim accessory and panel joint locations for accurate installation.
2. Locate trim accessoriesand panel joints to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

D. Install factory-laminated panels using concealed mounting splines in panel joints.

E. Install trim accessories with adhesive Do not fasten through panels.

F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION

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SECTION 071113 - BITUMINOUS DAMPPROOFING

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. This Section includes the following:
   1. Cold-applied, emulsified-asphalt dampproofing.

1.3 SUBMITTALS

A. Product Data:
   1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of dampproofing.
   2. For fluid applied materials provide the minimum time that must pass before additional applications of fluid applied material may be installed.
      a. For primers provide the maximum time that may pass before primer must be reapplied.
      b. For membrane materials provide the maximum time that may pass before solvent wiping or abrasion is required before application of additional coats of membrane materials.
      c. For systems that require different primers for different substrates, indicate if one primer must be installed before or after another type of primer on an adjacent substrate.

B. For membrane at expansion joints, submit the manufacturer's written product and technical data, as well as, tested physical performance properties.

C. Shop Drawings: Show locations and extent of dampproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining dampproofing, and other termination conditions.

D. Material Certificates: For each product, signed by manufacturers.

E. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

F. Sample Warranty: Copy of special dampproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting dampproofing.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

B. Installer Qualifications: A qualified installer with a minimum of 5 years experience installed bituminous dampproofing who is authorized, approved, or licensed by dampproofing manufacturer to install manufacturer's products.

C. Mockups: Apply dampproofing to 100 sq. ft. of wall to demonstrate surface preparation, crack and joint treatment, corner and termination treatment, thickness, texture, and ex-ecution quality.
   1. If Architect/Engineer determines mockups do not comply with requirements, remove dampproofing and prepare substrate, reapply dampproofing until mockups are approved.
   2. Document precipitation prior to the mock-up, surface preparation, use of moisture barrier or primer, temperature and sun exposure, if applicable, at each step, mixing paddle type, mixer speed and duration of mixing, and wet film thickness of various layers.
   3. Cut out samples of cured membrane and document the presence of blisters, bubbles, and/or pinholes, if any, as well as thickness of complete system.
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site. Review requirements for dampproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, temperature and dew point before and after installation, time of day for installation, minimum curing period, forecasted weather conditions, special de-tails and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Apply dampproofing within the range of ambient and substrate temperatures recommended by dampproofing manufacturer. Do not apply dampproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply dampproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of dampproofing materials.

1.6 WARRANTY

A. Special Manufacturer's Warranty: Written warranty, signed by dampproofing manufacturer and Installer agreeing to repair or replace dampproofing that does not comply with requirements or that does not remain watertight within specified warranty period.

1. Warranty does not include failure of dampproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.

B. Warranty Period: Five years after date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Sonneborne Building Products /Div., "Hydrocide 700 Mastic".
2. Henry 789 Asphalt Emulsion Dampproofing
3. Karnak Chemical Corporation, "220 AF".
4. W.R. Meadows, Inc. "Type 2".

C. Trowel Coats: ASTM D 1227, Type II, Class 1.

D. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

E. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.2 AUXILIARY MATERIALS

A. Primer: Manufacturer's standard, factory-formulated with separate products for concrete, sheathing and metal surfaces if required.

B. Glass-Fiber Mat: Non-woven fiberglass fabric of continuous filament or jack-straw filament/yarn pattern of glass fiber, impregnated and bound together with type of organic/synthetic binder that is compatible with type of bituminous compound indicated to be reinforced, weighing 1.0 to 1.5 lbs. per 100 sq. ft,. 36-inch-wide

C. Bituminous Grout: Comply with ASTM D 147.

D. Plastic Cement: Asphalt based, complying with ASTM D 491, except provide coal tar base where specifically recommended by manufacturer of bituminous dampproofing materials.

E. Miscellaneous Materials:

1. Membrane at Expansion Joints: 50 mil minimum, non-staining, uncured sheet neoprene. Tensile Strength: ASTM D 412, Die C - 1400 pounds per square inch minimum.
   a. Elongation: ASTM D 412 - 300 percent minimum.
   b. Tear Resistance: ASTM D 624, Die C - 125 pounds per square inch minimum.
   c. Brittleness: ASTM D 2137 - does not break at minus 30 degrees F.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.
2. Verify that concrete has cured and aged for minimum time period recommended by dampproofing manufacturer.
3. Verify that concrete finish texture is wood float or shutter finish as required by manufacturer.
4. Verify that substrate is visibly dry and free of moisture. Test for surface moisture according to ASTM D 4263.
5. Utilize techniques demonstrated to be effect in mock-up installation.
6. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean and prepare substrate according to ASTM D 5295 and manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for dampproofing application.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of dampproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

F. Install cant strips and similar accessories as shown and as recommended by prime materials manufacturer even though not shown.

G. Prime substrate as recommended by prime materials manufacturer.

H. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to dampproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 dry methods before coating surfaces.

3.4 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
3. Allow 24 hours drying time prior to backfilling.

3.5 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Apply two coats of dampproofing, by brushing or spraying at rate of 2 to 3 gallons per 100 sq. ft. per coat, to produce uniform, dry film thickness of not less than 30 mils or manufacturer's minimum thickness greater than 30 mils, whichever is greater.

B. Reinforcement: At changes in plane or where otherwise shown as "Reinforced," install lapped course of glass-fiber mat in first coat dampproofing compound before it thickens.

C. Tape joints and abutting dissimilar substrates by bonding reinforcing and flashing mesh in manner recommended by prime materials manufacturer. Comply with details shown and manufacturer's recommendations.

1. Tape all joints, penetrations, and terminations of dampproofing substrates with a 6" wide layer of glass fabric mesh tape set in initial coat of dampproofing, Topcoat tape extending topcoat application approximately 3" onto initial coat. Lap all tape splices shingle fashion a minimum of 3". Apply top coat of dampproofing material as specified.

3.6 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course.

1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.
2. Install protection course [on same day] [within 24 hours] of installation of dampproofing (while coating is tacky) to ensure adhesion.

3.7 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect dampproofing from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes as recommended by manufacturer's requirements. Provide temporary coverings where dampproofing will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 071900

WATER REPELLENTS

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 penetrating water-repellent treatments for the following vertical and horizontal surfaces:
   1. Precast concrete.
   2. Cast stone.
   3. Concrete unit masonry.
   4. Cast-in-place concrete.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Water repellents shall meet performance requirements indicated without failure due to defective manufacture, fabrication, or installation.
   1. Water Repellents: Comply with performance requirements specified, as determined by preconstruction testing on manufacturer's standard substrate assemblies representing those indicated for this Project.

B. Water Absorption: Minimum 90 percent reduction of water absorption after 24 hours in comparison of treated and untreated specimens.
   1. Precast Concrete: ASTM C 642.
   2. Cast Stone: ASTM C 1195.
   3. Concrete Masonry Units: ASTM C 140.
   4. Natural Stone: ASTM C 97.

C. Water-Vapor Transmission: Comply with one or both of the following:
   1. Maximum 10 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, according to ASTM E 96.
   2. Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, according to ASTM D 1653.

D. Water Penetration and Leakage through Masonry: Minimum 90 Insert number percent reduction in leakage rate in comparison of treated and untreated specimens, according to ASTM E 514.

E. Durability: Maximum 5 percent loss of water-repellent properties after 2500 hours of weathering according to ASTM G 154 in comparison to water-repellent-treated specimens before weathering.

F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
   1. Reduction of Water Absorption: 80 percent.
   2. Reduction in Chloride Content: 80 percent.

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Installed water repellents shall comply with performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard substrate assemblies by a qualified testing agency.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated submit water-repellent manufacturer’s literature including product description and written instructions for storage, handling, substrate preparation, protection of surrounding areas not to receive water-repellent, application, and final cleaning.
   1. Include manufacturer's printed statement of VOC content.
   2. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.

B. Environmental Submittals:
   1. Environmental regulations applicable to site.
   2. Certifications, signed by water-repellent manufacturers, that water repellents comply with environmental regulations applicable to site.

C. Samples: For each type of water repellent and substrate indicated, 8 by 8 inches in size, with specified water-repellent treatment applied to half of each Sample.

D. Applicator Qualifications:

1. Certification signed by water-repellent manufacturer, certifying that Applicator complies with manufacturer's requirements to install specified water repellent.
2. Submit evidence that Applicator's existing company has minimum of 3-years continuous experience in application of specified materials. Submit list of at least five completed projects of similar scope and size, including:
    a. Project name.
    b. Owner's name.
    c. Owner's Representative name, address, and telephone number.
    d. Description of work.
    e. Water repellents used.
    f. Project supervisor.
    g. Total cost of water-repellent work and total cost of project.
    h. Completion date.

E. Product Certificates: For each type of water repellent, from manufacturer certifying that the product to be used complies with regulations controlling use of VOC'.

F. Preconstruction Testing Reports: For each water-repellent-treated substrate, submit third party test reports certifying the specified performance requirements.

G. Warranty: Special warranty specified in this Section.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: Qualified firm that is approved, authorized, or licensed by water-repellent manufacturer to install water repellent. Must have installations of specified materials in local area in use for minimum of three years.
1. Employ foreman trained by water-repellent manufacturer and with minimum of 3-years experience as foreman on similar projects, to be on site at all times during Work.

B. Preinstallation Conference: Conduct conference at Project site.
1. Review requirements for water-repellent application, including:
    a. Construction schedule and availability of materials, Applicator's personnel, equipment, and facilities needed to make progress and avoid delays.
    b. Site use, access, staging, and set-up location limitations.
    c. Approved mockup procedures.
    d. Forecast weather conditions.
    e. Surface preparation and substrate condition and pretreatment.
    f. Application procedures.
    g. Minimum curing period.
    h. Testing and inspection requirements.
    i. Site protection measures.
    j. Governing regulations, including environmental regulations, if applicable.
2. Contractor's site foreman, water-repellent manufacturer's technical representative, water-repellent Applicator, Owner's Representative, and Architect/Engineer shall attend.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with water-repellent manufacturer's name, product brand name and type, date of manufacture, lot number, and directions for storing.

B. Store materials in original, undamaged containers in clean, dry, protected, cool, well-ventilated location on raised platforms with weather-protective coverings, within temperature range required by water-repellent manufacturer and away from sources of ignition. Protect stored materials from direct sunlight. Water-repellent manufacturer's standard packaging and covering is not considered adequate weather protection.

C. Limit stored materials on structures to safe loading of structure at time materials are stored, and to avoid permanent deck deflections.

D. Handle materials to avoid damage. Keep containers tightly sealed when not is use, as atmospheric moisture will react with and alter water-repellent solution.

E. Remove and replace materials that cannot be applied within stated shelf life, or that are damaged or otherwise unsuitable.

F. Conspicuously mark damaged or opened containers or containers with contaminated materials, and remove from site as soon as possible.

G. Dispose of unused or unsuitable materials in accordance with water-repellent manufacturer's recommendations and governing environmental regulations. Do not flush debris or water repellent down existing drains.

1.8 PROJECT CONDITIONS

A. Verify existing dimensions and details prior to installation of materials. Notify Architect/Engineer of conditions found to be different than those indicated in Contract Documents. Architect/Engineer will review situation and inform Contractor and Applicator of changes.

B. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to manufacturers' written instructions and warranty requirements:
   1. Concrete surfaces and mortar have cured for not less than 28 days.
   2. Building has been closed in for not less than 30 days before treating wall assemblies.
   3. To substrates that are damp or wet, or that have dew, frost, snow, or ice on them.
   4. To substrates below 40 degrees F or less than 5 degrees F above dew point, or above 90 degrees F.
   5. When ambient temperature is below 40 degrees F, or is predicted to fall below 40 degrees F within 8 hours after application, or is above 90 degrees F.
   6. When rain, snow, fog, or mist is predicted within 24 hours.
   7. When wind speeds are at or above 15 miles per hour, or if windy conditions exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.
   8. On new concrete or brick masonry exterior walls for at least 30 days following building close-in.

C. Install materials in strict accordance with safety requirements required by water-repellent manufacturer, Material Safety Data Sheets, and local, state, and federal rules and regulations.

D. Maintain adequate ventilation during preparation and application of water-repellent materials. Notify Owner’s Representative at least 1 week in advance of Work with materials with noxious vapors. Review application schedule and venting precautions with Owner’s Representative prior to beginning application.

1.9 WARRANTY

A. Manufacturer’s Warranty: Written warranty, signed by water repellant manufacturer, that the water repellant system will be free of defects related to workmanship or material deficiency for a ten (10) year period from the date of completion of the work provided under this section of the specification. The following performance standards shall be specifically covered under the warranty.
   1. Loss of water repellency:
      a. Using ASTM D 6489 procedure the treated concrete shall not absorb more than 1.0% water by weight for a period of 24 hours.
   2. All defective areas shall be retreated by the system manufacturer as determined by the Architect/Engineer. The required written warranty shall be provided by the system manufacturer.
   3. The Water Repellant Manufacturer shall be responsible for providing labor and material to reseal areas of the substrate where sealer effectiveness does not meet the specified limits.
   4. Provide access to warranty repair and replacement areas.

B. Installer’s Warranty: Written warranty, signed by Applicator, that the water repellant system will be free of defects related to workmanship for a five (5) year period from the date of completion of the work provided under this section of the specification.
   1. Provide access to warranty repair and replacement areas.
   2. Repair or replacement, to satisfaction of Owner, of other work or items which may have been displaced or damaged as consequence of defective work.
   3. Make immediate emergency repairs within 48 hours of notice of loss of water repellancy.

PART 2 - PRODUCTS

2.1 PENETRATING WATER REPELLENTS

A. Siloxane, Penetrating Water Repellent: Clear, containing 10 percent or more solids of oligomerous alkylalkoxysiloxanes; with alcohol, ethanol, mineral spirits, water, or other proprietary solvent carrier; and with 400 g/L or less of VOCs.

B. Silane/Siloxane-Blend, Penetrating Water Repellent: Clear, silane and siloxane blend with 400 g/L or less of VOCs.
   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. BASF Construction Chemicals, LLC; Enviroseal 7.
      b. Degussa Corporation; Protectosil Aqua-Trete EM.
      c. Pecora Corporation; KlereSeal 910-W.
      d. PROSOCO, Inc.; Weather Seal GP.
      e. BASF Construction Chemicals; Hydrozo Clear Double 7 VOC.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
   1. Ensure that Work done by other trades is complete and ready to receive water repellent.
   2. Verify that surfaces are clean and dry according to water-repellent manufacturer's requirements. Check moisture content in three representative locations by method recommended by manufacturer.
   3. Inspect for previously applied treatments that may inhibit penetration or performance of water repellents.
   4. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
   5. Verify that required repairs are complete, cured, and dry before applying water repellent.

B. Test pH level according to water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.

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

D. Notify Architect/Engineer in writing of conditions which may adversely affect water-repellent installation or performance. Do not proceed with water-repellent installation until these conditions have been corrected

3.2 PREPARATION

A. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product according to water-repellent manufacturer's written instructions and as follows:
   1. Allow wet substrates to dry for at least 24 hours. Verify that substrate is sound and is visibly dry and free of moisture.
   2. Provide clean, dust-free, and dry substrate.
   3. Proceed with application only after unsatisfactory conditions have been corrected. Commencing application constitutes acceptance of work surfaces and conditions.
   4. Precast Concrete and Concrete Unit Masonry: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
   5. Concrete: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents according to ASTM E 1857.
      a. Verify that concrete has cured and aged for minimum time period recommended by water-repellent manufacturer.
      b. Remove grease, oil, asphalt solids, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete. Use concrete cleaner approved by water-repellent manufacturer where necessary. If cleaner is used, rinse thoroughly to remove cleaner residue.
      c. Thoroughly sweep substrate and clean with oil-free compressed air.
   6. Natural Stone: Clean natural stone substrates in accordance with ASTM C 1515 and water repellant manufacturer’s recommendations.

B. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.

C. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured and aged for minimum time period recommended by water-repellent manufacturer.

D. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and for minimum time period recommended by water-repellent manufacturer..
   1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.

3.3 APPLICATION

A. Before beginning application
   1. Provide and maintain traffic barricades and control measures, well outside limits of wind-drifting, during application and drying of water repellent to protect vehicular and pedestrian traffic from contact with water repellent. Enclose Work area to contain wind-blown overspray.
   2. Provide adequate ventilation during and after application of water repellent.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate

before application of water repellent and to instruct Applicator on the product and application method to be used.

C. Apply water repellent at coverage rate demonstrated in mock-up, in uniform manner, using low-pressure spray equipment, brushes, and rollers. Use brooms and squeegees to achieve even distribution. Do not alter or dilute material. Comply with manufacturer's written instructions for using airless spraying procedure.
   1. Prior to use, thoroughly clean spray equipment, tanks, and hoses, and make free of water, foreign matter, and oily residues. Flush with anhydrous alcohol or small amounts of silane.
   2. On vertical surfaces, apply from bottom up, with controlled run-down of about 8 inches, with hand-spray unit, brushes, and rollers.
   3. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces.
   4. If water-repellent application is not completed at one time, clearly mark location where application is terminated.
   5. Allow water repellent to dry for at least 12 hours before exposing to vehicular, construction, or pedestrian traffic.
   6. Apply additional coats in accordance with the manufacturer's recommendations. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if standard written instructions are not applicable to Project conditions.

3.4 FIELD QUALITY CONTROL

A. Water-repellent manufacturer's representative shall inspect and approve preparation of substrate and protection of adjacent surfaces before application of water repellent.

B. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
   1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
   2. Testing agency will perform tests for compliance of water-repellent material with product requirements.
   3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor shall remove non-complying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect. [Insert additional requirements to suit Project].

C. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application. Test location to be chosen by Architect.
   1. Notify Architect seven days in advance of the dates and times when surfaces will be tested.
   2. Reapply water repellent until coverage test indicates complete coverage at no cost to Owner.

3.5 CLEANING

A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.

B. Comply with manufacturer's written cleaning instructions.

END OF SECTION

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SECTION 072100 - THERMAL INSULATION

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. Foam-plastic board insulation.
   2. Glass-fiber blanket insulation.

1.3 ACTION SUBMITTALS

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

1.4 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.

1.5 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.

B. Protect foam-plastic board insulation as follows:
   1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
   3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, 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:
      a. DiversiFoam Products.
      b. Dow Chemical Company (The).
      c. Owens Corning.
      d. Pactiv Building Products.
   2. Type IV, 25 psi.

B. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

2.2 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. CertainTeed Corporation.
   2. Guardian Building Products, Inc.
   3. Johns Manville.
   4. Knauf Insulation.
   5. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

1. Acceptable Product: Thermaliner Insulation System by Butler.
2. R Values: R-30 at roofs.
3. Provide poultry wire mesh or horizontal wires at 24 inches on center to hold insulation in place at roof.
4. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
5. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

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.
B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
C. 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.
D. 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.
B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.
C. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
    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.
    2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
    3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
    4. 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.

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

SECTION 072600 - UNDER SLAB VAPOR BARRIER

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. Sheet materials for controlling vapor diffusion through concrete slabs-on-grade.

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data, specifications, and installation instructions. Include vapor barrier manufacturer™s requirements for placement, seaming and pipe book installation.
B. Sample Warranties: Copies of waterproofing manufacturer' warranty, Installer's warranty, and General Contractor's warranty, all stating obligations, remedies, limitations, and exclusions. Submitted with Bid.
C. Test Reports: Manufacturer's independent laboratory test reports showing compliance with ASTM and ACI Standards.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer (applicator) who is acceptable to manufacturer, who has completed applications similar in material and extent to that required for this Project, and whose work has resulted in construction with a record of successful in-service performance.
B. Source Limitations: Vapor Barrier and components to be from one source from a single manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and application.
B. Store materials in a clean dry location in accordance with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.
C. Stack membrane on elevated wood platform to eliminate warping.
D. Protect materials during handling and application to prevent damage or contamination.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written recommendations for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting materials performance. Do not apply on frozen ground.
B. Close areas to traffic during application and for time period after application recommended in writing by manufacturer.

1.7 COORDINATION

A. Coordinate placement of sheet vapor barrier with Division 03 sections.
B. Coordinate placement of sealer and hardener with Division 03 sections and with requirements of finish flooring products, including adhesives, specified in Division 09 Sections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Sheet Vapor Barrier:
   1. Type: 15 mil polyolefin film meeting requirements of ASTM E 1745, Class A.
   2. Water Vapor Transmittance (After mandatory condition per ASTM E154 sections 8,11,12,13): Maximum perm rating of 0.01 as tested in accordance with ASTM E 1745 Section 7.
   3. Strength: ASTM E 1745: Class A.

B. Acceptable Products:
   1. Subject to compliance with requirements, provide one of the following:
      a. Stego Wrap Vapor Barrier by Stego Industries, LLC, 15 mils.
      b. Zero-Perm Vapor Barrier by Alumiseal.
      c. Perminator by W.R. Meadows.
      d. Xtreme by Tex-Trude

C. Accessories:
   1. Bonding Agent: Manufacturer's approved or recommended vapor barrier bonding agent.
   2. Sealing and Seaming Tape: High density polyethylene tape a minimum of 4 inches in width, compatible with vapor barrier membrane, and manufactured by or recommended by vapor barrier membrane manufacturer. Tape for joints shall have at least the same permeability rating as the vapor barrier specified. Provide product equal to Stego Crete Claw.
   3. Vapor Proofing Mastic: Manufacturer™s approved or recommended vapor proofing mastic with the same permeability rating as the vapor barrier specified.
   4. Pipe Boot: Construct pipe boots from vapor barrier material and pressure sensitive tape in accordance with manufacturer™s instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 PREPARATION

A. Level or tamp or roll aggregate, sand or granular base.

3.3 INSTALLATION

A. Vapor Barrier:
   1. Place, protect, and repair vapor barrier sheets according to ASTM E 1643 and manufacturer's written instructions.
   2. Unroll vapor barrier with the longest dimension parallel with the direction of the concrete pour.
   3. Install vapor barrier without tears, voids, and holes. Lap ends and edges as recommended by manufacturer, but not less than 6 inches over adjacent sheets. Seal laps with tape.
   4. Turn up sheets at perimeter, at footings and vertical walls, and against penetrations, and seal joints with tape.
   5. Seal joints, tears, holes, perimeter, and penetrations through vapor with tape in accordance with manufacturer's recommendations.
   6. Point exposed edges with pointing mastic to prevent water from traveling under membrane.
   7. Adhere membrane to vertical surfaces with adhesive.

3.4 PROTECTION

A. Protect complete membrane from damage. Prior to pouring concrete, inspect membrane for punctures or damage and repair as required to maintain vapor barrier integrity.

END OF SECTION

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 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.
3. Provide WUFI analysis of representative wall sections.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer. Include list of ABAA-certified installers and supervisors employed by the Installer, who work on Project.

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

1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

B. Mockups: Build mockups to set quality standards for materials and execution.

1. Build integrated mockups of exterior wall assembly per Drawing A-90.01 incorporating backup wall construction, external cladding, window, storefront, door frame and sill, insulation, ties and other penetrations, and flashing to demonstrate surface preparation, crack and joint treatment, application of air barriers, and sealing of gaps, terminations, and penetrations of air-barrier assembly.
    a. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.
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 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.

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

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

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

2.2 PERFORMANCE REQUIREMENTS

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

2.3 VAPOR-PERMEABLE MEMBRANE AIR-BARRIER

A. Fluid-Applied, Vapor-Permeable Membrane Air Barrier: Elastomeric, modified bituminous or synthetic polymer membrane.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Elastomeric, Modified Bituminous Membrane:

1) Meadows, W. R., Inc.; Air-Shield LMP.

2) Tremco Incorporated, an RPM company; ExoAir 220R.

b. Synthetic Polymer Membrane:

1) Carlisle Coatings & Waterproofing Inc.; Barritech VP.

2) Grace, W. R., & Co. - Conn.; Perm-A-Barrier VP.

3) Henry Company; Air-Bloc 31 typical and Air-Bloc 33 at rainscreen applications.

4) Tremco Incorporated, an RPM company; ExoAir 230.

5) Sto; StoGuard Systems 80210 Air Seal.

2. Physical and Performance Properties:

a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.

b. Vapor Permeance: Minimum 10 perms; ASTM E 96/E 96M.

c. Ultimate Elongation: Minimum 200 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

D. Joint Reinforcing Strip: Air-barrier manufacturer's glass-fiber-mesh tape.

E. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

F. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0187 inch thick, and Series 300 stainless-steel fasteners.

G. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

H. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

I. Preformed Silicone-Sealant Extrusion: Manufacturer's standard system consisting of cured low-modulus silicone extrusion, sized to fit opening widths, with a single-component, neutral-curing, Class 100/50 (low-modulus) silicone sealant for bonding extrusions to substrates.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 123 Silicone Seal.
      b. Pecora Corporation; Sil-Span.
      c. Tremco Incorporated, an RPM company; Spectrem Simple Seal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
   1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
   2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
   3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
   4. Verify that masonry joints are flush and completely filled with mortar.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.
B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.
C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
D. Remove excess mortar from masonry ties, shelf angles, and other obstructions.
E. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.
   1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.
B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.
   1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
   2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.
B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip preformed silicone-sealant extrusion so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.
   1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.
   2. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

E. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

F. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

G. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, strip.

H. 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.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.
   1. Apply primer to substrates at required rate and allow it to dry.
   2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.
   1. Vapor-Permeable Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness.

C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections will occur trice each week may include the following:
   1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
   2. Continuous structural support of air-barrier system has been provided.
   3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
   4. Site conditions for application temperature and dryness of substrates have been maintained.
   5. Maximum exposure time of materials to UV deterioration has not been exceeded.
   6. Surfaces have been primed, if applicable.
   7. 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.
   8. Strips and transition strips have been firmly adhered to substrate.
   9. Compatible materials have been used.
   10. Transitions at changes in direction and structural support at gaps have been provided.
   11. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
   12. All penetrations have been sealed.

B. Tests: As determined by Owner's testing agency from among the following tests:
   1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.

C. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to 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.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.
1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30 days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION

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SECTION 072730 - SPF INSULATION

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. Thermal Barrier:
   1. SPF Insulation must be separated from the occupied interior space by a thermal barrier meeting the requirements of IBC Chapter 26.
      a. Separated by gyp board see plans
      b. Separated by an approved spray on Thermal Barrier.
         1) Where shown on the plans
   2. SPF applied in the crawl space shall be installed with an ignition barrier. See ignition barrier in this specification.

1.3 DEFINITIONS

A. Perm: 1 grain/h•ft2•in-Hg.

1.4 PERFORMANCE REQUIREMENTS

A. Provide SPF system constructed to perform as continuous air barrier.

B. Provide system constructed to perform as continuous air barrier system and as building thermal insulation. System shall accommodate movements of building materials by providing expansion and control joints as required, with accessory air seal materials at such locations, changes in substrate and perimeter conditions.

C. System Characteristics:
   1. Continuous, with joints and transitions made air-tight.
   2. Withstand positive and negative combined design wind, fan and stack pressures on envelope without damage or displacement, and transfer load to structure.
   3. Air barrier shall not displace adjacent materials under full load.
   4. System shall be joined in airtight and flexible manner to air barrier material of adjacent systems, allowing for relative movement of systems due to thermal and moisture variations and creep.
   5. System Penetrations: Penetrations of system and paths of air infiltration / exfiltration shall be made air-tight.

1.5 SUBMITTALS

A. Product Data:
   1. Submit product data for each product including membrane, primers, sealants, adhesives, and auxiliary materials.
   2. Include manufacturer's printed instructions for evaluating, preparing, and treating substrate, temperature and other limitations of installation conditions, technical data, and tested physical and performance properties.
   3. Submit copy of Evaluation Report (such as CCMC Evaluation Report) or copies of test reports from accredited testing laboratory, for each physical property, indicating that product meets requirements of ULC S705.1-01.

B. Shop Drawings: Show locations and extent of system and details of all typical conditions, intersections with other envelope systems and materials, membrane counter-flashings, and details showing how gaps in construction will be bridged, how inside and outside corners are negotiated and how miscellaneous penetrations such as conduits, pipes electric boxes and similar conditions are sealed.

C. Samples: Provide sample of product applied to following substrates:
   1. CMU.
   2. Concrete.

D. Submit following Informational Submittals:
   1. Certifications specified in Quality Assurance article.
   2. Provide evidence of testing by accredited laboratory confirming material has been tested and conforms to requirements of ASTM E2178, Standard for Air Barrier Materials.
      a. Submit test results of air permeability testing of primary air barrier material (ASTM E 2178)

b. Submit test results of assembly in accordance with ABAA test protocol.

3. Certification by air/vapor barrier manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
4. Certification of compatibility by air/vapor barrier manufacturer, listing all materials on project that it connects to or that come in contact with it.
5. Installer qualifications.
6. Manufacturer's instructions.
7. Manufacturer's field reports.

E. Closeout Submittals:
1. Submit under provisions of Section 017800.
2. Warranty: Submit specified warranty.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility:
1. Obtain system materials from single manufacturer regularly engaged in manufacturing product.
2. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

B. Manufacturer Qualifications: Manufactures materials licensed and certified by Air Barrier Association of America's (ABAA's) Quality Assurance Program.

C. Installer Qualifications:
1. Certified in writing by system manufacturer as qualified for specified systems.

D. Certifications:
1. Submit manufacturer's certification that products furnished for Project meet or exceed specified requirements.
2. Submit manufacturer's certification stating that installed system is in compliance with specified requirements.
3. Certification by air barrier manufacturer that products supplied comply with regulations controlling use of volatile organic compounds (VOCs).

1.7 MOCK-UPS

A. Include mock-up of product on substrates.

B. Field-Constructed Mock-Ups:
1. Construct typical area, not less than 100 s.f., incorporating joint preparation, stud and top of wall conditions, and thermal/ignition barrier and illustrating materials interface and seals.

1.8 PRE-INSTALLATION CONFERENCE

A. Agenda:
1. Review Project Specifications and Drawings.
2. Establish installation schedules and sequence.
3. Coordinate work with in-place and subsequent construction.
4. Review weather and working conditions.
5. Review installation procedures, including:
a. Substrate requirements for Project acceptance (curing of concrete surface, form release agents, temperature).
b. Material installation.
c. Phasing and sequencing requirements.
d. Termination, flashing, expansion joint, and penetration requirements.
e. Location and installation methods for ignition barrier and thermal barrier.
6. Discuss necessary protection of people and materials from over-spray and contact with chemicals and gases.

B. Conduct tour of areas to receive system and report on surface acceptance, possible problem areas, and recommended remedies.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product, date of manufacture, expiration date, and directions for storage.

B. Store materials in their original undamaged packages in clean, dry, protected location and within temperature range required by air/vapor barrier manufacturer. Protect stored materials from direct sunlight.

C. Avoid spillage. Immediately notify Owner if spillage occurs and start clean up procedures.

D. Clean spills and leave area as it was prior to spill.

1.10 PROJECT CONDITIONS

A. Environmental Conditions: Apply system within range of ambient and substrate temperatures recommended by system manufacturer. Do not apply system to damp or wet substrate, unless manufacturer specifically permits that for product.
   1. Do not apply system in snow, rain, fog, or mist.
   2. Do not apply system when temperature of substrate surfaces and surrounding air temperatures are below those recommended by manufacturer.
   3. Do not install product after expiration date printed on label of each container. Product has shelf life of 6 months from date of manufacture.

1.11 SEQUENCING

A. Begin installation only after substrate work is complete and penetrations are securely anchored.

1.12 WARRANTY

A. Provide manufacturers warranty for period of 3 years from date of Substantial Completion.
   1. Include primary air/vapor barrier and installed accessory sealant and membrane materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sprayed polyurethane foam material, when tested, shall meet requirements of ULC S705.1-01 Standard for Thermal Insulation-Spray Applied Rigid Polyurethane Foam, Medium Density, Material- Specification.
B. Material containers shall be labeled with Evaluation Report number of evaluation agency.
C. Design R value: R-26.7 (fill stud cavity).
D. Foamed-in-Place Insulation: Hydrophobic, low-density, open-cell modified polyurethane spray insulation; conforming to following.
   1. Thermal Resistance (R-Value/inch), ASTM C 518: 4.45 /inch.
   2. Corrosion: No significant corrosion when in contact with steel under 85 percent relative humidity.
   3. Flame Spread and Smoke Developed Rating, ASTM E 84: Less than 25, less than 350 respectively.
E. Products supplied by but not limited to one of following:
   1. Demilec, Agribalance, Arlington, Texas 76011.
   2. Comparable products by BASF Corporation or Dow Styrofoam.
   3. Accepted Substitute in accordance with Section 012500.

2.2 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended by air/vapor barrier manufacturer for intended use and compatible with air/vapor barrier.
B. Primer: Water based liquid primer for concrete, masonry, gypsum sheathing, wood, metal, and painted substrates;
   1. Air-Shield™ LM, W.R. Meadows, Inc., Hampshire, Illinois 60140.
   2. Aquatac®, Henry Company Inc., El Segundo, CA 90245.
   3. Mel-Prime™ Water-Based Primer, W. R. Meadows, Inc., Hampshire, Illinois 60140.
   4. Accepted Substitute in accordance with Section 012500.
   5. Ignition Barrier: Install Ignition Barrier meeting the requirements of Chapter 26 of the IBC for Attic and Crawl Spaces. Apply ignition barrier recommended and/or compatible with SPF Insulation Manufacturer. Follow criteria for SPF Insulation in Crawl Spaces contained in AC 377. Meet the requirements of NFPA 286, UL 1715 and UBC 26-3 [1]. Acceptable Ignition Barrier manufacturers are:
      a. Elasticoat 1500 Ignition Barrier by BASF
      b. Aldocoat 800 Intumescent Coating by Aldo Products Company
      c. NoBurn Plus Intumescent Coating by No-Burn Inc.
      d. Substitutions in accordance with Section 012500.
   6. Qualifications and testing criteria for Ignition Barrier and Thermal Barrier products shall receive approval from Agency Having Jurisdiction (AHJ). The Contractor shall provide AHJ approval letters as a required submittal. Listed manufacturers above are subject to this required prior approval.

C. Closed Cell Backer Rods:
   1. All joints shall be protected from SPF contamination by the placement of a closed cell backer rod of suitable size to protect the joint from SPF contamination. Protected joints shall include but shall not be limited to:
      a. Horizontal and vertical precast joints
      b. Precast and curtain wall joints
      c. Precast and HM frame joints
      d. Precast and Louver/metal panel joints.

2.3 EQUIPMENT
A. Equipment used to spray polyurethane foam material shall be in accordance with ULC S705.2-02 and equipment manufacturer's recommendations for specific type of application.
B. Equipment settings are to be recorded on Daily Work Record as required by ULC S705.2-02 Installation standard.
C. Each proportioner unit to supply only one spray gun.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine conditions and proceed with Work in accordance with Section 017300.
B. Verify that substrate work is complete, clean and dry before beginning installation of system materials.
   1. Do not proceed with installation until after minimum curing period recommended by system manufacturer.
   2. Ensure that:
      a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.
      b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
   3. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
   4. Notify Architect in writing of anticipated problems using air/vapor barrier over substrate.
   5. Commencement of work shall be deemed as acceptance of existing work and conditions.
   6. Examine joints before sealing to ensure configurations, surfaces and widths are suitable for spray polyurethane foam. Report in writing defects stating locations of joints deemed unacceptable for application of spray polyurethane foam.

3.2 PREPARATION
A. SPF System:
   1. Remove rough or sharp projections, loose particles, and foreign matter detrimental to adhesion and application of air/vapor barrier.
   2. Clean and prepare surfaces to receive air/vapor barrier in accordance with manufacturer's instructions.
   3. Seal penetrations and cracks, and reinforce changes in substrate and other areas as recommended by manufacturer.
      a. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air/vapor barrier and at protrusions according to air/vapor barrier manufacturer's written instructions.
   4. Apply manufacturer's recommended primer when required for substrate application.
   5. Fill voids as recommended by manufacturer.
   6. Clean metal studs to ensure proper adhesion.
B. Protect people and materials from over-spray and contact with chemicals and gases.
C. Protection of Adjacent Surfaces:
   1. Mask and cover adjacent areas to protect from over spray.
   2. Ensure required foam stop or back up material are in place to prevent over spray and achieve complete seal.
   3. Install temporary ducting and fans to exhaust fumes. Provide as necessary for make-up air.
   4. Erect barriers, isolate area and post warning signs to advise non-protected personnel to avoid spray area.
   5. Install backer rods in precast to precast joints to prevent spray from contaminating joint and preventing acceptable bond of silicone weather seal joints at the precast to precast joint or precast to fenestration products.

D. Surface Preparation
1. Ensure surfaces to receive foam insulation are clean, dry, and properly secured to ensure adhesion of polyurethane foam to substrate.
2. Ensure that all work that may penetrate through system is in place and complete.
3. Ensure that surface preparation and primers required conform to manufacturer's instructions.
4. Prepare surfaces by brushing, scrubbing. Scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion and integrity of spray polyurethane foam. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in solvent compatible with spray polyurethane foam. Ensure surfaces are dry before proceeding.
5. Install transition membranes to applicable surfaces and ensure proper adhesion of transition membranes to substrate, capable of having spray polyurethane foam insulation.
6. Install counter-flashings"
   a. Metal: Mechanically fasten metal counter-flashings with screws at 8 inches o.c.
   b. Membrane: Cut into and uncover only 3 inches of siliconized release paper along one edge of counter-flashing membrane. Adhere membrane flashing to pre-primed substrate minimum of 3 inches and roll firmly in place.

3.3 INSTALLATION
A. Spray Polyurethane Foam:
1. Spray-application of polyurethane foam shall be installed in accordance with ULC S705.2-02 and manufacturer's instructions.
2. Apply only when surfaces and environmental conditions are within limits prescribed by material manufacturer and ULC S705.2 Installation standard.
3. Apply in consecutive passes as recommended by manufacturer to thickness as indicated on Drawings. Passes shall be not less than 1/2 inch and not greater than 2 inches.
4. Do not install spray polyurethane foam within 3 inches of heat emitting devices such as light fixtures and chimneys.
5. Finished surface of foam insulation shall be free of voids and embedded foreign objects.
6. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.
7. Trim, as required, any excess thickness that would interfere with application of cladding/covering system of other sections.
8. Clean and restore surfaces soiled or damaged by work of this Section. Consult with section of work soiled before cleaning to ensure methods used will not damage work.
9. Do not permit adjacent work to be damaged by work of this Section. Damage to work of this section caused by other sections shall be repaired by this section at no additional expense to Owner.
10. Complete connections to other components or repair gaps, holes or other damage using material which conforms to ULC S710.1 Polyurethane Sealant Foam – One Component – Material or ULC S711.1 Polyurethane Sealant Foam – Two Components – Material and shall be installed in accordance with ULC S710.2 Polyurethane Sealant Foam – One component – Installation or ULC S711.2 Polyurethane Sealant Foam – Two Component – Installation, whichever is appropriate.

B. Tolerances: Maximum variation from indicated thickness:
1. Minus (-)1/4 inch;
2. Plus (+)1/2 inch.

C. Apply ignition barrier and thermal barrier in accordance with manufacturer's instructions.

3.4 FIELD QUALITY CONTROL
A. Comply with requirements of Section 014000.
B. Manufacturer's Field Services:
1. Notify manufacturer in timely manner to arrange for manufacturer's technical representative's site visits to ensure proper installation, verify work is in accordance with manufacturer's requirements, and warranty requirements have been met.
2. Manufacturer's Qualified Technical Representative: Monitor activities and advise applicator of proper installation procedures and precautions.
3. Minimum Site Visits:
   a. Pre-construction conference.
   b. First day of installation on site including acceptance of substrate conditions.
   c. Periodic Visits: Weekly during installation and upon completion to verify that installed system complies with ABAA Quality Assurance Program.
4. Submit reports; include site observations, instructions, and monitoring activities.

3.5 PROTECTION

A. Protect system from damage during installation and while left exposed during construction. Repair damage before proceeding with subsequent construction.

END OF SECTION

SECTION 074100 - METAL ROOF PANELS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Included: The contractor shall provide all material, labor, and administration and other items to provide a complete standing seam metal roof system complying with performance requirements indicated and capable of withstanding structural movement, thermally Induced movement and exposure to weather without failure or infiltration of water into the building interior.

B. Coordinate standing seam metal roof system with roofing substructure work.

C. Documents affecting work of this Section include, but are not necessarily limited to, General Conditions, Supplementary General Conditions, and Sections in Division 1 of these Specifications.

1.2 SECTION INCLUDES

A. Preformed and prefinished standing seam metal roof system with continuous mechanically seamed ribs, concealed clips and fastening devices.

B. Color coordinated ridge, hip, valley, gable, eave, comer, rake, headwall, counterflashings and miscellaneous flashings and attaching devices.

C. Provide concealed clips, fasteners, closures and factory and field applied sealants as necessary to meet design criteria and ensure a weathertlght Installation.

D. Bituthane membrane roofing underlayment.

E. 3-1/2" polyisocyanurate nail base rigid insulation (R-20.5) over apparatus bays and support spaces and 1-1/2 inch of polyisocyanurate nail base rigid insulation (R-8.5) over balance of building.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. The standing seam metal roof system, including: panels, flashings, attachment clips and attachment screws shall be designed by the metal roof system manufacturer per to meet the following design criteria:
   a. 2012 version of the International Building Code.
   b. A basic wind speed as indicated on Structural Drawings.
   c. Listing of applicable loads by roof zones (interior. edges and corners).
   d. The building importance factor is one- Essential Facilities.
   e. Roof snow load is zero.
   f. The building exposure factor is as indicated on Structural Drawings.
2. The standing seam metal roof system manufacturer shall provide an engineered analysis of the roofing system, sealed by a registered Structural Engineer employed by the manufacturer and licensed in the State of Texas, verifying that the product and attachment methods will resist wind pressures imposed upon it pursuant to the design criteria and that the roofing system fully complies with all specified requirements.
3. The panel system shall bear fully documented proof that it has been Independent laboratory evaluated using the U.S. Army Corps of Engineers Guide Specification (CEGS) 07416.
   a. Testing shall include establishment of ultimate and allowable system uplift capacities for both the "field• and •areas of discontinuity".
   b. “Proof” shall be defined as both the manufacturer and the product being included in the document entitled: ·List of Approved Standing Seam Metal Roof Systems" as published by the U.S. Army Corps of Engineers.
4. Provide factory preformed panel system that has been pretested and certified by manufacturer to comply with specified requirements under installed conditions.
5. Provide factory engineered and tested end lap (splice) details at roof third points, per ASTM 2140 water immersion testing.
6. Provide continuous mechanically seamed ribs that inherently Increase load span capability, stiffness and flexural stress handling capacity.
7. Provide continuous butyl sealant within the confines of the female flange.
8. Provide factory-preformed panel that has been tested and approved for a Class 4 Impact {Hail) resistance rating per UL 2218. UL listing shall be present on the UL website (Refer to Underwriters Laboratories website at www.ul.oom}.
9. On-site or field manufactured panels are not acceptable. Field curving of pre-manufactured panels is acceptable.

B. Structural Requirements:
   1. Panel structural properties determined In accordance with latest edition of American Iron and Steel Institute's "Cold Formed Steel Design Manual, D using "effective width" concepts.
   2. Wind uplift design for roof assemblies shall be calculated by the standing seam metal rooting system manufacturer per ASTM E 1592. Calculations shall include establishment of ultimate and allowable roof system uplift capacities for both the "field end "areas of discontinuity"'.
   3. Provide confirmation of positive and negative buckling moments and uplift capacity determined by full-scale tests.

C. Substrate Criteria:
   1. Standing Seam Metal Roofing System: Engineer standing seam metal roof system installed over underlayment and three and polyisocyanurate Nailbase clad rigid insulation over 22-gaugemetal decking that is capable of withstanding the design loads when applied at 90º to the surface and spaced as shown on the approved shop drawings.
   2. Waterproof Membrane Underlayment: Apply waterproof membrane and felt inner ply under entire roof surface per manufacturers written Instructions.
   3. Polyisocyanurate Nailbase clad Rigid Insulation: Attach polyisocyanurate Nallbase clad Rigid Insulation to metal decking as per the manufacturers written instructions and In the required pattern to resist the design loading.

D. Environmental Requirements: Actual independent laboratory certified test results must be submitted.
   1. Resistance to air Infiltration: .002 cfm per linear foot of joint when tested in accordance with ASTM E 1680 at static test pressure differential of 12.00 psf.
   2. Resistance to water infiltration: No leakage through panel joints when tested in accordance with ASTM E 1648 at static test pressure differential of 20.00 psf.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's specifications, engineered detail drawings, and installation instructions.

B. Shop Drawings:
   1. Submit one set of 24 by 36 inch PDF approval I design drawings produced by the standing seam metal roof system manufacturer indicating thickness and dimensions of parts, fastenings and anchoring methods, details and locations of seams, transitions and other provisions necessary for thermal expansion and contraction.
   2. Indicate roof terminations, clearly showing flashings and change of direction caps.
   3. Clearly indicate locations of field and factory applied sealant
   4. Show locations, spacing patterns and types of hold-down clips and fasteners.
   5. Provide 24.x36" produced drawings provided by the standing seam metal roof system manufacturer showing a complete roof plan, roof panel layout, and cross section details for every individual condition of the entire roof system.

C. In addition to the requirements outlined under Paragraph 3.12 of the General Conditions and under Section 013300, submit the following for each type of product provided under work of this Section:
   1. Recycled Content:
      a. Indicate recycled content; indicate percentage of post-consumer and post-industrial recycled content per unit of product.
   2. Regional Materials:
      a. Indicate location of manufacturing facility; indicate distance between facility and the project site.
      b. Indicate location of extraction, harvesting, and recovery; indicate distance between extraction, harvesting, and recovery and the project site.

D. Samples:
   1. Submit two (2) samples, twelve-inch (12") tong by full width of panel, showing proposed metal gauge and seam profile.
   2. Submit color samples on metal for Architect's selection from manufacturer's standard color offering.

E. Test Reports: Submit verification the panel system meets the Environmental Conditions for the Indicated test pressures and performance listed for Air and Water Infiltration.

F. Engineered Design Calculations:
   1. Submit panel system manufacturer's design calculations verifying the panel system meets the specified building code as defined In Section 1.03 System Description, Design Requirements listed above.
   2. Design calculations shall be seated by a registered Structural Engineer employed by the standing seam metal roof system manufacturer and licensed In the State of Texas.

G. Certification:
   1. Submit manufacturer's certification that materials and finishes meet specified requirements.

2. Submit written verification of panel Applicator's factory installation training performed by the standing seam metal roof system manufacturer and a copy of the Panel Applicator's "Authorized Applicator" certificate.

1.5 QUALITY ASSURANCE:

A. Manufacturer's Qualifications:
   1. Minimum twenty (20) years' experience in the fabrication of standing seam metal roof systems on projects of similar size and scope. Upon request, submit a minimum of five (5} project references for Architect's review. List project address, date of installation, Architects and Owner's name and telephone numbers.
   2. No other manufacturer of standing seam metal roof systems will be accepted· without prior written approval of the Architect and based upon the manufacturer verifying the product can meet or exceed performance criteria listed in these specifications.
   3. Requests to be listed as an approved manufacturer must be submitted in writing a minimum 7 days prior to bid date accompanied by product literature, technical information, sealed engineer's calculations verifying conformance, and a product sample. Approved manufacturers will only be set forth in a written and issued addendum.

B. Applicator Qualifications:
   1. Panel Applicator must have a minimum of five (5) years' experience in the application of standing seam metal roof systems.
   2. Panel Applicator must be factory trained by the standing seam metal roof system manufacturer prior to the bid date in order to obtain a contract for installation.
   3. Use adequate members of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work in this Section.
   4. Use equipment of adequate size, capacity and numbers to accomplish the work of this Section in a timely manner.
   5. Upon request, submit a minimum of five (5) successfully completed protects of similar size and scope. List project address, date of installation, Architect and Owner's name and telephone numbers.
   6. Single Source Responsibility. Provide all items of the standing seam metal roof system work specified herein by a single roofing contractor to provide undivided responsibility.

C. Regulatory Requirements: Comply with all requirements of applicable building codes and other agencies having jurisdiction for positive and negative design loads of standing seam metal roof systems.

1.6 DELIVERY, STORAGE AND HANDLING:

A. Delivery:
   1. Delivery of material shall be made only after suitable facilities for Its storage and protection area available on the site.
   2. Protect products and accessories from damage and discoloration during transit and at project site.
   3. Upon receipt of prefinished preformed metal panels, flat sheets, flashings and panel accessories, Panel Applicator shall examine each container for damage and for completeness of the consignment.

B. Storage:
   1. Store materials out of the weather in a clean, dry place. One end of each container should be slightly elevated and covered with a loose weatherproof covering to prevent condensation.
   2. Panels and/or flashings with strippable film must not be stored in areas exposed to direct sunlight.
   3. Care should be taken to prevent contact with any substance that may cause discoloration.
   4. Store materials to provide ventilation and prevent bending, abrasion or twisting.
   5. Do not overload roof structure with stored materials. Do not permit material storage or traffic on completed roof surfaces.

C. Handling:
   1. Care should be taken to avoid gouging, scratching or denting.
   2. Do not allow traffic on completed roof. If required, provide cushioned walk boards.
   3. Protect installed products from damage caused by foreign objects and construction until completion of project.
   4. Comply with pertinent provisions of Supplementary General Conditions.

1.7 WARRANTY:

A. Furnish manufacturer's standard 20 year written finish warranty stating that architectural fluorocarbon finish will be:
   1. Free from fading or color change In excess of five (5) NBS units as measured per ASTM 2244-68.

2. Will not chalk In excess of a numerical rating of seven (7) when measured in accordance with standard procedures specified In ASTM D 659-74.
3. Will not peal, crack, chip or delaminate.

B. Furnish a written warranty signed by the Panel .Applicator for a two (2) year period from thedate of substantial completion of the building guaranteeing materials and workmanship for weathertightness of the roofing system, flashings, penetrations and against all leaks.

C. Special Weathertight Warranty: Furnish manufacturer's 20 year. full system, non-prorated, no dollar limit weathertight warranty to be jointly signed by the manufacturer and the Panel Applicator.

D. Protect products and accessories from damage and discoloration during transit and at Project Site. Store sheets and components in dry storage area to prevent condensation.

E. Do not overload roof structure with stored materials. Do not permit material storage or traffic an completed roof surfaces.

1.8 PRE-INSTALLATION CONFERENCE:

A. Convene prior to commencing work of this Section.

B. Attendants: Panel Applicator, installer of each component of associated work, Installers of deck or substrate construction to receive roofing work, Architect, Owner or Owner's Representative, Roofing system manufacturer's technical representative and General Contractor.

C. Record discussion, decisions and agreements reached and furnish a copy to each attendant.

D. Review installation procedures and coordination required with related Work.

E. Tour representative areas of roofing substrates, Inspect and discuss condition of substrates. roof drains, curbs, penetrations, wood nailers and other preparatory work performed by other trades.

F. Review structural loading limitations of steel deck and inspect deck for loss of flatness and as required for mechanical fastening.

G. Review roofing system requirements (approved manufacturer's shop drawings, specifications and other contract documents.

H. Review required submittals.

I. Review and finalize construction schedule related to roofing work and verify availability of materials, installer's personnel, equipment and facilities needed to avoid delays.

J. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing.

K. General Contractor to document the meeting with written minutes and copy all in attendance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Standing Seam Metal Roof System: Pac-Clad or prior approved equal. Prior approval is required per Supplementary General Conditions, and alternate manufacturers must be approved per written and issued addendum a minimum of fifteen (15} days prior to the bid date.
1. Pac Clad Tite-Loc Plus, Contact is Chris Headley, (214)914-6907, ckheadley@gmail.com.
2. Carlisle, CMP-200.

B. Bituthane Membrane Waterproof Underlayment: A 40 mil self-adhering membrane, or prior approved equal.
1. Hyload.

C. Four and a half inch (4-1/2”) Polyisocyanurate Nallbase-Ciad Rigid Insulation: Rmax, Inc., or prior approved equal to achieve an R-value of 20 minimum.
1. Rmax "Multi-Max FA", contact (972) 387-4500
2. GenFlex Roofing Systems "GenFlex ISOflber", contact: (800) 443-4272

D. Substitutions:
1. Requests to be listed as an approved manufacturer must be submitted in writing a minimum fifteen (15) days prior to bid date accompanied by product literature, technical information, sealed engineer's calculations verifying conformance, and a product sample. Approved manufacturers will only be set forth in a written and issued addendum.
2. Alternate manufacturers must fully comply with all specified requirements.

2.2 MATERIALS:

A. Panels:
1. Prefinlshed Galvalume® sheet, ASTM AZSO made of 55% aluminum, 1.6% silicon and the balance zinc as described In ASTM specification A792.
2. Panels shall be 22-gauge with a Polyvinylidene (Kynar 500) Finish.

3. Factory fabricated panel with integral continuous overlapping seams suitable for continuous locking or crimping by mechanical means during installation. Onsite or field manufactured panel profiles are not acceptable.
4. Seam Size: 2 inch high x width as indicated on Drawings.
    a. Provide butyl sealant within the confines of female seam flange, on the bottom edge of female seam flange, designed to seal against adjacent male panel leg.

B. Clip Fastener Assemblies:
1. Typical clip, UL-90 requirements:
    a. Wind Rated Fasteners: As per approved manufacturer's engineered shop drawings.
    b. Wind Rated Clip: Sliding 22-gauge galvanized steel hook in combination with a double fastened 16--gauge galvanized steel base. both at Fy (MIN) = 33 ksi. Clip hook shall have a shop Installed hot-melt butyl sealant for continuity of seal at clip locations.
2. Typical Low Clip Requirements:
    a. UL-90 Fasteners: As per approved manufacturer's engineered shop drawings.
    b. Sliding 26-gauge at Fy--40ksi {MIN) galvanized steel hook in combination with a double fastener 18-gauge at Fy =50 ksi (MIN) galvanized steel base. Clip hook shall have a shop Installed hot-melt butyl sealant for continuity of seal at clip locations.
3. Standard Flashing Fasteners: Same as Wind Rated Fasteners specified above.

C. Accessories:
1. Provide manufacturer's standard accessories and other items essential to completeness of the standing seam metal roof Installation.
2. Roof Jacks: Manufacturer's standard EPDM with an aluminum sealing base ring; for openings twelve Inches (12") or smaller.
3. Roof Curbs: fabricated to the specifications of the standing seam metal roof manufacturer, thereby assuring compatibility with the roof construction framing and covering. Roof curbs shall be of sufficient size and design to coordinate with requirements for support of heat and smoke vents specified In another Division 7Section. Roof curb flashing and framing shall provide for the expected expansion and contraction of the standing seam metal roofing system.
4. Gutters and downspouts will be fabricated to the same gauge and specification as panel.
5. Provide custom made roof jacks.

D. Field Sealants:
1. Color coordinated primerless silicone, urethane, or high grade, non-curing butyl asrecommended and engineered by panel manufacturer.
2. Do not use sealants containing asphalt.

E. Bituthane Membrane Waterproof Underlayment:
1. 40 mil flexible, self-adhering rubberized asphalt sheet membrane with a polymeric filmon the surface and a removable silicone-treated release sheet on the adhesive side
2. Bituthane membrane under1ayment shall be rated for high temperature resistance upto 260 F.
3. Bituthane membrane shall have a maximum permeance rating of 0.05 perms.
4. Minimum thickness shall be 40 mils.

F. Felt Interply:
1. Shall be Underwriters laboratory approved and fisted in the FM Global ApprovalGuide.

G. Shall be Type IV fiberglass ply sheet, Underwriters Laboratory Type G-1, meetingFederal Specification No. S8-R-620B, ASTM D 2178, Type Ill, or approved equal.
1. PolylsocyanurateNailbase Clad Rigid Insulation: Rigidclosed cell polyisocyanurate, clad on top sidewith minimum 5/8 inch plywood surface (OSB not allowed); verify compatibility with roofing membrane manufacturer.

2.3 FABRICATION

A. Panels:
1. Provide factory formed panel widths of sixteen inch (16"), with a one and one-half inch (1-1/2”) high standing seam.
2. On-site or field manufactured panels are not acceptable. Field curving of pre-manufactured panels is acceptable.
3. Provide panels with engineered end laps (splices) at third points, shingled to accommodate water run-off (fabricated with overtap in direction of water flow).
4. Roof panels shall have flush horizontal and vertical surfaces to facilitate sealing at terminations. Panel configurations that create voids and require supplemental closure devices are acceptable.

B. Seams:
1. Panel seams shall interlock entire length of seam, by means of a mechanically driven rib seamer.
2. Design standing seam to lock up and resist joint disengagement during design wind uplift conditions as calculated to comply with local building codes and design uplift criteria.

3. Provide factory sealant within confines on trailing edge of female seam leg to aid in resistance of leaks and provide panel-to-panel seal while allowing expansion and contraction movement, and the seams shall be continuously locked or crimped together by mechanical means during installation.

C. Clips:
1. Provide Wind Rated Clips designed to allow panels to thermally expand and contract and provide a minimum of ±one inch (1") of thermal movement. Clips shall incorporate a self-centering feature to allow a minimum of one inch (1") of movement in both directions along panel length.
2. Clips shall be designed to meet positive and negative pressures as calculated and engineered by the standing seam metal roofing system manufacturer.

D. Engineer panels to use concealed anchors that permit expansion and contraction, including at roof end laps (splices).

E. Trim/Flashings:
1. Prefinished sheet metal designed by the manufacturer In the same gauge, material and finish as the standing seam metal roofing system.
2. Locations, design, sealing and fastening methods as per the manufacturer's approved engineered shop drawings.

2.4 FINISH:

A. Fluorocarbon Coating:
1. Full strength 70% Kynar 500® coating baked on for fifteen (15) minutes at 450°F to dry-film thickness of 1.0 mil.
2. 15% reflective gloss (ASTM D 523). (low-gloss).
3. 0.3 mil baked on epoxy primer.
4. Backer side of panels to be painted with an off-white polyester coating.
5. Top Side Color: As selected by Architect from manufacturer's standard color offering.
6. Panel coating color shall be "Musket Gray".

2.5 PROTECTION

A. Metal Roofing: Protect work as required to ensure that the standing seam metal roof system will be without damage at time of final completion.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Workmanship: Standing seam metal roof and sheet metal work shall be fabricated, assembled, and installed in a manner consistent with best trade practice.

B. All aspects of installation of roof panels shall be in conformance with the building manufacturer's recommendations. Position and align panels with ribs parallel to the roof slopes. Roofing panels shall be field roll formed in order to provide full lengths without end seams. The roof covering shall be properly flashed and caulked to make a watertight assembly.

3.2 TOUCH UP & CLEAN

A. Factory film coating shall be removed after installation.

B. Field touch-up of scratches or defaced metal panels will be permitted only if approved by the Architect in writing. Otherwise, any and all defective materials shall be replaced with new materials.

C. Keep job site clean of rubbish and debris.

END OF SECTION

SECTION 074213

METAL WALL AND SOFFIT PANELS

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. Exposed-fastener, lap-seam metal wall panels.
   2. Metal soffit panels.

1.3 DEFINITION

A. Metal Wall Panel Assembly: Metal wall panels, attachment system components, miscellaneous metal framing, thermal insulation, and accessories necessary for a complete weathertight wall system.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Metal wall panel assemblies shall comply with performance requirements without failure due to defective manufacture, fabrication, installation, or other defects in construction.

B. Delegated Design: Design metal wall panel assembly, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Air Infiltration: Air leakage through assembly of not more than 0.06 cfm/sq. ft. of wall area when tested according to ASTM E 283 at the following test-pressure difference:
   1. Test-Pressure Difference: 1.57 lbf/sq. ft.

D. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:
   1. Test-Pressure Difference: 2.86 lbf/sq. ft.

E. Water Penetration under Dynamic Pressure: No evidence of water leakage when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of inward-acting, wind-load design pressure of not less than 6.24 lbf/sq. ft. and not more than 12 lbf/sq. ft.
   1. Water Leakage: As defined according to AAMA 501.1.
   2. Water Leakage: Uncontrolled water infiltrating the system or appearing on system's normally exposed interior surfaces from sources other than condensation. Water controlled by flashing and gutters that is drained back to the exterior and cannot damage adjacent materials or finishes is not water leakage.

F. Structural Performance: Provide metal wall panel assemblies capable of withstanding the effects the following loads and stresses within limits and under conditions indicated, based on testing according to ASTM E 1592:
   1. Design Wind Loads: As indicated on structural drawings or as otherwise determined using design wind loads applicable to Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure."
   2. Deflection Limits: Metal wall panel assemblies shall withstand wind loads with horizontal deflections no greater than 1/240 of the span.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of wall panel and accessory.

B. Shop Drawings: Show fabrication and installation layouts of metal wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details. Distinguish between factory-, shop- and field-assembled work.
   1. Accessories: Include details of the following items, at a scale of not less than 1-1/2 inches per 12 inches:

a. Flashing and trim.
b. Anchorage systems.

C. Samples for Initial Selection: For each type of metal wall panel indicated with factory-applied color finishes.
1. Include similar Samples of trim and accessories involving color selection.
2. Include manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each sealant exposed to view.

D. Delegated-Design Submittal: For metal wall panel assembly indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For Installer.

F. Maintenance Data: For metal wall panels to include in maintenance manuals.

G. Warranties: Sample of special warranties.

H. Provide mock-up, not less than 10 feet in length, demonstrating physical appearance of completed system.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Source Limitations: Obtain each type of metal wall panel from single source from single manufacturer.

D. Fire-Resistance Ratings: Where indicated, provide metal wall panels identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
1. Build mockup of typical wall panels as shown on Drawings; including, supports, attachments, and accessories. If not indicated on Drawings, build mock-up of appropriate size to show overall panel conditions.
2. Conduct water spray test of mockup of metal wall panel assembly, testing for water penetration according to AAMA 501.2.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Package metal wall panels for protection during transportation and handling.

B. Unload, store, and erect metal wall panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal wall panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal wall panels to ensure dryness, with positive slope for drainage of water. Do not store metal wall panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal wall panel for period of metal wall panel installation.

E. Protect foam-plastic insulation as follows:
1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic insulation materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal wall panels to be performed according to manufacturers' written instructions and warranty requirements.

B. Field Measurements: Verify locations of structural members and wall opening dimensions by field measurements before metal wall panel fabrication, and indicate measurements on Shop Drawings.

1.9 COORDINATION

A. Coordinate metal wall panel assemblies with rain drainage work, flashing, trim, and construction of girts, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal wall panel assemblies that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including rupturing, cracking, or puncturing.
      b. Deterioration of metals and other materials beyond normal weathering.
   2. Warranty Period: Five years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal wall panels that show 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 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      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 PANEL MATERIALS

A. Metallic-Coated Steel Sheet: Restricted flatness steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755.
   1. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792, Class AZ50 coating designation, Grade 40; structural quality.
   2. Surface: Smooth, flat finish.
   3. Exposed Coil-Coated Finish:
      a. 2-Coat Fluoropolymer: AAMA 621. 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.
      b. 3-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   4. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

B. Panel Sealants:
   1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, nontoxic, non-staining tape 1/2 inch wide and 1/8 inch thick.
   2. Joint Sealant: ASTM C 920; elastomeric silicone sealant; of type, grade, class, and use classifications required to seal joints in metal wall panels and remain weathertight; and as recommended in writing by metal wall panel manufacturer.
   3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.2 MISCELLANEOUS METAL FRAMING

A. Miscellaneous Metal Framing, General: ASTM C 645, cold-formed metallic-coated steel sheet, ASTM A 653, G90s hot-dip galvanized or coating with equivalent corrosion resistance unless otherwise indicated.

B. Subgirts: Manufacturer's standard C- or Z-shaped sections, 0.064-inch nominal thickness.

C. Zee Clips: 0.079-inch nominal thickness.

D. Base or Sill Angles: 0.079-inch nominal thickness.

E. Hat-Shaped, Rigid Furring Channels:
   1. Nominal Thickness: As required to meet performance requirements.
   2. Depth: 7/8 inch.

F. Cold-Rolled Furring Channels: Minimum 1/2-inch- wide flange.
   1. Nominal Thickness: As required to meet performance requirements.
   2. Depth: 3/4 inch.
   3. Tie Wire: ASTM A 641, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

G. Z-Shaped Furring: With slotted or non-slotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, and depth required to fit insulation thickness indicated.
   1. Nominal Thickness: As required to meet performance requirements.

H. Fasteners for Miscellaneous Metal Framing: Of type, material, size, corrosion resistance, holding power,

and other properties required to fasten miscellaneous metal framing members to substrates.

2.3 MISCELLANEOUS MATERIALS

A. Panel Fasteners: Self-tapping screws, bolts, nuts, self-locking rivets and bolts, end-welded studs, and other suitable fasteners designed to withstand design loads. Provide exposed fasteners with heads matching color of metal wall panels by means of plastic caps or factory-applied coating. Provide EPDM, PVC, or neoprene sealing washers.

2.4 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.

B. Trapezoidal-Profile, Exposed-Fastener Metal Wall Panels: Formed with raised, trapezoidal ribs and recesses that are approximately same size, evenly spaced across panel width, and with rib/recess sides angled at approximately 45 degrees.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide McElroy Metal; Marquee, or comparable product by one of the following:
      a. AEP-Span.
      b. Berridge Manufacturing Company.
      c. CENTRIA Architectural Systems.
      d. MBCI; Div. of NCI Building Systems.
      e. Petersen Aluminum Corporation.
   2. Material Aluminum-zinc alloy-coated steel sheet, 22 gage nominal thickness.
      a. Exterior Finish: 2-coat fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   3. Panel Coverage: 8 inches.
   4. Panel Height: 7/8 inch.

C. Tapered-Rib-Profile, Concealed-Fastener Metal Wall Panels: Formed with raised, trapezoidal ribs.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing; HR-16, or comparable product by one of the following:
      a. Alcoa Architectural Products (USA).
      b. ATAS International, Inc.
      c. CENTRIA Architectural Systems.
      d. VICWEST; Div. of Jenisys Engineered Products.
   2. Material Aluminum-zinc alloy-coated steel sheet, 24 gage nominal thickness.
      a. Exterior Finish: 2-coat fluoropolymer.
      b. Color: As selected by Architect from manufacturer's full range.
   3. Panel Coverage: 36 inches.
   4. Panel Height: 1-1/2 inches.

2.5 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners in side laps.

B. Flush Metal Soffit Panels: Perforated panels formed with vertical panel edges and flat pan between panel edges.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide McElroy Metal; Marquee-Lok, or a comparable product of one of the following:
      a. AEP-Span.
      b. Berridge Manufacturing Company.
      c. CENTRIA Architectural Systems.
      d. MBCI; Div. of NCI Building Systems.
      e. Petersen Aluminum Corporation.

2.6 ACCESSORIES

A. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels, unless otherwise indicated.
   1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal wall panels.
   2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
   3. Closure Strips: Closed-cell, expanded, cellular, rubber or cross-linked, polyolefin-foam or closed-

cell laminated polyethylene; minimum 1-inch- thick, flexible closure strips; cut or pre-molded to match metal wall panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

B. Flashing and Trim: Formed from 0.018-inch minimum thickness, zinc-coated (galvanized) steel sheet or aluminum-zinc alloy-coated steel sheet prepainted with coil coating. Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal wall panels.

2.7 FABRICATION

A. General: Fabricate and finish metal wall panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal wall panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.

C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal wall panel joints with factory-installed captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, and that will minimize noise from movements within panel assembly.

E. Sheet Metal Accessories: Fabricate flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
4. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, non-corrosive metal recommended by metal wall panel manufacturer.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in finish and appearance, as determined by Architect, are not acceptable.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal wall panel supports, and other conditions affecting performance of work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal wall panel manufacturer.
3. Verify that weather-resistant sheathing paper has been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
4. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

B. Examine roughing-in for components and systems penetrating metal wall panels to verify actual locations of penetrations relative to seam locations of metal wall panels before metal wall panel installation.

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

3.2 PREPARATION

A. Miscellaneous Framing: Install subgirts, base angles, sills, furring, and other miscellaneous wall panel support members and anchorages according to ASTM C 754 and metal wall panel manufacturer's written recommendations.
   1. Soffit Framing: Clip furring channels to supports, as required to comply with requirements for assemblies indicated.

3.3 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts and subgirts unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Commence metal wall panel installation and install minimum of 300 sq. ft. in presence of factory-authorized representative.
   2. Shim or otherwise plumb substrates receiving metal wall panels.
   3. Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until weather barrier and flashings that will be concealed by metal wall panels are installed.
   4. Install screw fasteners in predrilled holes.
   5. Locate and space fastenings in uniform vertical and horizontal alignment.
   6. Install flashing and trim as metal wall panel work proceeds.
   7. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
   8. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.
   9. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
   10. Provide weathertight escutcheons for pipe and conduit penetrating exterior walls.

B. Fasteners:
   1. Steel Wall Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action as recommended by metal wall panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.
   1. Seal metal wall panel end laps with double beads of tape or sealant, full width of panel. Seal side joints where recommended by metal wall panel manufacturer.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

E. Lap-Seam Metal Wall Panels: Fasten metal wall panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
   1. Lap ribbed or fluted sheets one full rib corrugation. Apply panels and associated items for neat and weathertight enclosure. Avoid "panel creep" or application not true to line.
   2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal wall panels.
   3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
   4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
   5. Provide sealant tape at lapped joints of metal wall panels and between panels and protruding equipment, vents, and accessories.
   6. Apply a continuous ribbon of sealant tape to weather-side surface of fastenings on end laps; on side laps of nesting-type panels; on side laps of corrugated nesting-type, ribbed, or fluted panels; and elsewhere as needed to make panels weathertight.
   7. At panel splices, nest panels with minimum 6-inch end lap, sealed with butyl-rubber sealant and fastened together by interlocking clamping plates.

F. Zee Clips: Provide Zee clips of size indicated or, if not indicated, as required to act as standoff from subgirts for thickness of insulation indicated. Attach to subgirts with fasteners.

G. Fire-Rated Metal Wall Panel Assemblies: Install metal liner panels on exterior side of girts, fastening

through faces of panels, with girts exposed to the interior. Install subgirts horizontally, fastened to legs of metal liner panels. Install substrate board as indicated in Division 06 Section "Sheathing," in number of layers required for fire rating, over subgirts, attached with board fasteners. Install second set of subgirts horizontally, fastened through substrate board into first set of subgirts. Install exterior metal wall panels, fastened to second set of subgirts.

1. Comply with UL requirements for fire-rated construction.

3.4 METAL SOFFIT PANEL INSTALLATION

A. General: Provide metal soffit panels of full length from eave to ridge, unless otherwise indicated or restricted by shipping limitations. Anchor metal soffit panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Field cutting of metal soffit panels by torch is not permitted.
   2. Install panels perpendicular to framing.
   3. Rigidly fasten eave end of metal soffit panels and allow wall end free movement due to thermal expansion and contraction. Predrill panels.
   4. Locate and space fastenings in uniform vertical and horizontal alignment.
   5. Panels shall run full width of soffit; panel splices will not be permitted.

B. Fasteners for Aluminum Soffit Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior and aluminum or galvanized steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal soffit panel manufacturer.
   1. Coat back side of aluminum soffit panels with bituminous coating where soffit panels will contact wood, ferrous metal, or cementitious construction.

3.5 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal wall panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.

B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
   1. Install exposed flashing and trim that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.
   2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Water-Spray Test: After completing the installation of 75-foot- by-2-story minimum area of metal wall panel assembly, test assembly for water penetration according to AAMA 501.2 in a 2-bay area directed by Architect.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect and test completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Additional tests and inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal wall panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal wall panel installation, clean finished surfaces as recommended by metal wall panel manufacturer. Maintain in

a clean condition during construction.

B. After metal wall panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal wall panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 075303 - FULLY ADHERED MULTI-PLY ROOF SYSTEM

PART 1 - GENERAL

1.1 Work shall include
- A. Description of Work: Installation of new white thermoplastic Elvaloy® membrane roofing with polyester fleece backing, as well as related flashings and accessories.
- B. Areas Covered
  1. Low Slope Areas

1.2 INSTALLER QUALIFICATIONS
- A. Roofing Installer must be:
  1. Currently prequalified with the Owner in accordance with Owner's prequalification requirements.
  2. Currently in good standing with the manufacturer for manufacturer's warranty requirements.
  3. Installer must be an experienced single firm specializing in the type of roofing repair and/or removal and replacement work required, employing only experienced workers for the class of work in which they are employed, having at least five (5) years successful experience on projects similar in size and scope and acceptable as applicators by the Owner's representative.
  4. Contractor must have successfully completed previous projects warranted by the manufacturer.
- B. It shall remain each Contractor's responsibility to determine his current status with the manufacturer's certification plan.

1.3 QUALITY ASSURANCE
- A. Testing Laboratory Services: Test results shall meet or exceed established standards.
- B. Underwriters Laboratory (Roofing Covering): Class A fire hazard classification.
- C. Code Compliance: Comply with governing local, state, and federal regulations, safety standards, and codes.
- D. Industry Standards
  1. The National Roofing Contractors Association (NRCA) - Roofing and Waterproofing Manual
  2. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - Architectural Sheet Metal Manual
  3. American Society of Civil Engineers – ASCE 7

1.4 REFERENCES (INCLUDING LATEST REVISIONS)
- A. The manufacturer's Technical Specifications and current NRCA, Underwriters Laboratory, and IBC guidelines shall be considered a part of this specification and shall be referred for general application procedures and recommendations.
- B. American Society for Testing and Materials:
  1. ASTM B 209, Specification for Aluminum and Aluminum Alloy Sheet and Plate
  2. ASTM C 719, Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cycle Movement (Hockman Cycle)
  3. ASTM C 794, Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
  4. ASTM C 920, Specification for Elastomeric Joint Sealants
  5. ASTM D 312, Specification for Asphalt Used in Roofing
  6. ASTM D 1863, Specification for Mineral Aggregate Used on Built-up Roofs
  7. ASTM D 2178, Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
  8. ASTM D 2824, Specification for Aluminum - Pigmented Asphalt Roof Coatings
  9. ASTM D 4586, Specification for Asphalt Roof Cement, Asbestos Free
  10. ASTM A 361, Sheet Steel, Zinc-Coated (Galv.) by the Hot-Dip Process for Roofing and Siding
  11. ASTM C 177, Test for Thermal Laboratory Services
  12. ASTM C 728, Perlite Thermal Insulation Board
- C. Federal Specifications:
  1. LLL-I-535B
  2. SS-A-701B
  3. SS-C-153
  4. SS-C-153C
  5. SS-R-620B
  6. TT-C-498C
  7. TT-P-320D
  8. TT-S-00227E

9. TT-S-00230C
10. SS-S-001534 (GSA-FSS)
11. L-P-375

1.5 SUBMITTALS

A. Samples and Manufacturer's Submittals: Submit prior to delivery or installation.
   1. Samples of all roofing system components including all specified accessories.
   2. Submit samples of proposed warranty complete with any addenda necessary to meet the warranty requirements as specified.
   3. Submit latest edition of manufacturer's specifications and installation procedures. Submit only those items applicable to this project.
   4. A written statement from the roofing materials manufacturer approving the installer, specifications and drawings as described and/or shown for this project and stating the intent to guarantee the completed project.
   5. Manufacturer's Equiviscous Temperatures (EVT) for the specified bitumens.

B. Shop Drawings: Provide manufacturer's approved details of all perimeter conditions, projection conditions, and any additional special job conditions which require details other than indicated in the drawings.

C. Maintenance Procedures: Within ten days of the date of Substantial Completion of the project, deliver to the Owner three copies of the manufacturer's printed instructions regarding care and maintenance of the roof.

1.6 DELIVERY, STORAGE, AND HANDLING

A. All materials shall be delivered with appropriate carton and can labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

B. Some of the indicated materials are extremely flammable and/or toxic. Use precautions indicated on can and carton labels.

C. Deliver materials in manufacturer's original, unopened containers and rolls with all labels intact and legible including labels indicating appropriate warnings, storage conditions, lot numbers, and usage instructions. Materials damaged in shipping or storage shall not be used.

D. Manufacturer's packaging and/or roll plastic is not acceptable for exterior storage. Tarpaulin with grommets shall be minimum acceptable for exterior coverings. All materials stored as above shall be four inches (4") minimum off the substrate, and the tarpaulin tied off with rope.

E. Deliver materials requiring fire resistance classification to the job with labels attached and packaged as required by labeling service.

F. Deliver materials in sufficient quantity to allow continuity of work.

G. Handle and store material and equipment in such a manner as to avoid damage. Liquid products shall be delivered sealed, in original containers.

H. Handle rolled goods so as to prevent damage to edge or ends.

I. Select and operate material handling equipment so as not to damage existing construction or applied roofing.

J. Moisture-sensitive products shall be maintained in dry storage areas and properly covered. Provide continuous protection of materials against wetting and moisture absorption. Store roofing and flashing materials on clean raised platforms with weather protective covering when stored outdoors.

K. Store rolled goods on end.

L. Protect materials against damage by construction traffic.

M. The proper storage of materials is the sole responsibility of the contractor and any wet or damaged roofing materials shall be discarded, removed from the project site, and replaced prior to application.

N. Comply with fire and safety regulations, especially with materials which are extremely flammable and/or toxic. Use safety precautions indicated on labels.

O. Products liable, such as emulsions, to degrade as a result of being frozen shall be maintained above 40° F in heated storage.

P. No storage of materials shall be permitted on roof areas other than those materials that are to be installed the same day.

Q. The contractor is to erect a temporary chain link fence, minimum six feet (6') in height, around work area stage and kettles. Fence shall be secured on a daily basis.

1.7 SITE CONDITIONS

A. Job Condition Requirements:
   1. Apply roofing in dry weather.

2. Do not apply roofing when ambient temperature is below 45° F.
3. Coordinate the work of the contractor with the work to be performed by the Owner's personnel, to ensure proper sequencing of the entire work. The Owner's personnel will be erecting interior protection for equipment, if required. The contractor is to schedule his work so that adequate time is allowed for the Owner's personnel to perform the work. No roof work shall be performed until the Owner's personnel have completed erection of the interior protection in that area.
4. Proceed with roofing work only when weather conditions are in compliance with manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with specifications.
5. Schedule the work so the building will be left watertight at the end of each day. Do not remove more roofing material than can be reinstalled in any working day.
6. All surfaces to receive new roofing shall be smooth, dry, and free from dirt, debris, and foreign material before any of this work is installed. Competent operators shall be in attendance at all times equipment is in use. Materials shall be stored neatly in areas designated by the Owner. Load placed on the roof at any point shall not exceed the safe load for which the roof is designed.
7. The contractor shall take all necessary precautions to protect the roof mat and deck from damage. The contractor shall be responsible for repairing all new areas of damage caused by the negligence of the contractor, at the contractor's expense. The Owner's on-site representative shall determine damage caused by contractor negligence.
8. The contractor shall follow local, state, and federal regulations, safety standards, and codes for the removal, handling, and disposal of asbestos containing materials, if present. When a conflict exists, use the stricter document.
9. Follow insurance underwriter's requirements acceptable for use with specified products or systems.
10. Due caution should be exercised so as not to alter the structural integrity of the deck. When cutting through any deck, care should be taken so as not to damage the deck or any part of the deck, such as post tension cables, etc.
11. All kettles shall have an automatic thermostat control, and temperature gauge, all in working order.
12. The contractor is to verify the location of all interior ducts, electrical lines, piping, conduit, and/or similar obstructions. The contractor is to perform all work in such a manner as to avoid contact with the above mentioned items.
13. Surface and air temperatures should be a minimum 45° F during applications of cleaner and waterproof coating and remain above 45° F for a minimum of four (4) hours following applications. Verify compatibility of cleaner with coatings, paints, primers and joint sealers specified. Advise Owner's representative of any problems in this regard prior to commencing cleaning operations.
14. Temporary Sanitary Facilities: The contractor shall furnish and maintain temporary sanitary facilities for employees use during this project. These will be removed after the completion of the project. All portable facilities shall comply with local laws, codes, and regulations.

B. Protection of Work and Property:
1. Work: The contractor shall maintain adequate protection of all his work from damage and shall protect the Owner's and adjacent property from injury or loss arising from this contract. He shall provide and maintain at all times any OSHA required danger signs, guards, and/or obstructions necessary to protect the public and his workmen from any dangers inherent with or created by the work in progress. All federal, state, and city rules and requirements pertaining to safety and all EPA standards, OSHA standards, NESHAP regulations pertaining to asbestos as required shall be fulfilled by the contractor as part of his proposal.
2. Property: Protect existing planting and landscaping as necessary or required to provide and maintain clearance and access to the work of this contract. Examples of two categories or degrees of protection are generally as follows: a) removal, protection, preservation, or replacement and replanting of plant materials; b) protection of plant materials in place, and replacement of any damage resulting from the contractor's operations.
3. Twenty-four Hour Call: The contractor shall have personnel on call 24 hours per day, seven (7) days per week for emergencies during the course of a job. The Owner's Project Manager is to have the 24 hour numbers for the contact. Contractor must be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers available to the Owner's Project Manager are to be both home and office numbers for:
    a) Job Foreman
    b) Job Superintendent
    c) Owner or Company Officer

C. Damage to Work of Others: The contractor shall repair, refinish, and make good any damage to the building or landscaping resulting from any of his operation. This shall include, but is not limited to, any damage to plaster, tile work, wall covering, paint, ceilings, floors, or any other finished work. Damage

done to the building, equipment, or grounds must be repaired at the successful contractor's expense holding the Owner harmless from any other claims for property damage and/or personal injury.

D. Measurements: It will be the contractor's responsibility to obtain and/or verify any necessary dimensions by visiting the job site, and the contractor shall be responsible for the correctness of same. Any drawings supplied are for reference only.

E. Use of Premises:
   1. The contractor is advised that the Owner will occupy the building at all times, and the contractor must provide all safeguards required to protect personnel and to keep noise levels as low as reasonably possible for each operation.
   2. The contractor shall:
      a) Coordinate work in such a manner as to not interfere with the normal operation of the building.
      b) Assume full responsibility for protection and safekeeping of products stored on premises.
      c) Agree to hold the Owner harmless in any and all liability of every nature and description which may be suffered through bodily injuries, including death of any persons by reason of negligence of the contractor, agents, employees, or subcontractors.

F. Cleaning and Disposal of Materials:
   1. Contractor shall keep the job clean and free from all loose materials and foreign matter. Contractor shall take necessary precautions to keep outside walls clean and shall allow no roofing materials to remain on the outside walls.
   2. All waste materials, rubbish, etc., shall be removed from the Owner's premises as accumulated. Rubbish shall be carefully handled to reduce the spread of dust. A suitable scrap chute or hoist must be used to lower any debris. At completion, all work areas shall be left broom clean and all contractor's equipment and materials removed from the site.
   3. All bituminous or roofing related materials shall be removed from ladders, stairs, railings, and similar parts of the building.
   4. Debris shall be deposited at an approved disposal site.

1.08 WARRANTIES

A. Roofing - Manufacturer: Project shall be installed in such a manner that the roofing material manufacturer will furnish a written twenty (20) year NDL type warranty with no exclusion for hail events containing hail stones of diameter up to and including four inches (4") from the date of substantial completion of the completed project. Manufacturer issuing warranty shall provide historical data supporting hail resistance.

B. Roofing - Contractor: The contractor, jointly with any subcontractors employed by him, shall guarantee the work required and performed under this contract will be free from defects in workmanship and materials, and that the building will be and remain waterproof for a two (2) year warranty period, after the Owner accepts the work as substantially complete. The warranty shall be in approved notarized written form, to obligate the contractor and his subcontractors, if any, to make good the requirements of the warranty.

C. Warranty repairs shall be performed by a certified installer. The repairs shall be performed in accordance with the manufacturer's written instructions and recommended procedures so as to not void the warranty. Repair of the system, including materials and labor, shall be done at no cost to the Owner.

D. During the proposal period each Bidder shall make arrangements with the material manufacturer to provide the required warranty.

PART 2 - PRODUCTS

2.1 GENERAL

A. All materials shall be furnished, specified, or approved in writing by the manufacturer issuing the warranty.

B. The roofing membrane manufacturer is defined as a company which makes the primary roofing membrane and flashing membrane in its own factories from raw materials. No “Private Label” material, in which one company’s name goes on a product manufactured by others, is acceptable for this project.

C. Samples of all materials used on the project, which are not supplied by the membrane manufacturer, shall be submitted to the membrane manufacturer for written approval prior to work starting.

D. The specified roofing system shall only be applied by manufacturer-approved and trained roofing contractors.

E. Compatibility: Provide materials that are recommended by manufacturers to be fully compatible with indicated substrates, or provide separation materials as required to eliminate contact between incompatible materials.

F. All roofing and roof accessories shall be installed in compliance with manufacturer's current specifications and details.

G. All materials used on the project shall be asbestos free.

2.2 FLEECE-BACKED FINISH MEMBRANE

A. The white thermoplastic Elvaloy® membrane shall be nominal ninety-five (95) mil in overall thickness consisting of a white forty-five (45) mil Elvaloy® thermoplastic membrane with fifty (50) mil thick backing of five ounce polyester fleece with a minimum one and one-half inch (1-1/2") dry selvage edge for welding. The high-performance thermoplastic Elvaloy® membrane shall be comprised of a minimum 50% of total polymer content of KEE (ketone ethylene ester). Membrane shall be manufactured; or prior approved equal.

B. The thermoplastic Elvaloy® membrane shall meet the following physical properties: Elongation 105%, ASTM D 412; Tensile Strength 1300 lbs/in2, ASTM D 412; Tear Strength 380 ppi, ASTM D 624; Density @ 70° F, 80 lbs/ft3; Low Temperature Flexibility, Pass, 37-GP-56M; and Water Absorption less than 0.1%, 37-GP-56M. Initial solar reflectance shall average 0.74; aged solar reflectance shall average 0.72.

2.3 REINFORCED/NON-FLEECED VERTICAL WALL MEMBRANE

A. Flashing membrane installed on the vertical beginning approximately eight inches (8") above the finished roof line shall be white non-fleeced thermoplastic Elvaloy® with KEE membrane reinforced with dispersed polyester fibers, as manufactured, or pre-approved equal.

B. The non-fleeced thermoplastic Elvaloy® membrane shall meet the following physical properties: Elongation 170%, ASTM D 412; Tensile Strength 1300 lbs/in2, ASTM D 412; Tear Strength 380 ppi, ASTM D 624; Density @ 70° F, 80 lbs/ft3; Low Temperature Flexibility, Pass, 37-GP-56M; and Water Absorption less than 0.1%, 37-GP-56M.

C. Non-fleeced flashing membrane shall also be utilized for multi-angled intersections, stripping ply, trim strips, and other conditions where molding/forming of the membrane is required.

2.4 DRAIN FLASHING MEMBRANE

A. Drain flashing shall be same material as the white sixty (60) mil fleece-backed finish membrane.

B. The thermoplastic Elvaloy® membrane with fleece backing shall meet the following physical properties: Elongation 105%, ASTM D 412; Tensile Strength 1300 lbs/in2, ASTM D 412; Tear Strength 380 ppi, ASTM D 624; Density @ 70° F, 80 lbs/ft3; Low Temperature Flexibility, Pass, 37-GP-56M; and Water Absorption less than 0.1%, 37-GP-56M.

2.5 PLY SHEETS

A. Shall be Underwriters Laboratory approved and listed in the FM Global Approval Guide.

B. Tough 85 mil SBS modified asphalt non-woven glass reinforced ply sheet: each roll shall be one and one-half squares of material, approximately 39.4” x 50.3’; meeting ASTM D6163, Type 1, Grade S, Ruberoid® 20 ply sheet, or prior approved equal.

2.6 SUBSTRATE BOARD DIRECTLY TO DECK

A. Substrate Board: Impact-resistant, nonstructural, specially engineered gypsum and cellulose fiber panels with 95% recycled content; uniform water-resistance throughout core and surface. Board size four feet by four feet (4' x 4'), thickness 1/2"; conforming to ASTM C 1278, meeting FM 4470 Class 1 criteria, classified by Underwriters Laboratories, and listed in the FM Global Approval Guide. Board will meet the following physical properties, Securock® Roof Board, as manufactured by USG Corporation, or approved equal.

Test	Typical Value	Test Method
Fire Resistance	Class A	UL 790
Permeance	≤ 30	ASTM C473
Surface water absorption	≤ 1.6 nominal grams	ASTM C473
Water resistance	Maximum 10% weight percentage gain	
Mold Resistance	Minimum rating of "10"	ASTM D3273

2.7 INSULATION – FLAT STOCK

A. All insulation shall be approved in writing by the membrane manufacturer as to thickness, type, and manufacturer. All insulation must be approved for the specific application, Underwriters Laboratory approved, and be listed in the FM Global Approval Guide.

B. Polyisocyanurate Roof Insulation: Insulation shall be two layers of rigid polyisocyanurate foam board; meeting Federal Specification No. HH-I-1972/1 or 2 with 20 psi minimum compressive strength and 2.0 pcf minimum density. First layer shall be a minimum thickness of one and one-half inch (1-1/2"). Average

R-value over each roof area shall meet or exceed R-25. Board shall be surfaced on two (2) sides with non-asphaltic facer material.

2.8 INSULATION – TAPERED

A. Factory Tapered Polyisocyanurate Crickets: Factory cut twenty-four inch by forty-eight inch (24" x 48") polyisocyanurate board cut to one-half inch (1/2") per foot slope used in conjunction with standard thickness of polyisocyanurate board to provide positive slope.

2.9 BITUMEN

A. Shall be ASTM D 312 Type IV steep asphalt.

2.10 BONDING ADHESIVE FOR FLASHING

A. Description: Adhesive is a bonding cement of synthetic rubber for fully adhering membranes to various substrates, or prior approved equal.

Typical Liquid Properties (Room Temperature)	
Color	Amber/Yellow
Base Product	Neoprene
Solids	25%
Specific Gravity	.87
Pounds/Gallon	7.25
Viscosity (CPS)	2500
Solvents	Ketone, Toluene, Aliphatic Hydrocarbon, Zylene
Estimated Coverage	
2 Sided Application	55/70 sq. ft. (2/2.5 mils dry)
DOT Label Required	Flammable Liquid
Code - 584661	

B. Handling: Contains ingredients which could be harmful if mishandled. Contact with skin and eyes should be avoided and necessary protective equipment and clothing should be worn.

2.11 FASTENERS AND PLATES

A. Fasteners and fastening plates or bars shall be listed in the FM Global Approval Guide, and be as recommended by the fastener manufacturer for the specific application.

B. General: All fasteners and plates for the installation of the base sheet shall be supplied and warranted by the membrane manufacturer for the specific application.

C. Membrane attachment toggles, if required, shall be provided and warranted by the membrane manufacturer.

D. All fasteners and plates shall be FM Global approved corrosion resistant screws or anchors supplied and warranted by the membrane manufacturer. Fasteners shall be of a type and length recommended by the manufacturer for fastening the insulation and/or protection layer (through the existing roof in reroofing) to the structural roof deck.

2.12 FASTENERS

A. Fasteners and fastening plates and/or termination bars shall be FM Approved and shall be listed in the FM Global Approval Guide, and as recommended by the insulation/fastener manufacturer for the specific application to meet the minimal requirements for wind uplift as required by the local jurisdiction and/or FM Global.

B. Standard Fastener for Steel Applications for 18-24 gauge Steel and Wood Substrates: Shall be a #14 fastener with a minimum .220 thread diameter and .12.5 buttress threads and a 30 degree spade point. Fasteners shall be fluorocarbon coated with CR-10 corrosion resistant coating when subjected to 30 Kesternich cycles (DIN 50018) shows less than 15% red rust which surpasses FM Global Approval Standard 4470, as manufactured by OMG Roofing Products, or approved equal. All fasteners shall be used in conjunction with the manufacturers approved round pressure plate. Fasteners, plates, and/or bars shall be FM approved and listed in the FM Global Approval Guide.

2.13 NON-STRUCTURAL CANT STRIP

A. Shall be wood fiber, conforming to ASTM C208 and C209.

B. Provide 45 degree cant strips (no partials) at all vertical and horizontal surfaces, such as walls, parapet walls, curbs, expansion joints, etc., and as recommended by membrane manufacturer.

C. Cants shall provide a four inch (4") rise above the roof's surface and extend a minimum of four inches (4") horizontally.

2.14 MISCELLANEOUS ROUGH CARPENTRY

A. All wood nailers, structural cants, curbs, and other miscellaneous rough carpentry, shall be lumber as recommended by NRCA, and Underwriters Laboratory guidelines.

B. Vertical Wall Shimming Material: Shall be exterior grade plywood, gypsum core board, or concrete core board unless otherwise accepted by Project Manager/Architect. Thickness shall be as required for attachment or to make material flashing flush or level with offsets and/or transitions, minimum three-fourths inch (3/4"). Proper selection of material is required to achieve UL guidelines.

2.15 ASPHALT ROOF PRIMER

A. Quick-dry asphalt-based primer for priming of asphalt roof surfaces, or prior approved equal.

Applicable Federal Specification	SS-A-701B
ASTM	D 41
Flash Point	105° F
Viscosity at 80° F (ASTM D 217)	50-60 K.U.
Weight per gallon	7.4 pounds
Drying time (to touch)	Min. 4 hours

2.16 SEAM SEALER

A. Special caulk compatible with Elvaloy® and thermoplastic membrane to seal exposed cut edges.

2.17 TRIM STRIP

A. The trim strip shall have the following minimum properties, or prior approved equal.
1. Six inch (6") wide non-fleeced 45 mil thermoplastic used for capping end laps of rolls.
2. The trim strip is seamed with the use of hot-air welding.

2.18 PITCH PAN SEALANT

A. Shall be one-part, self-leveling polyurethane sealant meeting Federal Specification No. TT-S-00230C, Type I, Class A, ASTM C 920, Type S, Grade P, Class 25, for use in new pitch pans, or prior approved equal.

2.19 TERMINATION/PRESSURE BARS

A. Aluminum strip shall be extruded channel bar with a mill finish, width one inch (1"), thickness 0.100" ± .008", leg height one-fourth inch (1/4") top and bottom, leg angle ninety degrees (90°), for perimeter and curb anchorage, having predrilled holes six inches (6") on center, as manufactured by Olympic Fasteners, or prior approved equal.

2.20 SEALANTS

A. Multi-Component Polysulfide Elastomeric Sealant: Except as otherwise indicated, provide manufacturer's standard, non-modified, 2-or-more-part, polyurethane-based, elastomeric sealant; complying with either ASTM C 920, Type M, Class 25, or FS TT-S-00227E, Class A; self-leveling grade/type where used in joints of surfaces subject to traffic, otherwise non-sag grade/type, or prior approved equal.
1. Durability: Less than 0.5 square inch adhesion/cohesion loss for three (3) samples of both mortar and aluminum; ASTM C 719 test procedure.
2. Adhesion in Peel: Fifteen pound (15#) peel strength and 10% maximum loss of bond to substrate; ASTM C 794.
3. Bituminous Modification: Where joint surfaces contain or are contaminated with bituminous materials, provide manufacturer's modified type sealant which is compatible with joint surfaces (modified with coal-tar or asphalt as required).

B. One-part Urethane Sealant: Sealant for use at coping joints, reglet joints, etc., shall be a one-component, high performance, non-priming, non-sag, gun grade elastomeric polyurethane sealant designed for use in active exterior joints, ASTM C 920, shall meet the following physical and performance properties, or prior approved equal.

Properties	Results	Test Methods
Movement capability, %	±35	ASTM C719
Tensile strength, psi (MPa)	350 (2.4)	ASTM D412
Tear strength, pli	50	ASTM D1004
Ultimate elongation at break, %	800	ASTM D412
Rheological, at 120° F (49° C) (sag in vertical displacement)	No sag	ASTM C639
Extrudability, 3 seconds	Passes	ASTM C603

Hardness, Shore A		ASTM C661
At standard conditions	25 – 30	
After heat aging (max Shore A: 50)	25	
Weight loss, after heat aging	3%	ASTM C792
Cracking and chalking, after heat aging	None	ASTM C792
Tack-free time, hrs, (maximum 72 hrs)	Passes	ASTM C679
Stain and color change	Passes (no visible stain)	ASTM C510
Bond durability,* on glass, aluminum, and concrete ±35% movement	Passes	ASTM C719
Adhesion* in peel, pli (min. 5 pli)	30	ASTM C794
Adhesion* in peel after UV radiation through glass (min. 5 pli)	Passes	ASTM C794
Artificial weathering, Xenon arc, 250 hours	Passes	ASTM C793
Artificial weathering, Xenon arc, 3,000 hours	No surface cracking	ASTM G26
Water immersion, 122° F (50° C)	Passes 10 weeks with movement cycling	ASTM C1247

*Primed for water immersion dictated by ASTM C920.

C. Silyl-terminated Polyether Sealant: Sealant shall be a thermosetting, solvent free, non-slump, self-fixturing, multipurpose structural sealant which shall meet the following physical and performance properties, or prior approved equal.

Properties	
Specific Gravity	1.62 (13.5 lbs./gallon)
Viscosity	800,000+ cps Brookfield RTV, TF spindle, 4 rpm 73° F.
Shear Strength (ASTM D-1002)	400 psi+ (7 day ambient cure)
Elongation @ break (ASTM D-412)	400-550% (7 day ambient cure)
Hardness Shore A (ASTM C-661)	45 ± 3
Tack free time (ASTM C-679)	20 minutes
Low temperature flex ASTM D-816)	Minus 10° F pass 1/4" mandrel
Slump (sag) (ASTM C-697)	Zero slump
Shrinkage (ASTM D-2453)	No measurable shrinkage (after 14 days)
Service temperature	-40° F to 200° F continuous service

2.21 SELF-ADHERING UNDERLAYMENT FOR TEMPORARY WATERPROOFING

A. A premium heavyweight, minimum 60 mil, self-adhering underlayment, to use as a temporary waterproofing barrier.

2.22 OVERNIGHT SEAL

A. Hot applied asphalt bitumen shall be provided for the purpose of night sealing the roof system.

2.23 MISCELLANEOUS MATERIALS

A. Other materials shall be as specified or of the best grade for the proposed use as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 REFERENCE

A. Application of materials shall be in strict accordance with the manufacturer's recommendations and current NRCA, Underwriters Laboratory and IBC guidelines, except where more stringent requirements (better quality or greater quantity of work) are shown or specified.

B. In the instance of a conflict between these specifications and those of the manufacturer and/or current NRCA, Underwriters Laboratory, and IBC guidelines, the more stringent specifications (better quality or greater quantity of work) shall take precedence.

3.2 GENERAL INSTALLATION

A. Comply with governing local, state, and federal regulations, safety standards, and codes.

B. Protect adjacent areas with tarpaulin or other durable materials.

C. Contractor shall prevent overspray, and be responsible for parking lot areas and/or adjoining areas not part of this contract.

D. Contractor shall be responsible for sealing, as required, all openings that may allow bitumen migration or drippage, i.e. pitch dams, envelopes, and filler strips.
E. Prepare surfaces according to manufacturer's or applicator's published instructions. All metal that is to receive bitumen, or come in contact with bitumen or adhesive, shall be first primed with appropriate primer. Any prefinished galvanized sheet steel that is to receive bitumen, or come in contact with bitumen or adhesive, shall be scored, scuffed or abraded before receiving primer application.
F. Use cleaning materials or primers necessary to render an acceptable surface/substrate.
G. All surfaces/substrates shall be clean and dry prior to application of materials.
H. Prior to application of felts and membrane, all foreign matter, gravel, etc., shall be removed from the insulation and/or substrate. Gravel or debris between the insulation/substrate and plies is not acceptable.
I. Prior to application of flashing membranes, substrate shall be clean and free of any previously installed roofing materials. Contractor shall ensure that all components of substrate be structurally sound before application of flashing materials.
J. Bitumen kettle shall have a fume recovery system, and visible thermometer to provide positive monitoring of the bitumen temperature when it is heated in accordance with manufacturer's instructions.
K. Ambient temperature shall be 45° F and rising.
L. The underlayment plies and field membrane are to be laid in the direction of maximum roof slope, working from bottom of slope toward ridge.
M. Wrinkles, buckles, kinks, and fish mouths are not acceptable when laying felt and membrane.
N. Dry voids of felt on felt or membrane on membrane are not acceptable.

3.3 ASPHALT HEATING

A. Use low burner flames during initial melt-downs. Circulate asphalt after initial melt-down. Maximum asphalt temperature shall be 25°F below the flash point.
B. Avoid prolonged heating of asphalt at high temperatures. Reduce the asphalt temperature to below 500°F if asphalt is not being used for periods of four (4) hours or more.
C. Kettle shall be free of contaminants.
D. Application rates: Bitumen quantities for waterstop/tie-offs, flashings, miscellaneous detail applications, and minimum kettle capacity are not included in application rates. To account for these factors, add approximately 25 percent additional bitumen on a total job average basis.

3.4 ROUGH CARPENTRY

A. Nailers shall be installed according to NRCA, Underwriters Laboratory, and IBC guidelines.
B. Wooden nailers shall be installed at gravel stops, drip edges, expansion joints, and on outside perimeter of building.
C. Gravel stop and drip edge nailers shall be the same height as the new insulation being installed where required.
D. Nailers shall be raised if necessary by anchoring an additional nailer of appropriate height to the existing nailer if the existing nailer is not to be replaced.
E. Expansion joint nailers shall extend upward a minimum of eight inches (8") above finish roof height.
F. Where parapet wall exists, specified vertical wall shimming material shall be installed beginning at roof height up to a minimum of twelve inches (12”) above finished roof surface, or as detailed, to provide substrate for horizontal termination of roof to wall flashing system.
G. Any lumber or shimming required for attachment, or to make material flashing flush or level with offsets and/or transitions, shall be incorporated in these specifications.

3.5 STRUCTURAL WOOD CANTS

A. Provide full 45 degree cant strips (no partials) at all intersections of vertical and horizontal surfaces, such as walls, parapet walls, curbs, expansion joints, etc., and as recommended by membrane manufacturer.
B. Cants shall provide a four (4) inch rise above the roof’s surface.
C. Toe of cant shall be level with the surface to receive new roof membrane and in all cases anchored according to NRCA, Underwriters Laboratory, and IBC guidelines.
D. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.
E. If a wood cant is used where insulation exists, cant shall be toe nailed into treated wood nailer under cant the same height as insulation.

3.6 NON-STRUCTURAL CANTS

A. Provide full 45 degree cant strips (no partials) at all intersections of vertical and horizontal surfaces, such as walls, parapet walls, curbs, expansion joints, etc., and as recommended by membrane manufacturer.
B. Cants shall provide a four inch (4") rise above the roof’s surface and extend a minimum of four inches (4")

horizontally.

C. Toe of cant shall be level with the surface to receive new roof membrane and in all cases anchored according to NRCA, Underwriters Laboratory, and IBC guidelines.

D. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.

3.7 INSULATION

A. Manufacturer's Instructions: In regard to attachment, the manufacturer's instructions or specifications shall determine the suitability for an application. Installation must meet ASCE 7 criteria and meet local governing building codes.

B. Precautions: The surface of the insulation must not be ruptured due to overdriving of fasteners.

C. Thermal insulation boards shall be laid on the substrate in parallel rows with end joints staggered and butted as close as possible. All joints shall be tight and at the roof perimeter and roof penetrations, insulation shall be cut neatly and fitted to reduce openings to a minimum. All openings one-fourth inch (1/4") or larger shall be filled with insulation.

D. Insulation shall be tapered or feathered at drains and scuppers to provide proper drainage.

E. No more insulation shall be installed than can be covered by the completed roof system by the end of the day or the onset of inclement weather.

F. Tapered insulation and/or crickets shall be placed in accordance with the drawings and/or as required to the minimum NRCA standards.

3.8 HOT APPLIED APPLICATION OF PLY SHEET

A. Base ply shall be covered with one (1) layer of SBS 85 mil SS base sheet two (2) layers of SBS 85 mil SS base sheet fully adhered as follows:

1. All layers shall be solid mopped at the nominal rate of thirty pounds (30#) ± 20 percent per one hundred (100) square feet using Type IV as required by slope, properly heated. Specified layers shall be applied in accordance with the manufacturer's recommendations and in accordance with general practices as set forth by the NRCA Roofing Manual.

3.9 APPLICATION OF FLEECE BACKED MEMBRANE

A. Fully Adhered Application: Fully adhere membrane to acceptable substrate with hot asphalt applied at the rate specified by the manufacturer.

1. The roof surface must be clean, dry and free of foreign material.
2. Position sheets as indicated on approved shop drawings.
3. Fold one end of the Elvaloy® sheet on top of itself until both ends meet. Apply hot asphalt to the prepared roof surface. The sheet can then be pulled and laid into the bonding material using care not to create any wrinkles.
4. Carefully push into place from fold line to overlap, avoiding wrinkles and air pockets. Roll or broom membrane flat. Using a minimum 200 lb water filled roller, roll membrane into the hot asphalt; NO EXCEPTIONS.
5. Repeat procedure for other sheet half.
6. Lap seams shall be done by lapping the two inch (2") selvedge edge over the non-selvedge edge of the previous roll. The selvedge edge seam shall be made with the heat gun method.
7. Roll ends are butted and capped with a six inch (6") wide trim strip. The trim strip is then seamed with the heat gun.

B. Lap Seaming Procedure: Overlap membrane for attachment method specified and hot-air welded with manufacturer's approved equipment.

1. **ALL SEAMS SHALL BE WELDED DAILY. NO EXCEPTIONS**.
2. All surfaces to be welded shall be clean, dry and free of foreign material.
3. All seams must then be checked with a needle probe and any voids repaired with the heat gun.
4. Caulk all exposed cut edges with seam sealer.

3.10 BACKNAILING/STRAPPING

A. On slopes greater than one inch (1") in twelve inches (12"), refer to NRCA and/or manufacturer's guidelines for backnailing procedures and follow the more stringent guidelines for all specified materials.

Slope	Interply& Top Pour	Backnail	Strap
0 - ½" per 12"	Type IV	No	No
½" - 2" per 12"	Type IV	Yes	Strap if possible
2" - 3" per 12"	Type IV	Yes	Yes

3.11 PERIMETER FASTENING

A. Wood nailers are required for perimeter gravel stops or drip edges. Field membrane and all plies shall be mechanically fastened to nailer on twelve inch (12") centers maximum.

3.12 FLASHING

A. Flash all penetrations, metal edge systems, walls, curbs, expansion joints, drains as shown on details and approved shop drawings with white Elvaloy® flashing membrane.
   1. Field fabricate flashings for vent pipes, vent stacks, or other multi-angled roof projections/penetrations.
   2. Mechanically fasten flashing at terminations according to approved details.
   3. Fastening membrane flashing through metal counterflashing without the use of a termination bar is not acceptable.

B. Any lumber or shimming required for attachment or to make material flashing flush or level with offsets and/or transitions shall be incorporated in the flashing specifications.

3.13 BASE FLASHING (APPROXIMATELY 8" IN HEIGHT MINIMUM)

A. Base flashings shall be installed using the flashing membrane, with length of run not to exceed eight linear feet (8').

B. Wooden nailers or curbs shall be installed at all edges and openings in the roof, mechanically fastened to the deck.

C. Cant strips shall be installed at the intersection of the deck and all vertical surfaces.

D. The roofing field membrane shall extend up over and a minimum two inches (2") above the top of cant strips at all vertical intersections or out to the roof's edge.

E. All flashings shall be mechanically fastened with a termination bar a maximum of six inches (6") on center, be a maximum of forty inches (40") above finished roof height, extend a minimum of four inches (4") / eight inches (8") onto the field of horizontal roof membrane, and not exceed eight linear feet (8') of run in length.

F. All vertical flashing butted seams of the flashing membrane shall be covered with a six inch (6") trim strip and hot-air welded.

G. All flashing membrane shall be adhered with flashing bonding adhesive to the vertical substrate and hot-air welded to the field of roof membrane; hot-air weld six inch (6") trim strip over the butted vertical seams/laps.

H. Flashing welds shall be a minimum two inch (2") width, no maximum.

I. Hot-Air Welding of Flashing:
   1. When using a hand-held hot-air welder, the seams should be pressed together using a hand-held roller. The speed and temperature settings of the welding equipment can be affected by the weather conditions at the site of application, therefore, these parameters should be set by trial and error using two (2) pieces of the flashing membrane. Minimum width of hot-air weld two inches (2"), no maximum.
   2. Lay the membranes together and apply pressure to the welded seam to ensure full adhesion.
   3. Allow the seams to set fully, and probe the entire length for voids. Reseam voids immediately with a hot-air gun and roller.

J. All hot-air welded seams/laps shall be tested daily with a probe for integrity, no variance.

3.14 VERTICAL WALL FLASHING (FOR USE APPROXIMATELY 8-18" ABOVE THE FINISHED ROOF LINE AND EXTENDING UPWARD)

A. Vertical flashing membrane shall be installed on the vertical beginning a minimum of eight inches (8") above the finished roof line (where the base flashing is terminated), with length of run not to exceed twenty feet (20'). Flashing shall be installed in strict accordance with the manufacturer's recommendations.

B. The termination bar used to terminate the minimum eight inch (8") high base flashing shall be covered with the lower edge of the upper vertical flashing. This will cause the termination bar to be buried at the termination point. The selvedge edge of the upper flashing shall be hot-air welded to the base flashing membrane. Care should be taken to ensure the top edge of the base flashing and bottom edge of the vertical flashing are both secured.

C. The vertical wall flashing membrane shall be set in flashing bonding adhesive according to manufacturer's guidelines.

D. All vertical flashing joints shall be butted together and covered with 6" trim strip and hot-air welded to the flashing membrane.

E. Flashing welds shall be minimum two-inch (2") width, no maximum.

F. Immediately following the laying of the flashing membrane, it shall be pressed or rolled in the width direction of the membrane. This will prevent excessive entrapment of air beneath the membrane. The pressing or rolling shall be in the width direction and with the laps so as not to buck the laps.

G. Any flashing extending further than eighteen inches (18") up onto a vertical surface shall be installed using a hidden termination bar. The termination bar used to terminate the first flashing shall be covered by the lower edge of the upper vertical flashing and the selvedge edge shall be hot air welded to the lower flashing. This will cause the termination bar to be hidden at the termination point. Care should be taken to ensure the top edge of the bottom flashing and bottom edge of the upper vertical flashing are both secured. The upper flashing shall be installed and extended up and over the parapet wall and fastened to the nailer on the outside of the wall.

H. The flashing membrane shall be run up the wall in lengths not to exceed twenty (20') linear feet, run under the coping cap and be terminated on the outside of the wall six inches (6") on center; then the coping cap shall be reset. All vertical butt joints are to be stripped in with the 6" trim strip and hot-air welded.

I. Hot-air Welding Laps/Joints/Seams:
   1. When using a hand-held hot-air welder, the seams should be pressed together using a hand-held roller. The speed and temperature settings of the welding equipment can be affected by the weather conditions at the site of application, therefore, these parameters should be set by the contractor by using two (2) pieces of flashing membrane. Minimum width of hot-air weld shall be two inches (2").
   2. Lay the laps together and apply pressure to the welded seam to ensure full adhesion.
   3. Allow the seams to set fully, and probe the entire length for voids. Reseam voids immediately with a hot-air gun and roller.

J. All hot-air welded seams/joints/laps shall be tested daily with a probe for integrity, no variance.

K. Any lumber or shimming required for attachment or to make material flashing flush or level with offsets and/or transitions shall be incorporated in the flashing specifications.

3.15 EDGING FLASHINGS

A. An NRCA-approved gravel stop/fascia system shall be installed in strict accordance with published instructions to meet ES-1.

3.16 PIPING/CONDUIT

A. Piping/conduit shall be raised to NRCA recommended heights, and new supports furnished. Permanent supports shall be installed upon pads approved by membrane manufacturer. Coordinate work with Project Manager/Architect.

B. All gas lines, piping, and conduits shall be coated with industrial grade yellow paint.

3.17 ROOF DRAINS

A. Inspect and test drain and drain lines prior to start of work in contact area. Open if blocked or clogged and repair/replace all broken, missing drain components and lines as required. Verify in writing that all drains and lines are free flowing and watertight prior to substantial completion. Comply with local plumbing codes.

B. Remove strainer and clamping ring. Repair (or replace if damaged) and reset.

3.18 DRAIN FLASHINGS

A. Build a sump to the drain and create a smooth transition by installing tapered insulation around the drain. The slope of the drain sump shall not exceed one inch (1") per horizontal foot (8%). The drain sump should be eight foot by eight foot (8' x 8') sump minimum per roof plans.

B. All drains shall receive new lead flashings. Flashings shall be installed in strict accordance with manufacturer's recommendations and with practices as set forth in the NRCA Roofing Manual.

C. Drain shall be covered with the drain flashing membrane and underlayment plies as specified, slitting the membranes over the drain hole with an "X".

D. Lead flashings as specified shall be installed and primed with asphalt base primer and allowed to dry prior to application of flashing layers.

E. Lead flashing shall be covered with flashing membranes consisting of one layer of fiberglass ply sheet and one layer of the drain flashing membrane. Each layer shall be installed in a solid bed of asphalt bitumen as specified and shall extend a minimum of twelve inches (12") past the outer edges of the three by three foot (3' x 3') lead flashing. Flashing membranes and lead flashing shall be slit over the drain hole with an "X", cutting excess material from the interior of the drain bowl.

3.19 EXPANSION JOINT

A. Expansion joints at walls and field of the roof shall be curbed as outlined in accordance with NRCA and SMACNA guidelines. The curbs will be flashed as outlined above in the Flashings paragraph.

3.20 CLEANING

A. After all membrane has been installed, it shall be cleaned with a cleaning agent compatible with the membrane to return the membrane to like new appearance.

B. Clean exposed surfaces of excess cement, adhesive, sealants, mortar and paint associated with the new work.

C. Clean work area of excess roofing materials and installation debris daily.

D. Repair or replace defaced or disfigured finishes caused by the work.

3.21 MEMBRANE PROTECTION

A. Where equipment pads, wood sleepers, or walkway slabs are to be installed over the roofing membrane, an additional layer of the roofing membrane shall be installed between the roofing membrane and the pad, sleeper, or slab. Due caution shall be exercised to prevent roofing membrane damage during placement. Where required, membrane shall be welded to field membrane to prevent slippage.

3.22 OVERNIGHT SEAL

A. Provide temporary weather protection during interval between demolition and removal of existing construction on exterior surfaces and installation of new construction to ensure that no water leakage or damage occurs to structure or interior areas of existing building.

B. Installation shall be performed according to accepted roofing practice as outlined in the NRCA Roofing Manual.

END OF SECTION

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SECTION 076200 - SHEET METAL FLASHING AND TRIM

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. Formed roof-drainage sheet metal fabrications.
   2. Formed low-slope roof sheet metal fabrications.
   3. Formed equipment support flashing.

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
   1. Certification Letter: ANSI SPRI ES1 for all roof termination metal.

B. Shop Drawings: For sheet metal flashing and trim.
   1. Include plans, elevations, sections, and attachment details.
   2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
   3. Include identification of material, thickness, weight, and finish for each item and location in Project.
   4. Include details for forming, including profiles, shapes, seams, and dimensions.
   5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
   6. Include details of termination points and assemblies.
   7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
   8. Include details of roof-penetration flashing.
   9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
   10. Include details of special conditions.
   11. Include details of connections to adjoining work.
   12. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of coping and roof edge flashing that is SPRI ES-1 tested.

1.6 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. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

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.

1.7 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 Hunter units when tested according to ASTM D 2244.

b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
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**] [**roof edge flashings**] tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Metallic-Coated Steel Sheet: Provide zinc-coated (galvanized) steel sheet according to ASTM A 653/A 653M, G90 coating designation; prepainted by coil-coating process to comply with ASTM A 755/A 755M.

1. Surface: Smooth, flat.
2. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 621. 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: As selected by Architect from manufacturer's full range.
4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

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. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
   b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Ultra.
   c. Henry Company; Blueskin PE200 HT.
   d. Polyguard Products, Inc.; Deck Guard HT.
   e. Protecto Wrap Company; Protecto Jiffy Seal Ice & Water Guard HT.
2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.
3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, 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.

C. Elastomeric Sealant: ASTM C 920, elastomeric [polyurethane] [polysulfide] [silicone] polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

2.5 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. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. 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.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. 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.

E. 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.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard and by FM Global Property Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.Rivet joints where necessary for strength.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.Rivet joints where necessary for strength.

K. Do not use graphite pencils to mark metal surfaces.

2.6 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters: Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96-inch- long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, expansion-joint covers, gutter bead reinforcing bars, and gutter accessories from same metal as gutters.Shop fabricate interior and exterior corners.
1. Gutter Profile: As indicated.
2. Expansion Joints: Butt type with cover plate.
3. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
a. Galvanized Steel: 0.022 inch thick.
4. Gutters with Girth 16 to 20 Inches: Fabricate from the following materials:
a. Galvanized Steel: 0.028 inch thick.

B. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.Shop fabricate elbows.
   1. Hanger Style: As indicated.
   2. Fabricate from the following materials:
      a. Galvanized Steel: 0.022 inch thick.

C. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes, exterior flange trim, and built-in overflows. Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

2.7 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Shop fabricate interior and exterior corners.Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

B. Counterflashing: Shop fabricate interior and exterior corners.Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

C. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

D. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

2.8 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

A. Counterflashing: Shop fabricate interior and exterior corners.Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

B. Flashing Receivers: Fabricate from the following materials:
   1. Galvanized Steel: 0.022 inch thick.

C. Roof-Penetration Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

2.9 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing: Fabricate from the following materials:
   1. Galvanized Steel: 0.028 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

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

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. 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, 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.
6. Do not use graphite pencils to mark metal surfaces.

B. 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.
1. Coat concealed side of sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. 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.
1. Form expansion joints of intermeshing hooked flanges, not less than 1 inchdeep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. 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.

F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

3.4 ROOF-DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof-drainage items to produce complete roof-drainage system according to cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

B. Hanging Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters at eave or fascia to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.
1. Fasten gutter spacers to front and back of gutter.
2. Anchor and loosely lock back edge of gutter to continuous cleat.
3. Anchor back of gutter that extends onto roof deck with cleats spaced not more than 24 inches apart.
4. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.
5. Install continuous gutter screens on gutters with noncorrosive fasteners, removable for cleaning gutters.

C. Downspouts: Join sections with 1-1/2-inch telescoping joints.
1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
2. Provide elbows at base of downspout to direct water away from building.

D. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of 1 inch below scupper or gutter discharge.

3.5 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.6 MISCELLANEOUS FLASHING INSTALLATION

A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.7 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials.

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. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 076210 - FLEXIBLE FLASHING

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. Formed Products: Concealed flashing within wall assemblies to protect and shed incidental water to the exterior.

1.3 PERFORMANCE REQUIREMENTS

A. General: Flashing and trim assemblies as indicated shall withstand 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. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store flashing materials in contact with other materials that might cause staining, denting, or other surface damage. Store flashing materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS

2.1 FLEXIBLE FLASHING

A. Self-Adhesive flexible flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 40 mils.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Advanced Building Products Inc.; Strip-N-Flash.
   b. Carlisle Coatings & Waterproofing; CCW-705 Air & Vapor Barrier Strips.
   c. Grace Construction Products; Perm-A-Barrier Detail Membrane.
   d. Henry; Blueskin SA

2.2 HIGH TEMPERATURE FLASHING

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by manufacturer.
   1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
   2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
   3. Products: Subject to compliance with requirements, provide one of the following:
      a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
      b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
      c. Henry Company; Blueskin PE200 HT.
      d. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, separators, sealants, and other miscellaneous items as required for complete metal flashing installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
   1. Verify compliance with requirements for installation tolerances of substrates.
   2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, 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 FLASHING INSTALLATION

A. General: Install as indicated on Drawings and per Manufacturer’s recommendations.

B. Self-Adhering Sheet Flashing: Install self-adhering sheet flashing, wrinkle free. Apply primer if required by flashing manufacturer. Comply with temperature restrictions of flashing manufacturer for installation. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover flashing with subsequent construction within 14 days.

C. Location:
   1. Flexible Flashing: As indicated on drawings, or at all exterior windows, doors or other penetrations where high temperature flashing is not required.
   2. High Temperature Flashing: As indicated on drawings, or at all locations where flashing will be in contact with metal coping or metal panels where high temperatures exist.

END OF SECTION

SECTION 077100 - ROOF SPECIALTIES

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. Roof-edge specialties.
   2. Roof-edge drainage systems.
   3. Reglets and counterflashings.
   4. Custom fabricated roof jacks fabricated out of pre-finished metal to match roof.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.
   1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
   2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
   3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
   4. Detail termination points and assemblies, including fixed points.
   5. Include details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of roof specialty.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.
   1. Build mockup of typical roof edge as shown on Drawings.
   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.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.8 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Roofing Section .

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:
   1. Design Pressure: As indicated on Drawings.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range):120 deg F, ambient; 180 deg F, material surfaces.

2.2 ROOF-EDGE DRAINAGE SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Cheney Flashing Company.
   2. Hickman Company, W. P.
   3. Merchant & Evans, Inc.
   4. Metal-Era, Inc.
   5. Metal-Fab Manufacturing, LLC.
   6. Insert manufacturer's name.

B. Gutters: Manufactured in uniform section lengths not exceeding [12 feet, with matching corner units, ends, outlet tubes, and other accessories. Elevate back edge at least 1 inch above front edge. Furnish flat-stock gutter straps, gutter brackets, expansion joints, and expansion-joint covers fabricated from same metal as gutters.
   1. Zinc-Coated Steel: Nominal 0.028-inch thickness.
   2. Gutter Profile: As indicated on Drawings.
   3. Corners: Factory mitered and mechanically clinched and sealed watertight.

2.3 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
   1. Cheney Flashing Company.
   2. Fry Reglet Corporation.
   3. Heckmann Building Products Inc.
   4. Hickman Company, W. P.
   5. Keystone Flashing Company, Inc.
   6. Metal-Era, Inc.
   7. Metal-Fab Manufacturing, LLC.

C. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:
   1. Zinc-Coated Steel: Nominal 0.022-inch thickness.
   2. Corners: Factory mitered and mechanically clinched and sealed watertight.
   3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.

D. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches and in lengths not exceeding 12 feet designed to snap into reglets and compress against base flashings with

joints lapped, from the following exposed metal:
1. Zinc-Coated Steel: Nominal 0.022-inch thickness.

E. Accessories:
1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

F. Zinc-Coated Steel Finish: Two-coat fluoropolymer.
1. Color: As selected by Architect from manufacturer's full range.

2.4 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.
3. Products: Subject to compliance with requirements, provide one of the following:
a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.
b. Grace Construction Products, a unit of W. R. Grace & Co.; Grace Ice and Water Shield HT.
c. Henry Company; Blueskin PE200 HT.
d. Metal-Fab Manufacturing, LLC; MetShield.
e. Owens Corning; WeatherLock Metal High Temperature Underlayment.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.6 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. 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.

D. Coil-Coated Galvanized-Steel Sheet Finishes:
1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
a. Two-Coat Fluoropolymer: AAMA 621. 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.
b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
   1. Apply continuously under copings roof-edge specialties.
   2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Do not use graphite pencils to mark metal surfaces.
B. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.
   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
   2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.
C. Fastener Sizes: Use fasteners of sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
D. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.
E. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

3.4 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.
B. Gutters: Join and seal gutter lengths. Allow for thermal expansion. Attach gutters to firmly anchored gutter supports spaced not more than 24 inches apart. Attach ends with rivets and seal with sealant to make watertight. Slope to downspouts.
   1. Install gutter with expansion joints at locations indicated but not exceeding 50 feet apart. Install expansion-joint caps.
C. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.
   1. Provide elbows at base of downspouts at grade to direct water away from building.
   2. Connect downspouts to underground drainage system indicated.

3.5 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.
B. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches over top edge of base flashings.
C. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.6 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 and sealants.
C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.
D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 077200

ROOF 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. Equipment supports.
   2. Roof hatches.
   3. Pipe supports.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Design Wind Loads: As indicated on structural drawings or as otherwise determined using design wind loads applicable to Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure."

1.4 SUBMITTALS

A. Product Data: For each type of roof accessory indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Sustainable Submittals:
   1. Provide product cost and pre-and post-consumer recycled content.

C. Shop Drawings: For roof accessories. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

D. Samples: For each exposed product and for each color and texture specified, prepared on Samples of size to adequately show color.

E. Operation and Maintenance Data: For roof accessories to include in operation and maintenance manuals. Provide at project close-out.

F. Warranty: Sample of special warranty.

1.5 COORDINATION

A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and non-corrosive installation.

B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.6 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finishes or replace roof accessories that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      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 METAL MATERIALS

A. Aluminum-Zinc Alloy-Coated Steel Sheet: ASTM A 792/A 792M, AZ50 coated.
   1. Exposed Coil-Coated Finish: Prepainted by the coil-coating process to comply with ASTM A 755/A 755M. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and

resin manufacturers' written instructions.
a. Two-Coat Fluoropolymer Finish: AAMA 621. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight.
2. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester-backer finish consisting of prime coat and wash coat, with a minimum total dry film thickness of 0.5 mil.

B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.
C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.
D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.
E. Galvanized-Steel Tube: ASTM A 500, round tube, hot-dip galvanized according to ASTM A 123/A 123M.
F. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
B. Glass-Fiber Board Insulation: ASTM C 726, thickness as indicated.
C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick. Provide fire retardent treated where required by code.
D. Underlayment:
1. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated.
E. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide non-removable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:
1. Fasteners for Zinc-Coated or Aluminum-Zinc Alloy-Coated Steel: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.
2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Copper Sheet: Copper, hardware bronze, or passivated Series 300 stainless steel.
4. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
F. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

2.3 EQUIPMENT SUPPORTS

A. Equipment Supports: Internally reinforced metal equipment supports capable of supporting superimposed live and dead loads, including equipment loads and other construction indicated on Drawings; with welded or mechanically fastened and sealed corner joints, integral metal cant, and integrally formed deck-mounting flange at perimeter bottom.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Curbs Plus, Inc.
b. Custom Solution Roof and Metal Products.
c. Pate Company (The).
d. Thybar Corporation.
B. Size: Coordinate dimensions with roughing-in information or Shop Drawings of equipment to be supported.
C. Material: 0.050 inch thick aluminum.
1. Finish: Two-coat fluoropolymer.
2. Color: As selected by Architect from manufacturer's full range.
D. Construction:
1. Insulation: Factory insulated with 1-1/2-inch- thick glass-fiber board insulation.
2. Liner: Same material as equipment support, of manufacturer's standard thickness and finish.
3. Factory-installed continuous wood nailers 3-1/2 inches wide at tops of equipment supports.
4. Metal Counterflashing: Manufacturer's standard, removable, fabricated of same metal and finish as equipment support.
5. Fabricate equipment supports to minimum height of 12 inches unless otherwise indicated.
6. Security Grille: Provide where indicated.

2.4 ROOF HATCH

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter

gasketing, stepped integral metal cant raised the thickness of roof insulation, and integrally formed deck-mounting flange at perimeter bottom.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Babcock-Davis.
   b. Bilco Company (The).
   c. J. L. Industries, Inc.
   d. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
   e. Nystrom.
   f. O'Keeffe's Inc.

B. Type and Size: Single leaf, 30 by 36 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: 0.090 inch thick aluminum.
   1. Finish: Mill finish.
   2. Color: As selected by Architect from manufacturer's full range.

E. Construction:
   1. Insulation: Glass-fiber board.
   2. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
   3. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
   4. Fabricate curbs to minimum height of 12 inches above roof surface unless otherwise indicated.
   5. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

F. Hardware: Stainless steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
   1. Provide two-point latch on lids larger than 84 inches.

G. Guardrail System: Roof hatch manufacturer’s standard guardrail device for attachment to hatch. Required for all roof hatches located within 10 feet of roof edge.
   1. Height: 42 inches above finished roof deck

H. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
   1. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
   2. Height: 42 inches above finished roof deck.
   3. Material: Aluminum.
   4. Post: 1-5/8-inch- diameter pipe.
   5. Finish: Manufacturer's standard baked enamel or powder coat.
      a. Color: As selected by Architect from manufacturer's full ranger.

2.5 PIPE SUPPORTS

A. Pipe Supports:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Portable Pipe Hangers Inc.
   2. Pipe Support Height: As indicated on Drawings.
   3. Roller Assembly: With stainless-steel roller and high density polypropylene base plate, sized for supported pipes.

2.6 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

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

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
   2. Anchor roof accessories securely in place so they are capable of resisting indicated loads.
   3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
   4. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slipsheet, or install a course of polyethylene sheet.

C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

D. Roof-Hatch Installation:
   1. Install roof hatch so top surface of hatch curb is level.
   2. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.
   3. Attach ladder-assist post according to manufacturer's written instructions.

E. Pipe Support Installation: Install pipe supports so top surfaces are in contact with and provide equally distributed support along length of supported item.

F. Seal joints with elastomeric sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing according to ASTM A 780.

B. Touch up factory-primed surfaces with compatible primer ready for field painting according to Division 09 painting Sections.

C. Clean exposed surfaces according to manufacturer's written instructions.

D. Clean off excess sealants.

E. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 078123

INTUMESCENT FIREPROOFING

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 mastic and intumescent fire-resistive coatings (MIFRC).

B. Related Requirements:

1. Section 078100 "Applied Fireproofing" for sprayed fire-resistive materials (SFRM).
2. Section 099646 "Intumescent Painting" for intumescent paints that are fire retarding, but not fire resistive.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Structural framing plans indicating the following:

1. Extent of fireproofing for each construction and fire-resistance rating.
2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
4. Treatment of fireproofing after application.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard dimensions in size.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of fireproofing.

B. Evaluation Reports: For fireproofing, from ICC-ES.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 50 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.

B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.

B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 Insert testing requirement by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Steel members are to be considered unrestrained unless specifically noted otherwise.

D. Asbestos: Provide products containing no detectable asbestos.

2.2 MASTIC AND INTUMESCENT FIRE-RESISTIVE COATINGS

A. MIFRC: Manufacturer's standard, factory-mixed formulation or factory-mixed, multicomponent system consisting of intumescent base coat and topcoat, and complying with indicated fire-resistance design.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Carboline Company, subsidiary of RPM International, Fireproofing Products Div.; AD Firefilm III for interior applications and Nullifire S605 for exterior applications.
      b. Comparable products by Albi Manufacturer, International Paint, Isolatch.
   2. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design.
   3. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 50 or less.
   4. Finish: Spray-textured finish.
      a. Color and Gloss: As selected by Architect from manufacturer's full range.
   5. Note: Exterior application requires top coat as recommended by manufacturer for application intended.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
C. Reinforcing Fabric: Glass- or carbon-fiber fabric of type, weight, and form required to comply with fire-resistance designs indicated; approved and provided by fireproofing manufacturer.
D. Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with fire-resistance design indicated; approved and provided by fireproofing manufacturer. Include pins and attachment.
E. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
   1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
   2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
   3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
B. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
B. Clean substrates of substances that could impair bond of fireproofing.
C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

3.3 APPLICATION

A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, topcoats, finishing, and other materials and procedures affecting fireproofing work.

B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
   1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
   2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.

D. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.

E. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.

F. Extend fireproofing in full thickness over entire area of each substrate to be protected.

G. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.

H. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.

I. Cure fireproofing according to fireproofing manufacturer's written recommendations.

J. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.

K. Finishes: Where indicated, apply fireproofing to produce the following finishes:
   1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
   2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
   3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
   4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.

3.4 FIELD QUALITY CONTROL

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
   1. Test and inspect as required by the IBC, 1704.11.

B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.

C. Fireproofing will be considered defective if it does not pass tests and inspections.
   1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
   2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.

D. Prepare test and inspection reports.

3.5 CLEANING, PROTECTING, AND REPAIRING

A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.

C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.

D. Repair fireproofing damaged by other work before concealing it with other construction.

E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION

SECTION 078413 - PENETRATION FIRESTOPPING

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. Penetrations in fire-resistance-rated walls.
   2. Penetrations in horizontal assemblies.
   3. Penetrations in smoke barriers.

B. Related Sections:
   1. Section 078446 "Fire-Resistive Joint Systems" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Product Data for Credit IEQ 4.1: For penetration firestopping sealants and sealant primers, documentation including printed statement of VOC content.

B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
   1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
   1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
      a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
      b. Classification markings on penetration firestopping correspond to designations listed by the following:
         1) UL in its "Fire Resistance Directory."

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.

C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grace Construction Products.
   2. Hilti, Inc.
   3. RectorSeal Corporation.
   4. Specified Technologies Inc.
   5. 3M Fire Protection Products.
   6. USG Corporation.

2.2 PENETRATION FIRESTOPPING

A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Fire-resistance-rated walls include fire walls fire-barrier walls smoke-barrier walls and fire partitions.
   2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
   1. Horizontal assemblies include floors floor/ceiling assemblies and ceiling membranes of roof/ceiling assemblies.
   2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
   3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Penetrations in Smoke Barriers: Provide penetration firestopping with ratings determined per UL 1479.
   1. L-Rating: Not exceeding 5.0 cfm/sq. ft. of penetration opening at 0.30-inch wg at both ambient and elevated temperatures.

E. W-Rating: Provide penetration firestopping showing no evidence of water leakage when tested according to UL 1479.

F. Exposed Penetration Firestopping: Provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

G. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
   1. Permanent forming/damming/backing materials, including the following:
      a. Slag-wool-fiber or rock-wool-fiber insulation.
      b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
      c. Fire-rated form board.
      d. Fillers for sealants.
   2. Temporary forming materials.
   3. Substrate primers.
   4. Collars.
   5. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

I. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces, and nonsag formulation for openings in vertical and sloped surfaces, unless indicated firestopping limits use of nonsag grade for both opening conditions.

2.4 MIXING

A. For those products requiring mixing before application, comply with penetration firestopping manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent penetration firestopping from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing firestopping's seal with substrates.

3.3 INSTALLATION

A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
   1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.

C. Install fill materials for firestopping by proven techniques to produce the following results:
   1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
   2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
   3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION (do not install where visible from apparatus bays)

A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
   1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Manufacturer's name.
   6. Installer's name.

3.5 FIELD QUALITY CONTROL

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

B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.

C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Firestop Systems with No Penetrating Items (FS-1): Comply with the following:
   1. Pipes, plastic or metal, conduit in vertical runs, installed through cast-in-place firestop devices.
      a. Acceptable UL-Classified Systems with FA 1000 Series Systems equivalent to, but not limited to, the following:
         1) FA1016, FA1017, FA2053, FA2054 by Hilti.
         2) CP 680 Cast-in Firestop Device by Hilti.
         3) CP653 Speed Sleeve by Hilti.

C. Firestop Systems with No Penetrating Items (FS-2): Comply with the following:
   1. Acceptable UL-Classified Systems with CAJ 0000 Series Systems equivalent to, but not limited to, the following: CAJ0055, CAJ0070 by Hilti or CAJ0012, CAJ0102 by Grace.
   2. Type of Fill Materials: One or more of the following:

a. Latex sealant.
b. Silicone sealant.
c. Acrylic sealant.
d. Intumescent putty.
e. Mortar.
f. Preformed intumescent blocks.
g. Pillows/Bags

D. Firestop Systems for Metallic Pipes, Conduit, or Tubing (FS-3): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ, WL, or FC 1000 Series Systems, equivalent to, but not limited to, the following: CAJ1184, CAJ1291, CAJ1277, CAJ1382, CAJ1388, WL1054, WL1249, FC1009 by Hilti or CAJ1403, CAJ1235, CAJ1406, WL1152, WL1207, FC1020 by Grace.
2. Type of Fill Materials: One or more of the following:
a. Latex sealant.
b. Silicone sealant.
c. Acrylic sealant.
d. Intumescent putty.
e. Mortar.
f. Polyurethane firestop foam.

E. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing (FS-4): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ, FA, or WL 2000 Series Systems, equivalent to, but not limited to, the following: CAJ2109, FA2053, WL2078, WL2128 by Hilti or CAJ2212, CAJ2171, CAJ2210, WL2167, WL2185, WL2170, WL2259 by Grace.
2. Type of Fill Materials: One or more of the following:
a. Intumescent sealant.
b. Intumescent putty.
c. Intumescent wrap strips.
d. Firestop device.
e. Firestop sleeve device.
f. Latex sealant.

F. Firestop Systems for Electrical Cables (FS-5): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ, FC, or WL 3000 Series Systems, equivalent to, but not limited to, the following: CAJ3095, FC3012, WL3065, WL3112 by Hilti or CAJ3185, CAJ3199, CAJ3234, FC3018, FC3060, WL3179 by Grace.
2. Type of Fill Materials: One or more of the following:
a. Intumescent sealant.
b. Latex Sealant
c. Pillows/bags
d. Intumescent putty.
e. Silicone foam.

G. Firestop Systems for Cable Trays (FS-6): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ or WL 4000 Series Systems equivalent to, but not limited to, the following: CAJ4035, CAJ4054, WL4011, WL4034 by Hilti or CAJ4035, CBJ4023, WL4025, WL4030 by Grace.
2. Type of Fill Materials: One or more of the following:
a. Intumescent sealant.
b. Intumescent putty.
c. Silicone foam.
d. Pillows/bags.
e. Foam blocks.
f. Firestop mortar.
g. Polyurethane firestop foam.

H. Firestop Systems for Insulated Pipes (FS-7): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ or WL 5000 Series Systems, equivalent to, but not limited to, the following: CAJ5091, WL5029 by Hilti or CAJ5222, WL5171 by Grace.
2. Type of Fill Materials: One or more of the following:
a. Intumescent sealant.
b. Silicone foam.
c. Intumescent wrap strips.
d. Pre-formed intumescent blocks.
e. Latex sealant.

I. Firestop Systems for Miscellaneous Electrical Penetrants (FS-8): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ 6000 Series Systems equivalent to, but not limited to, the following: CAJ6006, CAJ 6017 by Hilti or CAJ6012, CAJ6013, CAJ6027 by Grace.

2. Type of Fill Materials: One or more of the following:
    a. Intumescent sealant.
    b. Latex sealant
    c. Intumescent putty.
    d. Mortar.

J. Firestop Systems for Miscellaneous Mechanical Penetrations (FS-9): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ 7000 Series Systems equivalent to, but not limited to, the following: CAJ7046, CAJ7051, CAJ7040, CAJ7021 by Hilti or CAJ7067, CAJ7075, CAJ7082 by Grace.
2. Type of Fill Materials: One or both of the following:
    a. Intumescent sealant.
    b. Latex sealant.
    c. Mortar.
    d. Acrylic sealant.
    e. Silicone sealant.

K. Firestop Systems for Groupings of Penetrations (FS-10): Comply with the following:
1. Acceptable UL-Classified Systems with CAJ or WL 8000 Series Systems, equivalent to, but not limited to, the following: CAJ8056, CAJ8096, WJ8007, WL8014, WL8019 by Hilti or CAJ8042, CAJ8101, CAJ8133, WL8007 by Grace.
2. Type of Fill Materials: One or more of the following:
    a. Latex sealant.
    b. Mortar.
    c. Intumescent wrap strips.
    d. Firestop device.
    e. Intumescent composite sheet.
    f. Pre-formed intumescent blocks.

END OF SECTION

SECTION 078446 - FIRE-RESISTIVE JOINT SYSTEMS

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. Joints in or between fire-resistance-rated constructions.
   2. Joints at exterior curtain-wall/floor intersections.
   3. Joints in smoke barriers.

1.3 ACTION SUBMITTALS

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

B. Sustainability Submittals:
   1. Product Data for Credit IEQ 4.1: For fire-resistive joint system sealants, documentation including printed statement of VOC content.

C. Product Schedule: For each fire-resistive joint system. Include location and design designation of qualified testing agency.
   1. Where Project conditions require modification to a qualified testing agency's illustration for a particular fire-resistive joint system condition, submit illustration, with modifications marked, approved by fire-resistive joint system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: From Installer indicating fire-resistive joint systems have been installed in compliance with requirements and manufacturer's written recommendations.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for fire-resistive joint systems.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with UL's "Qualified Firestop Contractor Program Requirements."

B. Installer Qualifications: A firm experienced in installing fire-resistive joint systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its fire-resistive joint system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

C. Fire-Test-Response Characteristics: Fire-resistive joint systems shall comply with the following requirements:
   1. Fire-resistive joint system tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.
   2. Fire-resistive joint systems are identical to those tested per testing standard referenced in "Fire-Resistive Joint Systems" Article. Provide rated systems complying with the following requirements:
      a. Fire-resistive joint system products bear classification marking of qualified testing agency.
      b. Fire-resistive joint systems correspond to those indicated by reference to designations listed by the following:
         1) UL in its "Fire Resistance Directory."

D. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Install and cure fire-resistive joint systems per manufacturer's written instructions using natural means of ventilation or, where this is inadequate, forced-air circulation.

1.7 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.
B. Coordinate sizing of joints to accommodate fire-resistive joint systems.
C. Notify Owner's testing agency at least seven days in advance of fire-resistive joint system installations; confirm dates and times on day preceding each series of installations.

PART 2 - PRODUCTS

2.1 FIRE-RESISTIVE JOINT SYSTEMS

A. Where required, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assemblies in or between which fire-resistive joint systems are installed. Fire-resistive joint systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.
B. Joints in or between Fire-Resistance-Rated Construction: Provide fire-resistive joint systems with ratings determined per ASTM E 1966 or UL 2079:
    1. Joints include those installed in or between fire-resistance-rated walls floor or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
    2. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of construction they will join.
    3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Grace Construction Products.
        b. Hilti, Inc.
        c. RectorSeal Corporation.
        d. Specified Technologies Inc.
        e. 3M Fire Protection Products.
        f. USG Corporation.
C. Joints at Exterior Curtain-Wall/Floor Intersections: Provide fire-resistive joint systems with rating determined by ASTM E 119 based on testing at a positive pressure differential of 0.01-inch wg or ASTM E 2307.
    1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the floor assembly.
    2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Grace Construction Products.
        b. Hilti, Inc.
        c. RectorSeal Corporation.
        d. Specified Technologies Inc.
        e. 3M Fire Protection Products.
        f. USG Corporation.
        g. .
D. Joints in Smoke Barriers: Provide fire-resistive joint systems with ratings determined per UL 2079.
    1. L-Rating: Not exceeding 5.0 cfm/ft of joint at 0.30 inch wg at both ambient and elevated temperatures.
    2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        a. Grace Construction Products.
        b. Hilti, Inc.
        c. RectorSeal Corporation.
        d. Specified Technologies Inc.
        e. 3M Fire Protection Products.
        f. USG Corporation.
E. Accessories: Provide components of fire-resistive joint systems, including primers and forming materials, that are needed to install fill materials and to maintain ratings required. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing agency for systems indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of the Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove stains. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify fire-resistive joint systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels will be visible to anyone seeking to remove or penetrate joint system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Fire-Resistive Joint System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

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

B. Where deficiencies are found or fire-resistive joint systems are damaged or removed due to testing, repair or replace fire-resistive joint systems so they comply with requirements.

C. Proceed with enclosing fire-resistive joint systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTING

A. Clean off excess fill materials adjacent to joints as the Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which joints occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

3.7 FIRE-RESISTIVE JOINT SYSTEM SCHEDULE

A. Floor-to-Floor, Fire-Resistive Joint System (FRJS-1):
   1. Acceptable UL-Classified Products:
      a. FFD1011, FFD1012, FFD1013, FFD1026 by Hilti.
      b. FFD1024 & FFD1027 – Grace Flamesafe.
   2. Assembly Rating: Refer to Drawings.
   3. Nominal Joint Width: As indicated.
   4. Movement Capabilities: Class II; refer to Drawings.

B. Floor-to-Wall, Fire-Resistive Joint System (FRJS-2):
   1. Acceptable UL-Classified Products:
      a. FWD1011, FWD1012, FWD1013, FWD1021 by Hilti.
      b. FWD1020 & FWD1024 – Grace Flamesafe.
   2. Assembly Rating: Refer to Drawings.
   3. Nominal Joint Width: As indicated.
   4. Movement Capabilities: Class II; refer to Drawings.

C. Head-of-Wall, Fire-Resistive Joint System (FRJS-3):
   1. Acceptable UL-Classified Products:
      a. HWD0042, HWD0045, HWD0046, HWD0097, HWD0098 by Hilti.
      b. HWD0107, HWD0146, HWD0144, HWD1047, HWD1021, HWD1024, HWD0148, HWD0149, HWD0150,HWD-0267,HWD-0299,HWD-257 & HWD-0300– Grace Flamesafe.
   2. Assembly Rating: Refer to Drawings.
   3. Nominal Joint Width: As indicated.
   4. Movement Capabilities: Class II; refer to Drawings.

D. Wall-to-Wall, Fire-Resistive Joint System (FRJS-4):
   1. Acceptable UL-Classified Products:
      a. WWD1011, WWD1012, WWD0017 by Hilti.
      b. WWD1028 & WWD1029 – Grace Flamesafe.
   2. Assembly Rating: Refer to Drawings.
   3. Nominal Joint Width: As indicated.
   4. Movement Capabilities: Class II; refer to Drawings.

3.8 PERIMETER FIRE-CONTAINMENT SYSTEMS

A. Where fire-rated floor assemblies are required, seal voids at intersection of exterior wall and floor assembly with an approved material per building code requirements.

B. Perimeter Fire Containment Systems are only valid if the certain wall construction details exactly match those called for in a selected UL/Omega Point-classified system. If the details do not match, submit an engineer judgement drawing from the firestop material manufacturer in accordance with the requirements of Part 1 of this Section.

C. Perimeter Fire-Containment System:
   1. Acceptable Omega Point-Classified Products:
      a. CEJ216P, CEJ244P, CEJ245P, CEJ246P, CEJ259P, CEJ260P, CEJ261P, CEJ262P, CEJ263P by Hilti.
      b. CEJ150P, CEJ151P, CEJ152P,CEJ153P, CEJ154P, CEJ-273P, CEJ-274P, CEJ-275P, CEJ-276P, CEJ-296P & CEJ-297P – Grace Flamesafe.
   2. Assembly Rating: Refer to Drawings.
   3. Nominal Joint Width: As indicated.
   4. Movement Capabilities: Class II; refer to Drawings.

END OF SECTION

SECTION 079200 - JOINT SEALANTS

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. Silicone joint sealants.
   2. Urethane joint sealants.
   3. Mildew-resistant joint sealants.
   4. Butyl joint sealants.
   5. Latex joint sealants.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.
B. Joint-Sealant Schedule: Include the following information:
   1. Joint-sealant application, joint location, and designation.
   2. Joint-sealant manufacturer and product name.
   3. Joint-sealant formulation.
   4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer
B. Field-Adhesion-Test Reports: For each sealant application tested.
C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
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.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
   3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with stone substrates.
   4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
   5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
   7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
B. 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.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. 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.
5. 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.
6. 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.

1.8 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.

1.9 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: Two 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: Five years from date of Substantial Completion.
C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
    1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
    2. Disintegration of joint substrates from causes exceeding design specifications.
    3. Mechanical damage caused by individuals, tools, or other outside agents.
    4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

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.
    1. Architectural sealants shall have a VOC content of 250 g/L or less.
    2. Sealants and sealant primers for nonporous substrates shall have a VOC content of 250 g/L or less.
    3. Sealants and sealant primers for nonporous substrates shall have a VOC content of 775 g/L or less.
B. Colors of Exposed Joint Sealants: Match adjacent substrates unless indicated otherwise.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: 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; 791.
        b. GE Construction Sealants; SCS2000 SilPruf.

c. Pecora Corporation; PCS.
d. Sika Corporation U.S.; [Sikasil WS-295] [Sikasil WS-295 FPS].

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

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; 795.
   b. GE Construction Sealants; SilPruf NB.
   c. Pecora Corporation; 864NST.
   d. Tremco Incorporated; Spectrem 2.

2.4 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 one of the following:
   a. BASF Construction Chemicals, LLC, Building Systems; Sonalastic TX1.
   b. Pecora Corporation; Dynatrol I-XL.
   c. Sherwin-Williams Company (The); .
   d. Sika Corporation U.S.; Sikaflex Textured Sealant.
   e. Tremco Incorporated; Dymonic.

B. Urethane, M, P, 25, T, NT: Multicomponent, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade P, Class 25, Uses T and NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Bostik, Inc.; Chem-Calk 555-SL.
   b. Pecora Corporation;
   c. Sherwin-Williams Company (The); Stampede-2SL.
   d. Tremco Incorporated; THC 900/901.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. 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.
   b. GE Construction Sealants; SCS1700 Sanitary.
   c. Tremco Incorporated; Tremsil 200.

2.6 BUTYL JOINT SEALANTS

A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Bostik, Inc.; Chem-Calk 300.
   b. Pecora Corporation; BC-158.

2.7 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.
   b. Pecora Corporation; AC-20.
   c. Sherwin-Williams Company (The); .
   d. Tremco Incorporated; Tremflex 834.

2.8 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.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide [product indicated on Drawings] <Insert manufacturer's name; product name or designation> or comparable product by one of the following:
    a. BASF Construction Chemicals, LLC, Building Systems.
    b. Construction Foam Products, a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C 1330, , and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. 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.

2.9 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.

B. 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.

C. 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.

B. 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.
2. 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.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.
3. Remove laitance and form-release agents from concrete.
4. 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.
    b. Glass.
    c. Porcelain enamel.
    d. 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.

C. 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.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. 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.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. 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.
   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.

F. 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.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
   4. Provide flush joint profile at locations indicated on Drawings according to Figure 8B in ASTM C 1193.
   5. 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.

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 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
      b. Perform one test for each 1000 feetof 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.
      b. Whether sealant dimensions and configurations comply with specified requirements.
      c. 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.
   5. 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 in horizontal traffic surfaces.
   1. Joint Locations:
      a. Isolation and contraction joints in cast-in-place concrete slabs.
      b. Joints between different materials listed above.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, pourable.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Locations:
      a. Construction joints in cast-in-place concrete.
      b. Joints between plant-precast architectural concrete units.
      c. Control and expansion joints in unit masonry.
      d. Joints in dimension stone cladding.
      e. Joints in exterior insulation and finish systems.
      f. Joints between different materials listed above.
      g. Perimeter joints between materials listed above and frames of doors windows andlouvers.
      h. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, non-sag.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
   1. Joint Locations:
      a. Isolation joints in cast-in-place concrete slabs.
      b. Control and expansion joints in stone flooring.
      c. Control and expansion joints in tile flooring.
      d. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, pourable.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. 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.
      b. Tile control and expansion joints.
      c. Vertical joints on exposed surfaces of unit masonry concrete walls.
      d. Other joints as indicated on Drawings.
   2. Joint Sealant: Urethane, non-sag.
   3. 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 not subject to significant movement.
   1. Joint Locations:
      a. Control joints on exposed interior surfaces of exterior walls.
      b. Perimeter joints between interior wall surfaces and frames of interior doors and elevator entrances.
      c. Other joints as indicated on Drawings.
   2. Joint Sealant: Latex.
   3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

F. 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.
      b. Tile control and expansion joints where indicated.

c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

G. Joint-Sealant Application: Concealed mastics.

1. Joint Locations:

a. Aluminum thresholds.

b. Sill plates.

c. Other joints as indicated on Drawings.

2. Joint Sealant: Butyl.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION

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DOCUMENT 081113 - HOLLOW METAL 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 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Glazing" for glass view panels in hollow metal doors.
3. Division 08 Section "Door Hardware".
4. Division 09 Sections "Exterior Painting" and "Interior Painting" for field painting hollow metal doors and frames.

C. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
10. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
11. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
13. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
14. FEMA P-361 2015 – Design and Construction Guidance for Community Safe Rooms.
15. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
16. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
17. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.

    a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Severe Storm Shelter Openings: Provide complete door systems for hurricane or tornado storm shelters, and other areas of refuge, complying and tested according to FEMA P-361, Third Edition (2015), Design and Construction Guidance for Community Safe Rooms; and ICC 500 (2014), ICC/NSSA Standard for the Design and Construction of Storm Shelters.

1. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

F. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).
3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard vertical steel-stiffener core. Minimum 22 gauge steel-stiffeners at 6 inches on-center construction attached by spot welds spaced not more than 5" on centers. Spaces between stiffeners filled with fiberglass insulation (minimum density 0.8#/cubic ft.).

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 1.
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.

7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:

1. CECO Door Products (C) Steel-Stiffened - Medallion Series.
2. Curries Company (CU) - Steel-Stiffened - 747 Series.

2.4 HOLLOW METAL DOORS FOR SEVERE STORM SHELTERS

A. General: Provide complete tornado or hurricane resistant door and frame shelter assemblies constructed to resist the design wind pressures for components and cladding and missile impact loads as described in ICC 500 - 2014, ICC/NSSA Standard for the Design and Construction of Storm Shelters. Only single opening and paired opening doors and their frames constructed to resist calculated design wind pressures and laboratory tested missile impacts are acceptable.

1. Door systems, both single doors and paired openings, tested and complying with ICC 500 - 2014 and FEMA P-361 (2015), Design and Construction Guidance for Community Safe Rooms and supported by third party test results.
2. Sheets fabricated on exterior openings from commercial quality hot dipped zinc coated steel complying with ASTM A924 A60. Gauges to be in accordance with manufacturers tested assemblies.
3. Vertical Edges: Vertical edges to have the face sheets joined by a continuous weld extending the full height of the door. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
4. Top Edge: Reinforce top of doors with a continuous steel channel extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached and welded in place with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".

B. Manufacturers Basis of Design:

1. CECO Door Products (C) - StormPro Series.
2. Curries Company (CU) - StormPro Series.

2.5 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Manufacturers Basis of Design:

a. CECO Door Products (C) – SR Series.
b. Curries Company (CU) – CM Series.

C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Manufacturers Basis of Design:

a. CECO Door Products (C) - BQ BU Series.
b. Curries Company (CU) - CM Series.

D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.6 FRAMES FOR SEVERE STORM SHELTERS

A. General: Subject to the same compliance standards and requirements as standard hollow metal frames, provide complete tornado or hurricane resistant door and frame assemblies, for both single doors and paired openings, tested and labeled as complying with ICC 500 - 2014 and FEMA P-361 (2015) and supported by third party test results.

1. Fabricate exterior frames from 14 gauge hot dipped zinc coated steel that complying with ASTM designations A924 A60.
2. Manufacturers Basis of Design:

    a. CECO Door Products (C) - StormPro Series.
    b. Curries Company (CU) - StormPro Series.

2.7 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.

1. Manufacturers: Subject to compliance with requirements, provide door manufacturers standard louver to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

2.9 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator's shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.10 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.11 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
4. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

    c. Severe Storm Shelter Openings: Provide jamb, head, and sill anchors in accordance with manufacturer's tested and approved assemblies.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.12 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

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.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

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

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

DOCUMENT 081423.16 - PLASTIC LAMINATE FACED WOOD DOORS

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. Solid core doors with high pressure decorative laminate faces.
2. Solid core moisture resistant doors with high pressure decorative laminate faces.
3. Factory fitting wood doors to frames and factory machining for hardware.
4. Louvers installed in flush wood doors.
5. Light frames and glazing installed in wood doors.

B. Related Sections:

1. Division 08 Section "Hollow Metal Doors and Frames" for wood doors in steel frames.
2. Division 08 Section "Glazing" for glass view panels in wood doors.
3. Division 08 Section "Door Hardware" for door hardware for flush wood doors and wood frames.
4. Division 08 Section "Access Control Hardware" for electromechanical hardware for flush wood doors and wood frames.

C. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A208.1 – Wood Particleboard.
2. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
3. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
6.
7. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush 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.1-A or AWS classifications. Include factory finishing specifications.

B. Shop Drawings shall include:

1. Indicate location, size, and hand of each door.
2. Indicate dimensions and locations of mortises and holes for hardware.
3. Indicate dimensions and locations of cutouts.
4. Indicate requirements for veneer matching.
5. Indicate location and extent of hardware blocking.
6. Indicate construction details not covered in Product Data.
7. Indicate doors to be factory finished and finish requirements.
8. Indicate fire protection ratings for fire rated 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.

B. Package pre-finished doors individually in plastic bags and wrap bundles of doors in plastic sheeting.

C. 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 weather tight, 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.

1.6 WARRANTY

A. Warranty: Manufacturer's standard form 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.
b. Telegraphing of core construction and delaminating of face.

2. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION – GENERAL

A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Custom.

B. Fire Rated Doors: Provide construction and core as needed to provide fire ratings indicated.

1. Category A Edge Construction: Provide fire rated door edge construction with intumescent seals concealed by outer stile (Category A) at 45, 60, and 90 minute rated doors. Comply with specified requirements for exposed edges.

2. Pairs: Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

a. Where required or specified, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

2.2 CORE CONSTRUCTION

A. Particleboard Core Doors:

1. Particleboard: Wood fiber based materials complying with ANSI A208.1 Particleboard standard. Grade LD-2.

2. Adhesive: Fully bonded construction using Polyurethane (PUR) glue.

3. Blocking: As indicated under article “Blocking”.

2.3 PLASTIC LAMINATE FACED WOOD DOORS

A. Manufacturers (Standard Doors): Subject to compliance with requirements, provide products by one of the following:

1. ASSA ABLOY Wood Doors (GR): GPD

B. Interior Solid Core Doors:

1. Faces: Plastic laminate faces as noted below.

2. Vertical Edges: Matching laminate. Edges applied before faces.

3. Horizontal Edges: Solid wood or structural composite material meeting the minimum requirements per WDMA section P-1, Performance Standards for Architectural Wood Flush Doors.

2.4 LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish.

2.5 LIGHT FRAMES AND GLAZING

A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:

1. Wood Species: Same species as door faces.
2. Profile:
   a. M1 Flush Bead.
   b. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire Rated Doors over 20-minute Rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.

1. Manufacturers:

   a. Air Louver (LV).
   b. All Metal Stamping (AP).

c. Anemostat (AN).
d. Pemko (PE).

C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.6 FABRICATION

A. Factory 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.
2. 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.

D. Openings: Cut and trim openings through doors in factory.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
3. Louvers: Factory install louvers in prepared openings.

E. Electrical Raceways: Provide flush wood doors receiving electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through wire transfer hardware or wiring harness specified in hardware sets in Division 08 "Door Hardware". Wire nut connections are not acceptable.

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.
2. 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."

B. 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.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

D. Field modifications to doors shall not be permitted, except those specifically allowed by manufacturer or fire rating requirements.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Finished Doors: 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 DOCUMENT

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SECTION 083513 - PANEL FOLDING DOORS

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 Four-Fold metal doors with surface mounted tube frames.
- B. Operation of Four-Fold metal doors includes overhead mounted electro-mechanical operators.

1.3 SUBMITTALS
- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each type of product specified consisting of manufacturer's technical Product Data and installation instructions for each type of door required, including data substantiating that products comply with requirements.
- C. Submittal Drawings showing fabrication and installation of Four-Fold metal doors including plans, elevations, sections, details of components, hardware, operating mechanism, and attachments to the other units of Work. Include wiring diagrams for coordination with electrical trade.
- D. Reference list including (5) successful installations of this type of door within the past two (2) years.

1.4 QUALITY ASSURANCE
- A. Doors shall be designed to withstand design wind loads as indicated on structural drawings or as otherwise determined using loads applicable to project from basic wind speed indicated in miles per hour according to ASCE. The maximum allowable deflection shall not exceed 1/120 of the span. Fiber stresses in main members shall be limited to 27,000 pounds per square inch. Steel frames shall be designed in accordance with the AISC "Steel Construction Manual".
- B. Door manufacturer shall have at least 10 years experience in manufacturing door type specified for emergency vehicle applications.

1.5 DELIVERY, STORAGE AND HANDLING
- A. Store delivered materials and equipment in dry locations with adequate ventilation, free from dust and water, and so as to permit access for inspection and handling.
- B. Handle materials carefully to prevent damage.

1.6 WARRANTY
- A. The door manufacturer shall provide a written standard limited warranty for material and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
- A. Manufacturers: Four-Fold industrial metal doors manufactured by Door Engineering and Manufacturing, 400 Cherry Street, Kasota, MN 56050, (800)-959-1352 or equal products by other manufacturers approved in advance.
- B. Acceptable Product: FF300 Series: Glazed, with foamed in place insulation.

2.2 MATERIALS
- A. Steel Tube: ASTM A513 and ASTM A500/A500M
- B. Steel Sheets: Steel sheets of commercial quality, complying with ASTM A1011/A1011M hot-rolled steel sheet.
- C. Hardware: Manufacturer's standard components.
- D. Fasteners: Zinc-coated steel.

2.3 FOUR-FOLD DOORS
- A. Construction: Door framing shall be minimum 14-gauge structural steel tube with 14-gauge steel sheet on the exterior and interior faces. Sheeting shall be formed on the vertical edges with no visible welds on the interior or exterior panel faces. All frames and framing members shall be true to dimension and square in all directions, and no door shall be bowed, warped, or out of line, in the vertical or horizontal

plane of the door opening by more than 1/8 inch in 20 feet. Exposed welds and welds which interfere with the installation of various parts shall be ground smooth and flush.

B. Surface Mounted Tube Frame: Supply pre-hung tube frame system constructed of minimum TS6x4x0.25, designed to anchor to masonry wall construction or weld to steel structure. All hinges, track supports and operator supports shall be factory attached.

C. Factory finish: All exposed steel shall be finished with manufacturer's standard epoxy primer and polyurethane top coat; color as selected by Architect from manufacturer's full available range.

D. Operating Hardware: Hardware shall include guide tracks and brackets, trolleys, center guides, not less than three pairs of jamb and fold hinges per opening, and all bolts, nuts, fasteners, etc. necessary for complete installation and operation. Jamb hinges shall be dual shear and have two thrust bearings and two needle bearings. Fold hinges shall be dual shear with two thrust bearings. All bearings shall be completely concealed within the hinge barrel and include grease zerks. All hinge pins shall be minimum ¾" diameter hardened steel.

E. Weatherstripping: Material shall be adjustable and readily replaceable and provide a substantially weather-tight installation. Weatherstripping at center shall be 1/16" cloth inserted neoprene and include no exposed fasteners on the exterior face of the panel. Weatherstripping at sill shall include two 1/16" cloth inserted neoprene sweeps with an aluminum retainer. The retainer shall be attached to the door with adhesive.

F. Perimeter Weatherstripping: Provide jamb and head weatherstipping of 1/16" cloth-inserted neoprene bulb (or closed cell neoprene).

G. Vision Panels: Provide 1" insulated vision panels of the size, shape and location as indicated in Section 008000.

2.4 OPERATOR

A. Each Four-Fold door shall be operated by an overhead mounted electro-mechanical drive unit designed for high cycle operation. Operator consists of an electric motor, gear reducer, and rotating drive arm. The door shall be operated with connecting rods attached to the rotating drive arm on the operator and to control arms attached to the jamb door section and to the door lintel. The connecting rods shall be positive drive, keeping the door under firm control at all times. The connecting rods shall be fitted with spherical bearings and control arms shall be equipped with oil impregnated bronze bearings on polished shafts.

B. Operator shall be instantly reversible, open and close rapidly and start and stop gradually. Operator shall be adjustable to allow door to fully clear the opening. Operator shall automatically lock the door in the closed position. Operator shall be equipped with disengaging mechanism to convert to free wheeling mode for manual operation.

C. Operator shall include a formed hood enclosing the motor, gearboxes and limit switches.

D. Electric motor shall be of sufficient size to operate doors under normal operating conditions at no more than 75 percent of rated capacity. The motor shall be wound for phase and voltage as provided on the electrical drawings.

E. Electric Controls: Controls shall be furnished by the door manufacturer and shall be complete for each door, and built in accordance with the latest NEMA standards. Incoming electrical shall be 120VAC single phase.

1. Controls shall include a programmable logic controller with digital message display or LED indicators. Controller shall include programmable close timers and programmable inputs/outputs.
2. Motor starters shall be magnetic reversing, factory wired with overload and under voltage protection, and equipped with mechanical interlocks. All control components shall be enclosed in one enclosure with a wiring diagram placed on the inside of the cover.
3. If incoming voltage is single phase, control panel shall include a variable frequency drive to convert voltage to 3-phase for the motor
4. Enclosures shall be NEMA 4 with disconnect switch.
5. Pushbuttons (interior) for each door shall have one (1) momentary pressure three-button push-button station marked "OPEN", "CLOSE" and "STOP". Push button enclosure shall be NEMA 4. Provide master doors control stations in Watch 103 and Vehicle Bay 140. Provide in custom back box (24 x 15-5/6 x 3-5/8 inch deep) with stainless steel face plate.
6. Provide external antenna for operation by remote control.
7. Limit switches shall be provided to stop the travel of the door in its fully open or fully closed position.
8. Safety edges: Provide electric safety edges on leading edge of all doors to reverse door upon contact with obstruction.
9. Motion, Sensor, and Safety Sensor: Provide (1) interior, overhead mounted, presence sensor.
   a. Basis-of-Design Product: BEA, Inc.; LZR-Widescan.
      i. Activation: Laser field.

ii. Modes: Detection and presence.
iii. Detection Field: 1.2 time mounting height for width and depth.
iv. Minimum Object Size: 6 inches, at 19.5 feet in proportion to object distance.
v. Emission Characteristics:
1. IR Laser: Wavelength 905 nm; maximum output pulse power 75 W, Class 1.
2. Visible Laser: Wavelength 650 nm; maximum output CW power 3 mW, Class 3R.
vi. Response Time: 100 ms typ., 500 ms max.
vii. Exposure Rating: NEMA 4/IP65

b. Radio controls: Provide one (1) radio receiver and (1) single button remotes per door. Remotes to open and close doors with single button.
c. Wiring: Door manufacturer shall supply controls and components only. Electrical contractor shall install controls and furnish and install conduits and wiring for jobsite power and control wiring.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Four-Fold metal doors in strict accordance with the approved drawings by qualified door erection crews. All door openings shall be completely prepared by the general contractor prior to the installation of the doors. Permanent or temporary electric wiring shall be brought to the door opening before installation is started and shall be completed so as not to delay the inspection test.
B. Doors shall be set plumb, level, and square, and with all parts properly fastened and mounted. All moving parts shall be tested and adjusted and left in good operating condition.

3.2 ADJUSTING AND CLEANING

A. Inspection of the doors and a complete operating test will be made by the installer in the presence of the general contractor or architect as soon as the erection is complete. Any defects noted shall be corrected. After door approval in the above test, the general contractor must assume the responsibility for any damage or rough handling of the doors during construction until the building is turned over to the owner and final inspection is made.
B. Clean surfaces and repaint abraded or damaged finished surfaces to match factory-applied finish.

END OF SECTION

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SECTION 083613 - SECTIONAL DOORS

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 electrically operated sectional doors.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Sectional doors shall meet performance requirements specified without failure due to defective manufacture, fabrication, installation, or other defects in construction and without requiring temporary installation of reinforcing components.

B. Structural Performance: Exterior sectional doors shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design Wind Loads: As indicated on structural drawings or as otherwise determined using design wind loads applicable to Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure."
2. Deflection Limits: Design sectional doors to withstand design wind loads without evidencing permanent deformation or disengagement of door components. Deflection of door in horizontal position (open) shall not exceed 1/120 of the door width.

C. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E 283.

1. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph.

D. Operation Cycles: Provide sectional door components and operators capable of operating for not less than number of cycles indicated for each door. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1.4 SUBMITTALS

A. Product Data: For each type and size of sectional door and accessory. Include the following:

1. Construction details, material descriptions, dimensions of individual components, profile door sections, and finishes.
2. Rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Maintenance Data: For sectional doors to include in maintenance manuals.

D. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Source Limitations: Obtain sectional doors from single source from single manufacturer.

1. Obtain operators and controls from sectional door manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Standard for Sectional Doors: Fabricate sectional doors to comply with DASMA 102 unless otherwise indicated.

E. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities".

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sectional doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.

b. Faulty operation of hardware.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use; rust through.
d. Delamination of exterior or interior facing materials.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 STEEL DOOR SECTIONS

A. Exterior Section Faces and Frames: Fabricate from zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653, with indicated zinc coating and thickness.
1. For insulated doors, provide sections with continuous thermal-break construction, separating the exterior and interior faces of door.

B. Section Ends and Intermediate Stiles: Enclose open ends of sections with channel end stiles formed from galvanized-steel sheet not less than 0.064-inch- nominal coated thickness and welded to door section. Provide intermediate stiles formed from not less than 0.064-inch- thick galvanized-steel sheet, cut to door section profile, and welded in place. Space stiles not more than 48 inches apart.

C. Reinforce bottom section with a continuous channel or angle conforming to bottom-section profile.

D. Reinforce sections with continuous horizontal and diagonal reinforcement, as required to stiffen door and for wind loading. Provide galvanized-steel bars, struts, trusses, or strip steel, formed to depth and bolted or welded in place. Ensure that reinforcement does not obstruct vision lites.

E. Provide reinforcement for hardware attachment.

F. Foamed-in-Place Thermal Insulation: Insulate interior of steel sections with door manufacturer's standard CFC-free polyurethane insulation, foamed in place to completely fill interior of section and pressure bonded to face sheets to prevent delamination under wind load, and with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within steel sections that incorporate the following interior facing material, with no exposed insulation:
1. Interior Facing Material: Zinc-coated (galvanized), cold-rolled, commercial steel (CS) sheet, complying with ASTM A 653, with indicated thickness.

G. Fabricate sections so finished door assembly is rigid and aligned, with tight hairline joints and free of warp, twist, and deformation.

2.2 TRACKS, SUPPORTS, AND ACCESSORIES

A. Tracks: Manufacturer's standard, galvanized-steel track system of configuration indicated, sized for door size and weight, designed for lift type indicated and clearances shown on Drawings, and complying with ASTM A 653 for minimum G60 zinc coating. Provide complete track assembly including brackets, bracing, and reinforcement for rigid support of ball-bearing roller guides for required door type and size. Slot vertical sections of track spaced 2 inches apart for door-drop safety device. Slope tracks at proper angle from vertical or design tracks to ensure tight closure at jambs when door unit is closed.

B. Track Reinforcement and Supports: Galvanized-steel track reinforcement and support members, complying with ASTM A 36 and ASTM A 123. Secure, reinforce, and support tracks as required for door size and weight to provide strength and rigidity without sag, sway, and vibration during opening and closing of doors.
1. Horizontal Track Assembly: Track with continuous reinforcing angle attached to track and supported at points from curve in track to end of track by laterally braced attachments to overhead structural members.

C. Weatherseals: Replaceable, adjustable, continuous, compressible weather-stripping gaskets of flexible vinyl, rubber, or neoprene fitted to bottom and top of sectional door unless otherwise indicated.

D. Windows: Manufacturer's standard window units of type and size indicated and in arrangement shown. Set glazing in vinyl, rubber, or neoprene glazing channel for metal-framed doors and elastic glazing compound for wood doors, as required. Provide removable stops of same material as door-section frames.

2.3 HARDWARE

A. General: Provide heavy-duty, corrosion-resistant hardware, with hot-dip galvanized, stainless-steel, or other corrosion-resistant fasteners, to suit door type.

B. Hinges: Heavy-duty, galvanized-steel hinges of not less than 0.079-inch- nominal coated thickness at each end stile and at each intermediate stile, according to manufacturer's written recommendations for door size. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners where access to nuts is not possible. Provide double-end hinges where required, for doors over 16 feet wide unless otherwise recommended by door manufacturer.

C. Rollers: Heavy-duty rollers with steel ball-bearings in case-hardened steel races, mounted with varying projections to suit slope of track. Extend roller shaft through both hinges where double hinges are required. Provide 3-inch- diameter roller tires for 3-inch- wide track.

D. Push/Pull Handles: For push-up or emergency-operated doors, provide galvanized-steel lifting handles on each side of door.

2.4 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb side, operable from inside only.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.5 COUNTERBALANCE MECHANISM

A. Torsion Spring: Counterbalance mechanism consisting of adjustable-tension torsion springs fabricated from steel-spring wire complying with ASTM A 229, mounted on torsion shaft made of steel tube or solid steel. Provide springs designed for number of operation cycles indicated.

B. Cable Drums and Shaft for Doors: Cast-aluminum or gray-iron casting cable drums mounted on torsion shaft and grooved to receive door-lifting cables as door is raised. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of torsion shaft. Provide one additional midpoint bracket for shafts up to 16 feet long and two additional brackets at one-third points to support shafts more than 16 feet long unless closer spacing is recommended by door manufacturer.

C. Cables: Galvanized-steel lifting cables with cable safety factor of at least 5 to 1.

D. Cable Safety Device: Include a spring-loaded steel or spring-loaded bronze cam mounted to bottom door roller assembly on each side and designed to automatically stop door if either lifting cable breaks.

E. Bracket: Provide anchor support bracket as required to connect stationary end of spring to the wall and to level the shaft and prevent sag.

F. Provide a spring bumper at each horizontal track to cushion door at end of opening operation.

2.6 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and "operation cycles" requirement specified, with electric motor and factory-pre-wired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking door, and accessories required for proper operation.
   1. Comply with NFPA 70.
   2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6; with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door-Operator Type: Unit consisting of electric motor, gears, pulleys, belts, sprockets, chains, and controls needed to operate door and meet required usage classification.
   1. Jackshaft, Center Mounted: Jackshaft operator mounted on the inside front wall above door and connected to torsion shaft with an adjustable coupling or drive chain.

D. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Division 26 unless otherwise indicated.
   1. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
   2. Motor Size: Minimum size large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
   3. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
   4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.
   5. Use adjustable motor-mounting bases for belt-driven operators.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Device: Equip motorized door with indicated external automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.
   1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.
      a. Self-Monitoring Type: Designed to interface with door operator control circuit to detect damage to or disconnection of sensor device. When self-monitoring feature is activated, door closes only with sustained pressure on close button.

G. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop."
   1. Interior units, full-guarded, flush-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.
   2. Exterior units, full-guarded, standard-duty, flush-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

I. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

J. Radio-Control System: Consisting of the following:
   1. Three-channel universal coaxial receiver to open, close, and stop door; two per operator.
   2. Multifunction remote control, 2 per door.
   3. Remote antenna and mounting kit.

2.7 DOOR ASSEMBLY

A. Steel Sectional Door: Sectional door formed with hinged sections, ship lapped design, and PVC thermal breaks.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Clopay Building Products; a Griffon company.
      b. Overhead Door Corporation.
      c. Raynor.

B. Operation Cycles: Not less than 100,000.

C. Installed R-Value: 17.0.

D. Steel Sections: Zinc-coated (galvanized) steel sheet with G90 zinc coating.
   1. Section Thickness: 2 inches.
      a. Surface: Flat.
   2. Insulation: Foamed in place.
   3. Interior Facing Material: Zinc-coated (galvanized) steel sheet of 0.022-inch- nominal coated thickness.

E. Track Configuration: High-lift.

F. Weatherseals: Fitted to bottom and top and around entire perimeter of door. Provide combination bottom weatherseal and sensor edge.

G. Exhaust Grilles: Provide in locations and size as indicated.

H. Windows: As indicated on Drawings; installed with insulated glazing of the following type:
   1. Insulating Glass: Manufacturer's standard.

I. Roller-Tire Material: Manufacturer's standard.

J. Locking Devices: Equip door with slide bolt for padlock.

K. Counterbalance Type: Torsion spring.

L. Electric Door Operator:
   1. Usage Classification: Standard duty, up to 60 cycles per hour. Provide with tamper proof counter.
   2. Operator Type: Jackshaft, center mounted.
   3. Motor Exposure: Interior, clean, and dry.
   4. Emergency Manual Operation: Push-up type.
   5. Obstruction-Detection Device: Automatic photoelectric sensor and pneumatic sensing edge ; self-monitoring type.
   6. Remote-Control Station: Interior.
   7. Other Equipment: Radio-control system.

M. Door Finish:
   1. Factory Prime Finish: Manufacturer's standard color.

2. Finish of Interior Facing Material: Match finish of exterior section face.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

A. Factory Prime Finish: Manufacturer's standard primer, compatible with field-applied finish. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

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

3.2 INSTALLATION

A. Install sectional doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Tracks:

1. Fasten vertical track assembly to opening jambs and framing, spaced not more than 24 inches apart.
2. Hang horizontal track assembly from structural overhead framing with angles or channel hangers attached to framing by welding or bolting, or both. Provide sway bracing, diagonal bracing, and reinforcement as required for rigid installation of track and door-operating equipment.
3. Repair galvanized coating on tracks according to ASTM A 780.

C. Accessibility: Install sectional doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

3.3 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust doors and seals to provide weathertight fit around entire perimeter.

D. Align and adjust motors, pulleys, belts, sprockets, chains, and controls according to manufacturer's written instructions.

E. Touch-up Painting: Immediately after welding galvanized materials, clean welds and abraded galvanized surfaces and repair galvanizing to comply with ASTM A 780.

END OF SECTION

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SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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. Exterior and interior storefront framing.
   2. Exterior and interior manual-swing entrance doors and door-frame units.
   3. Operable windows.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:
   1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
   2. Dimensional tolerances of building frame and other adjacent construction.
   3. Failure includes the following:
      a. Deflection exceeding specified limits.
      b. Thermal stresses transferring to building structure.
      c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
      d. Noise or vibration created by wind and by thermal and structural movements.
      e. Loosening or weakening of fasteners, attachments, and other components.
      f. Sealant failure.
      g. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:
   1. Design Wind Loads: As indicated on structural drawings or as otherwise determined using design wind loads applicable to Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure."

D. Deflection of Framing Members:
   1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft. .

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum

static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..
   1. Maximum Water Leakage: No uncontrolled water penetrating aluminum-framed systems or water appearing on systems' normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

I. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
   2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.
      a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
      b. Low Exterior Ambient-Air Temperature: 0 deg F.
   3. Interior Ambient-Air Temperature: 75 deg F.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Other Action Submittals:
   1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
   1. Detail fabrication and assembly of aluminum-framed systems.
   2. Include design calculations.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

C. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.
   1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

D. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration caused by thermal movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water leakage through fixed glazing and framing areas.
      e. Failure of operating components.
   2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      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 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kawneer North America; an Alcoa company.
   2. YKK AP America Inc.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Sheet and Plate: ASTM B 209.
   2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
   3. Extruded Structural Pipe and Tubes: ASTM B 429.
   4. Structural Profiles: ASTM B 308.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads. Framing and backer plate to be thermally broken.
   1. Construction: Screw spline.
   2. Glazing System: Retained mechanically with gaskets on four sides.
   3. Glazing Plane: Center.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads[, finished to match framing system] [, fabricated from stainless steel].

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123 or ASTM A 153.

E. Concealed Flashing: Manufacturer's standard corrosion-resistant, non-staining, non-bleeding flashing compatible with adjacent materials.

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."
B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.
C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ENTRANCE DOOR SYSTEMS
A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
2. Door Design: Wide stile; 5-inch nominal width, with 10 inch bottom rail.
3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
B. Entrance Door Hardware: As specified in Division 08 Section "Door Hardware."

2.6 ACCESSORY MATERIALS
A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."
1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.
C. Operable Windows: Oldcastle ZS operable vents or approved equal.

2.7 FABRICATION
A. Form or extrude aluminum shapes before finishing.
B. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from interior for vision glass and exterior for spandrel glazing or metal panels.
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
C. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.
D. Storefront Framing: Fabricate components for assembly using screw-spline system.
E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
1. At exterior doors, provide compression weather stripping at fixed stops.
2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.
F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
2. At exterior doors, provide weather sweeps applied to door bottoms.
G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES
A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.
1. Color: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and conditions, 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 INSTALLATION

A. General:
   1. Comply with manufacturer's written instructions.
   2. Do not install damaged components.
   3. Fit joints to produce hairline joints free of burrs and distortion.
   4. Rigidly secure non-movement joints.
   5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
   6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:
   1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
   2. Alignment:
      a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
      b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows and in successive phases as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.
   1. Water Spray Test: Before installation of interior finishes has begun, a minimum area of 75 feet by 1 story of aluminum-framed systems designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

END OF SECTION

SECTION 086250 - TUBULAR DAYLIGHTING DEVICE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Tubular daylighting device, consisting of roof dome, reflective tube, and diffuser assembly; configuration as indicated on the drawings.

1.2 PERFORMANCE REQUIREMENTS

A. Completed tubular daylighting device assemblies shall be capable of meeting the following performance requirements:
   1. Air Infiltration Test: Air infiltration will not exceed 0.30 cfm/sf aperture with a pressure delta of 1.57 psf across the tube when tested in accordance with ASTM E 283.
   2. Water Resistance Test: No uncontrolled water leakage at 10.5 psf pressure differential with water rate of 5 gallons/hour/sf when tested in accordance with ASTM E 547.
   3. Uniform Load Test:
      a. No breakage, permanent damage to fasteners, hardware parts, or damage to make system inoperable or cause excessive permanent deflection of any section when tested at a Positive Load of 150 psf or Negative Load of 60 psf in accordance with ICC AC-16 Section A, or Negative Load of 70 psf if tested per ICC AC-16 Section B.
      b. All units shall be tested with a safety factor of (3) for positive pressure and (2) for negative pressure, acting normal to plane of roof in accordance with ASTM E 330.

1.3 SUBMITTALS

A. Submit under provisions of Section 013300.
B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
C. Shop Drawings. Submit shop drawings showing layout, profiles and product components, including anchorage, flashings and accessories.
D. Verification Samples: As requested by Architect.
E. Test Reports: Independent testing agency or evaluation service reports verifying compliance with specified performance requirements.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engaged in manufacture of tubular daylighting devices for minimum 15 years.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.7 WARRANTY

A. Daylighting Device: Manufacturer's standard warranty for 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Solatube International, Inc., which is located at: 2210 Oak Ridge Way ; Vista, CA 92081; Toll Free Tel: 888-765-2882; Tel: 760-477-1120; Fax: 760-597-4488 ; Email: request info (commsales@solatube.com); Web: www.solatube.com
B. Requests for substitutions will be considered in accordance with provisions of Section 012500.

2.2 TUBULAR DAYLIGHTING DEVICES

A. Tubular Daylighting Devices General : Transparent roof-mounted skylight dome and self-flashing curb, reflective tube, and ceiling level diffuser assembly, transferring sunlight to interior spaces; complying with ICC AC-16.

B. SolaMaster Series: Solatube Model 750 DS-C Penetrating Ceiling, 21 inch (530 mm) Daylighting System:

1. Roof Dome Assembly: Transparent, UV and impact resistant dome with flashing base supporting dome and top of tube.
   a. Outer Dome Glazing: Type DA, 0.125 inch (3.2 mm) minimum thickness injection molded acrylic classified as CC2 material; UV inhibited, impact modified acrylic blend.
   b. Inner Dome Glazing: Type DAI, 0.,115 inch (3 mm) minimum thrikncess acrylic classified as CC2 material.
2. Roof Flashing Base: One piece, seamless, leak-proof flashing functioning as base support for dome and top of tube.
   a. Base Material: Sheet steel, corrosion resistant conforming to ASTM A 653/A 653M or ASTM A463/A 463M, 0.028 inch (0.7 mm) thick.
3. Flashing Insulator: Type FI, Thermal isolation material for use under flashing.
4. Tube Ring: Attached to top of base section; 0.090 inch (2.3 mm) nominal thickness injection molded high impact PVC; to prevent thermal bridging between base flashing and tubing and channel condensed moisture out of tubing.
5. Dome Seal: Adhesive backed weatherstrip 0.63 inch (16 mm) tall by 0.28 inch (7 mm).
6. Reflective Tubes: Aluminum sheet, thickness 0.018 inch (0.5 mm).
   a. General:
7. Interior Finish: Spectralight Infinity high reflectance specular finish on exposed reflective surface. Specular reflectance for visible spectrum (400 nm to 760 nm) greater than 99 percent. Total solar spectrum reflectance (400 nm to 2500 nm) less than 93 percent.
8. Color: a* and b* (defined by CIE L*a*b* color model) shall not exceed plus 2 or be less than minus 2 as determined in accordance to ASTM E 308.
   a. Top Tube Angle Adapter and Bottom Top Tube Angle Adapter Kit, Type AK:
9. Reflective 30 degree adjustable top and bottom angle adapters (one each), 16 inches (406 mm) long
   a. Extension Tube:
10. Reflective extension tube, Type EXX, Notched for Open Ceiling diffuser attachment, 24 inches (610 mm) long
11. Diffuser Assemblies for Tubes Penetrating Ceilings: Solatube Model 750 DS-C. Ceiling mounted box transitioning from round tube to square ceiling assembly, supporting light transmitting surface at bottom termination of tube; 23.8 inches by 23.8 inches (605 mm by 605 mm) square frame to fit standard suspended ceiling grids or hard ceilings.
    a. Round to square transition box made of opaque polymeric material, classified as CC2, Class C, 0.110 inch (2.8 mm) thick.
    b. Natural Effect Lens made of acrylic, classified as CC2, Class C, 0.060 inch (1.5 mm) thick, with open cell foam seal to minimize condensation and bug, dirt, and air-infiltration per ASTM E283.
    c. Lens: Type L1 OptiView Fresnel lens design to maximize light output and diffusion with extruded aluminum frame. Visible Light Transmission shall be greater than 90 percent at 0.022 inch (0.6 mm) thick. Classified as CC2.
12. Accessories:
    a. Local Dimmer Control: Provided with dimmer switch and cable.
       1) Daylight Dimmer: Type D Electro-mechanically actuated daylight valve; for universal input voltages ranging between 90 and 277 V at 50 or 60 Hz; maximum current draw of 50 ma per unit; controlled by low voltage, series Type T02: circuited, 4 conductor, size 22 cable; providing daylight output between 2 and 100 percent. Provided with dimmer switch and cable.
       2) Switch: Type SW, Manufacturer-specific low voltage DC DP/DT switch (white) required to operate Daylight Dimmer. Note: only one switch is required per set of synchronously
       3) controlled dimmers.
       4) Cable: Type CA, Two conductor low voltage cable (500 ft.) for multiple unit DC connection. Catalog Number: S750 DS-C-DA-FC-FI-AK-E
       5) Wire dimmer to lighting control system keypad.

2.3 ACCESSORIES

A. Fasteners: Same material as metals being fastened, non-magnetic steel, non-corrosive metal of type recommended by manufacturer, or injection molded nylon.

B. Suspension Wire: Steel, annealed, galvanized finish, size and type for application and ceiling system requirement.

C. Sealant: Polyurethane or copolymer based elastomeric sealant as provided or recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

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

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

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

B. After installation of first unit, field test to determine adequacy of installation. Conduct water test in presence of Owner, Architect, or Contractor, or their designated representative. Correct if needed before proceeding with installation of subsequent units.

3.4 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

DOCUMENT 087100 – DOOR HARDWARE

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 commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware; power supplies, battery back-ups, and surge protectors
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. FEMA P-361 2015 - Design and Construction Guidance for Community Safe Rooms.
3. ICC 500-2014, ICC/NSSA Standard for the Design and Construction of Storm Shelters.
4. ICC/IBC - International Building Code.
5. NFPA 70 - National Electrical Code.
6. NFPA 80 - Fire Doors and Windows.
7. NFPA 101 - Life Safety Code.
8. NFPA 105 - Installation of Smoke Door Assemblies.
9. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.
h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance. Installers trained by primary product manufacturers.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying. Responsible for door scheduling, hardware, and keying schedule.

D. Windstorm Assembly Installer Qualifications: Installers are to be factory trained for shop and field installation prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project. A pre-installation site inspection of the frame and floor conditions shall be conducted by the factory trained installer prior to any Windstorm assembly hardware applied to the opening.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

1. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

C. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Manufacturers:

a. Hager Companies (HA).
b. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
c. Stanley Hardware (ST).

B. Concealed Hinges: Hinges mortised into door and frame so that they are concealed when the door is closed. Hinges shall be adjustable three ways; vertically, horizontally and compression (in/out) capable of supporting doors up to 282 pounds with four hinges with a 180 degree swing.

1. Manufacturers:

a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
b. Soss Door Hardware.
c. Tectus by Simonswerk.

C. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:

a. McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).
b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).

2.3 DOOR OPERATING TRIM

A. Automatic, Self-Latching, and Manual Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Manufacturers:

a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
b. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Manufacturers:

a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
b. Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Match Facility Restricted Keyway.

D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.

a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.
b. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.
c. Level 3 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders to be UL437 certified and constructed to provide protection against bumping, picking, and drilling.
d. Refer to hardware sets for specified levels.

2. Manufacturers:
a. Sargent Manufacturing (SA) - Degree Series.
b. Corbin Russwin (RU) – Access 3 Series.

E. Keying System: Each type of lock and cylinders to be factory keyed.

1. Conduct specified "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
3. New System: Key locks to a new key system as directed by the Owner.

F. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)

2. Master Keys (per Master Key Level/Group): Two (2)
3. Construction Control Keys (where required): Two (2).
4. Permanent Control Keys (where required): Two (2).
5. Grand Master One (1)
6. Top Master Key (1)

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Manufacturers:

a. Lund Equipment (LU).
b. MMF Industries (MM).
c. Telkee (TK).

I. Key Control Software:

a. Key Wizard

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) – ML2000 Series.
b. Sargent Manufacturing (SA) – 8200 Series.

B. Multi-Point Locksets: Vertical rod locking devices designed for openings requiring multiple latching points within one locking mechanism. Rods are retracted by dual mounted outside lever trim controls available in a variety of ANSI/BHMA operational functions. Option for single top latching only eliminates the need for bottom strikes.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) – MP9800 Series.
b. Sargent Manufacturing (SA) - 7000 Series.

C. Multi-Point Locksets, FEMA: Three-point locking system device engineered for in-swinging and out-swinging door applications on windstorm safe shelter rooms. Extra heavy duty steel component construction securing the door to the frame at top, bottom and center latch positions. All three latching points are automatically activated when the device is locked. Multi-Point Deadlocking System shall be used only with doors, frames and associated hardware that have been engineered, tested and approved for a complete opening assembly system.

1. ANSI-BHMA listed to A156.37 Grade 1 for multi-point locks:

a. Lever torque to retract all bolts less than 28 in.lb.
b. Cycle tested to 800,000 cycles.

2. NFPA 80 and NFPA 101 life safety requirements.

3. UL10B or UL10C, 3-hour fire rated openings.

4. Latchbolt Construction:
   a. Center Bolt to be one piece, ¾" throw anti-friction stainless steel latch and one piece, 1" throw, hardened stainless steel deadbolt; 2-3/4" standard backset.
   b. Top and Bottom Bolts to be ¾" x ¾" stainless steel square latchbolt with ¾" projection.

5. Independent top and bottom bolt projection shall be field adjustable:
   a. From the center mortise pocket.
   b. Ability to make field adjustments while the door is in the hung position without the removal of the door.
   c. Top and Bottom Bolts and the Center Mortise Case shall be factory installed into the door assembly.

6. Bottom strike shall be offset and reversible to accommodate alignment issues due to rough opening tolerances.

7. Devices must be able to accommodate sectional rose and lever trim to match the design style and architectural finishes of the balance of the lockset and latches as specified.

8. Devices must be available with electronic access control options for higher or everyday use and traceability.

9. Devices must be available with rod-dogging indicator options:
   a. Operated by single-point latching for non-emergency or normal use of the space.
   b. Ability to hold rods in a retracted state.
   c. Day-to-day operations with mortise lock only.
   d. Indicator to show status.

10. Manufacturers:

    a. Corbin Russwin Hardware (RU) - FE6600 Series.
    b. Sargent Manufacturing (SA) - FM7300 Series.
    c. No Substitution.

D. Tubular Locksets, Grade 1 (Extra-Heavy Duty): ANSI/BHMA A156.2 Series 4000, Grade 1 certified.

1. Locksets to withstand 3000 inch pounds of torque applied to the locked lever without gaining access.

2. Locksets to fit a standard 2 1/8" bore without the use of through-bolts.

3. Lever handles to be made of solid material with no plastic fillers.

4. Latchbolt head to be one-piece stainless steel construction encased within the lock body.

5. Extended cycle test: Locks to have been cycle tested in ordinance with ANSI/BHMA A156.2 requirements to 34 million cycles.

6. Furnish with standard 2 3/4" backset and 1/2" throw latchbolt (3/4" at rated paired openings).

7. Manufacturers:

a. Corbin Russwin Hardware (RU) – CL3100 Series.
b. Sargent Manufacturing (SA) – 11 Line.

2.6 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.7 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Heavy Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 1 with minimum holding force strength of 1,200 pounds. Locks to be capable of either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Electronics are to be fully sealed against tampering and allow exterior weatherproof applications. As indicated in Hardware Sets, provide specified mounting brackets and housings. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.

1. Manufacturers:

a. Securitron (SU) – M62 Series.

2.8 ELECTRIC STRIKES

A. Surface Mounted Rim Electric Strikes: Surface mounted rim exit device electric strikes conforming to ANSI/BHMA A156.31, Grade 1, and UL Listed for both Burglary Resistance and for use on fire rated door assemblies. Construction includes internally mounted solenoid with two heavy-duty, stainless steel locking mechanisms operating independently to provide tamper resistance. Strikes tested for a minimum of 500,000 operating cycles. Provide strikes with 12 or 24 VDC capability supplied standard as fail-secure unless otherwise specified. Option available for latchbolt and latchbolt strike monitoring indicating both the position of the latchbolt and locked condition of the strike. Strike requires no cutting to the jamb prior to installation.

1. Manufacturers:

HES

FOLGER ADAMS

B. Provide electric strikes with in-line power controller and surge suppressor by the same manufacturer as the strike with the combined products having a five year warranty.

2.9 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
b. Detex (DE) - Advantex Series
c. Sargent Manufacturing (SA) - 80 Series.

C. Conventional Push Rail Exit Devices (Commercial Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Fabricate latchbolts from cast stainless steel, Pullman type, incorporating a deadlocking feature.

1. Manufacturers:

a. Adams Rite (AD) - EX Series.
b. Cal Royal (CA) - 7700 Series.
c. Falcon Hardware (FA) - 24/25 Series.
d. Hager (HA) - 4500 Series.
e. PDQ (PQ) - 6200 Series.
f. Stanley Commercial (ST) - QED110 Series.
g. Yale Locks and Hardware (YA) - 2100 Series.
h. Yale Locks and Hardware (YA) - 6000 Series.

2.10 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) – DC6000 Series.
b. Sargent Manufacturing (SA) - 351 Series.
c. Norton Door Controls (NO) - 7500 Series.

C. Door Closers, Surface Mounted (Unitrol): Unitrol arms to have door stop mechanism to absorb dead stop shock on arm and top hinge. Hold-open arms to have a spring loaded mechanism in addition to shock absorber assembly. Arms to be provided with rigid steel main arm and secondary arm lengths proportional to the door width.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - Unitrol Series.
b. Norton Door Controls (NO) - Unitrol Series.

D. Door Closers, Surface Mounted (Commercial Duty): ANSI/BHMA 156.4, Grade 1 certified surface mounted, institutional grade door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck, closing sweep, and latch speed control valves. Provide non-handed units standard.

1. Manufacturers:

a. Corbin Russwin Hardware (RU) - DC6000 Series.
b. Norton Door Controls (NO) - 8500 Series.
c. Sargent Manufacturing (SA) - 1431 Series.

2.11 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Where plates are applied to fire rated doors with the top of the plate more than 16” above the bottom of the door, provide plates complying with NFPA 80. Consult manufacturer’s catalog and template book for specific requirements for size and applications.

4. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

a. Stainless Steel: 300 grade, 050-inch thick.

5. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

6. Manufacturers:

a. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
b. Trimco (TC).

2.12 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

a. Hiawatha, Inc. (HI).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

a. Rixson Door Controls (RF).
b. Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
c. Sargent Manufacturing (SA).

2.13 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NPFA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).

2. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
3. Reese Enterprises, Inc. (RE).

2.14 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.15 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 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.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should 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 and functionality.

B. Manufacturer's Abbreviations:

C. Refer to Section 080671, Door Hardware Sets, for hardware sets.

1. MK - McKinney
2. PE - Pemko
3. RO - Rockwood
4. RU - Corbin Russwin
5. SU - Securitron
6. HS - HES
7. RF - Rixson
8. NO - Norton
9. OT - OTHER

Hardware Sets

Set: 2.0

Doors: 100A, 101A

1	Continuous Hinge (alum/glass door)	DFM83SLF-HD1		PE	087100
1	Mortise Lock (storeroom)	ML2057 NSA C6	613E	RU	087100
1	Interchangeable Core	8500 AP	613E	RU	087100
1	Electric Strike	1006CS	613E	HS	087400 ⚡
1	SMART Pac Bridge Rectifier	2005M3		HS	087100 ⚡
1	Closer (surface, Unitrol)	DC8210 A11	613E	RU	087100
1	Threshold (alum/glass door)	2005DP MSES25 x OW		PE	087100
1	Perimeter Gaskets (alum/glass door)	By Frame & Door Manufacturer		00	
1	Rain Guard	346D TKSP8 x FW		PE	087100
1	Door Sweep (alum/glass door)	315DN TKSP8 x DW		PE	087100
1	ElectroLynx Harness	QC-C3000P (electric device to device controller)		MK	087100 ⚡
1	Power Supply	BPS-24-1		SU	087400 ⚡

Notes: DPS by Security

Set: 2.1

Doors: 107A

1	Continuous Hinge (alum/glass door)	CFM83SLF-HD1		PE	087100
1	Mortise Lock (storeroom)	ML2057 NSA C6	626	RU	087100
1	Interchangeable Core	8500 AP	626	RU	087100
1	Electric Strike	1006CS	630	HS	087100
1	SMART Pac Bridge Rectifier	2005M3		HS	087100
1	Closer (surface, Unitrol)	DC8210 A11	689	RU	087100
1	Threshold (alum/glass door)	2005AP MSES25 x OW		PE	087100
1	Perimeter Gaskets (alum/glass door)	By Frame & Door Manufacturer		00	
1	Door Sweep (alum/glass door)	315CN TKSP8 x DW		PE	087100
1	Hardware by Security Contractor	Card Reader, DPS, Power Supply		OT	

Notes:

Set: 4.0

Doors: 120A

1	Continuous Hinge	CFM83SLI-HD1		PE	087100
1	Mortise Lock (storeroom)	ML2057 NSA C6	626	RU	087100
1	Interchangeable Core	8500 AP	626	RU	087100
1	Electric Strike	1006CS	630	HS	087100
1	SMART Pac Bridge Rectifier	2005M3		HS	087100
1	Closer (surface, Unitrol)	DC8210 A11	689	RU	087100
1	Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	087100
1	Threshold	171A MSES25 x OW		PE	087100
1	Rain Guard	346C TKSP8 x FW		PE	087100
1	Weatherstrip	332CS TKSP8 x H&J		PE	087100
1	Door Sweep w/ Drip	345APK TKSP8 x DW		PE	087100
1	Hardware by Security Contractor	Card Reader, DPS, Power Supply		OT	

Set: 4.1

Doors: 105A, 137A, 137C, 141A, 141B, 150A, 150B

1	Continuous Hinge	CFM83SLI-HD1		PE	087100
1	Exit Device (rim, passage)	ED5200A N910	626	RU	087100
1	Closer (surface)	DC8200/10 x arm to suit application	689	RU	087100
1	Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
1	Threshold	171A MSES25 x OW		PE	087100 1
1	Wall Stop	408/409 As Required	US32D	RO	087100
1	Gasketing (smoke/odor/light/sound)	S88BL x H&J		PE	087100

Notes: Door normally closed and latched, ingress by lever, free egress at all times.

Set: 4.2

Doors: 100B, 145A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Mortise Lock (storeroom)	ML2057 NSA C6	626	RU	087100
1 Interchangeable Core	8500 AP	626	RU	087100
1 Electric Strike	1006CS	630	HS	087400 ⚡
1 SMART Pac Bridge Rectifier	2005M3		HS	087100 ⚡
1 Closer (surface)	DC8200/10 x arm to suit application	689	RU	087100
1 Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
1 Wall Stop	408/409 As Required	US32D	RO	087100
3 Silencer - Metal Frame	608		RO	087100
1 Card Reader	Provided by Security		00	
1 ElectroLynx Harness	QC-C3000P (electric device to device controller)		MK	087100 ⚡
1 Power Supply	BPS-24-1		SU	087400 ⚡
1 Viewer	622	CRM	RO	087100

Notes: Door normally closed and latched, ingress by key or valid credential, free egress at all times. Card reader, door position switch, wire and wiring by electrical and security, coordinate.

Set: 4.3

Doors: 155A, 155B, 156A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (storeroom)	CL3357 NZD C6	626	RU	087100
1 Interchangeable Core	8500 AP	626	RU	087100
1 Closer (surface)	DC8200/10 x arm to suit application	689	RU	087100
1 Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
1 Wall Stop	408/409 As Required	US32D	RO	087100
3 Silencer - Metal Frame	608		RO	087100

Set: 5.1

Doors: 151A, 151B, 151C, 151D

1 Overhead Sectional Door Assembly	All hardware by manufacturer		00

Set: 8.0

Doors: 104A, 116A

6 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
2 Manual Flush Bolts	555/557 to suit door type	US26D	RO	087100
1 Dust Proof Strike	570	US26D	RO	087100
1 Cylindrical Lock (storeroom)	CL3357 NZD C6	626	RU	087100

1 Interchangeable Core	8500 AP	626	RU	087100
2 Surface Overhead Stop	10-X36	652	RF	087100
2 Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
2 Silencer - Metal Frame	608		RO	087100

Set: 9.1

Doors: 111A, 112A, 113A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (storeroom)	CL3357 NZD C6	626	RU	087100
1 Interchangeable Core	8500 AP	626	RU	087100
1 Wall Stop	408/409 As Required	US32D	RO	087100
3 Silencer - Metal Frame	608		RO	087100

Set: 9.4

Doors: 114A, 115A
Description: STORM DOORS FEMA

4 Hinge	SP3786 5" x 4-1/2"	US26D	MK	087100
1 Multi-Point Lock	FE6618 NSA CT6G	630	RU	087100
1 Interchangeable Core	8000-	626	RU	087100
1 Surface Closer	DC8210 A3	689	RU	087100
1 Door Stop	481	US26D	RO	087100
1 Threshold	1715A		PE	087100
1 Gasketing	S88D 17'		PE	087100

Set: 11.0

Doors: 138A, 142A, 148A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (office)	CL3351 NZD C6	626	RU	087100
1 Interchangeable Core	8500 AP	626	RU	087100
1 Wall Stop	408/409 As Required	US32D	RO	087100
3 Silencer - Metal Frame	608		RO	087100

Set: 12.1

Doors: 102A, 117A, 118A, 140A, 144A, 146A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (privacy)	CL3320 NZD	626	RU	087100
1 Closer (surface)	DC8200/10 x arm to suit application	689	RU	087100
1 Wall Stop	408/409 As Required	US32D	RO	087100
1 Gasketing (smoke/odor/light/sound)	S88BL x H&J		PE	087100

Set: 13.0

Doors: 109A, 109B, 139A, 143A, 148B

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (passage)	CL3310 NZD	626	RU	087100
1 Closer (surface, dead stop)	DC8210 A4	689	RU	087100
1 Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
1 Gasketing (smoke/odor/light/sound)	S88BL x H&J		PE	087100

Notes: Closer w/ Integrated Stop

Set: 13.1

Doors: 119A, 122A, 124A, 126A, 128A, 130A, 132A, 134A, 136A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (passage)	CL3310 NZD	626	RU	087100
1 Closer (surface, dead stop)	DC8210 A4	689	RU	087100
1 Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
1 Gasketing (smoke/odor/light/sound)	S88BL x H&J		PE	087100

Set: 13.2

Doors: 149A, 152A

3 Hinge	TA2714 4-1/2" x 4-1/2" (NRP)	US26D	MK	087100
1 Cylindrical Lock (passage)	CL3310 NZD	626	RU	087100
1 Closer (surface)	DC8200/10 x arm to suit application	689	RU	087100
1 Kick Plate	K1050 10" x DW-2" 4BE CSK	US32D	RO	
1 Wall Stop	408/409 As Required	US32D	RO	087100
3 Silencer - Metal Frame	608		RO	087100

Set: 15.0

Doors: 151E, 151F, 151G, 151H

1 Four-Fold Door	All hardware by manufacturer		OT	

Set: 16.0

Doors: 137B, 152B, 154A, 158A

1 Continuous Hinge (alum/glass door)	DFM83SLF-HD1		PE	087100
1 Mortise Lock (storeroom)	ML2057 NSA C6	613E	RU	087100
1 Interchangeable Core	8500 AP	613E	RU	087100
1 Electric Strike	1006CS	613E	HS	087400 ⚡
1 Surface Closer	1601 x Stop	690	NO	087100
1 Threshold	2005DV		PE	087100
1 Rain Guard	346D TKSP8 x FW		PE	087100
1 Door Sweep (alum/glass door)	315DN TKSP8 x DW		PE	087100

1	Hardware by Security Contractor	Card Reader, DPS, Power Supply	OT

Notes: Openings to receive card reader/key pad dual credential reader. Provide electrolynx harnesses as/if required.

END OF DOCUMENT

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SECTION 088000 - GLAZING

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 glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
   1. Windows.
   2. Doors.
   3. Storefront framing.
   4. Interior borrowed lites.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
C. Interspace: Space between lites of an insulating-glass unit.

1.4 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:
   1. Design Wind Pressures: As indicated on Drawings.
   2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Basic Wind Speed: As indicated on drawings.
   3. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
   4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.
C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.5 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
   2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
   3. Test no fewer than [eight] [Insert number] Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
   4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
   5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.

1.6 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.
B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.
C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
E. Product Certificates: For glass and glazing products, from manufacturer.
F. Preconstruction adhesion and compatibility test report.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.
B. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.
D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
E. Source Limitations for Glass: Obtain insulating glass from single source from single manufacturer for each glass type.
F. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.
G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
    1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
    2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."
H. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
I. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
B. Comply with insulating-glass manufacturer's written recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
    1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
    1. Warranty Period: 10 years from date of Substantial Completion.
B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
    1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.
   2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
   1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick.
   2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   3. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   4. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   5. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.3 INSULATING GLASS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. PPG.
   2. Guardrail.
   3. Viracon.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by designations in "Insulating-Glass Types" Article and in "Insulating-Laminated-Glass Types" Article.

2.4 FIRE-PROTECTION-RATED GLAZING

A. Fire-Protection-Rated Glazing, General: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252 for door assemblies.

B. Monolithic Ceramic Glazing: Clear, ceramic flat glass.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Safti First; SuperLite . I-XL IGU
      b. Comparable procuts by Vetrotech Saint-Gobain and Nippon Electric Glass.

C.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. Neoprene complying with ASTM C 864.
   2. EPDM complying with ASTM C 864.

3. Silicone complying with ASTM C 1115.
4. Thermoplastic polyolefin rubber complying with ASTM C 1115.

2.6 GLAZING SEALANTS

A. General:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Corning Corporation; 790.
b. GE Advanced Materials - Silicones; SilPruf LM SCS2700.
c. Pecora Corporation; 890.
d. Tremco Incorporated; Spectrem 1.

C. Glazing Sealant: Neutral-curing silicone glazing sealant complying with 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; 795.
b. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
c. Pecora Corporation; 864.
d. Tremco Incorporated; Spectrem 2.

D. Glazing Sealants for Fire-Rated Glazing Products: Products that are approved by testing agencies that listed and labeled fire-resistant glazing products with which they are used for applications and fire-protection ratings indicated.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 804.3 tape, where indicated.
2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
G. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

2.9 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

2.10 MONOLITHIC-GLASS TYPES

A. Clear float glass fully tempered float glass.
   1. Thickness: 6.0 mm.
   2. Provide safety glazing labeling.

2.11 INSULATING-GLASS TYPES

A. Low-e-coated, clear insulating glass.
   1. Overall Unit Thickness: 1 inch.
      a. 5/8 inch at exterior hollow metal frames.
   2. Thickness of Each Glass Lite: 6.0 mm.
   3. Outdoor Lite: Float glass (heat-strengthened where recommended by manufacturer or fully tempered where required by code).
   4. Interspace Content: Air.
   5. Indoor Lite: Float glass (heat-strengthened where recommended by manufacturer or fully tempered where required by code).
   6. Low-E Coating: Sputtered on second surface.
   7. Visible Light Transmittance: 54 percent minimum.
   8. Shading Coefficient: 0.32
   9. Winter Nighttime U-Factor: 0.29maximum.
   10. Summer Daytime U-Factor: 0.27 maximum.
   11. Solar Heat Gain Coefficient: 0.28 maximum.
   12. Provide safety glazing labeling.
   13. Acceptable product: Guardian SuperNeutral 54(#2).

B. Clear interior insulating glass.
   1. 5/8 inch at interior hollow metal frame transom and sidelites.

2.12 FIRE-PROTECTION-RATED GLAZING TYPES

A. Glass Type [__]: 60-minute fire-rated glazing; monolithic ceramic glazing units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Presence and functioning of weep systems.
   3. Minimum required face and edge clearances.
   4. Effective sealing between joints of glass-framing members.

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

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
G. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
K. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
L. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING
A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.
D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
E. Do not remove release paper from tape until right before each glazing unit is installed.
F. Apply heel bead of elastomeric sealant.
G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 GASKET GLAZING (DRY)
A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
E. Install gaskets so they protrude past face of glazing stops.

3.6 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.7 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION

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SECTION 088300 - MIRRORS

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 the following types of silvered flat glass mirrors:
  1. Annealed monolithic glass mirrors.
  2. glass mirrors qualifying as safety glazing.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
- B. Sustainability Submittals:
  1. For adhesives, documentation including printed statement of VOC content.
- C. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.

1.4 INFORMATIONAL SUBMITTALS
- A. Product Certificates: For each type of mirror and mirror mastic.

1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE
- A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.7 PRECONSTRUCTION TESTING
- A. Preconstruction Mirror Mastic Compatibility Test: Submit mirror mastic products to mirror manufacturer for testing to determine compatibility of mastic with mirror backing.
  1. Testing is not required if data are submitted based on previous testing of mirror mastic products and mirror backing matching those submitted.

1.8 DELIVERY, STORAGE, AND HANDLING
- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.9 FIELD CONDITIONS
- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.10 WARRANTY
- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.
  1. Warranty Period: Five years from date of Substantial Completion] [manufacture.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Avalon Glass and Mirror Company.
   2. Binswanger Glass.
   3. Guardian Industries Corp.
   4. Virginia Mirror Company, Inc.

B. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

C. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, .
   1. Nominal Thickness: 6.0 mm.

2.3 MISCELLANEOUS MATERIALS

A. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Franklin International.
      b. Laurence, C. R. Co., Inc.
      c. Liquid Nails Adhesive.
      d. Palmer Products Corporation.
      e. Royal Adhesives & Sealants, LLC.

2.4 MIRROR HARDWARE

A. Provide continuous mirror top and bottom channels.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Fabricate mirrors in the shop to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: .
   1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
   2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
   1. GANA Publications: "Laminated Glazing Reference Manual," "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
   1. Mirror Clips: Place a felt or plastic pad between mirror and each clip to prevent spalling of mirror edges. Locate clips so they are symmetrically placed and evenly spaced.
   2. Install mastic as follows:
      a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
      b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
      c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION

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SECTION 089119 - FIXED LOUVERS

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. Fixed, louvers.

1.3 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 axes of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axes 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 according to AMCA 500-L.

1.4 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, flashing, sealant, and other means of preventing water intrusion.
  2. Show mullion profiles and locations.
- C. Samples: For each type of metal finish required.

1.5 INFORMATIONAL SUBMITTALS
- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to 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.

1.6 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel according to the following:
  1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.7 FIELD CONDITIONS
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
- A. Source Limitations: Obtain 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. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components,

noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

C. 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 according to AMCA 500-L.

D. 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.

E. 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 :
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airolite Company, LLC (The).
   b. Arrow United Industries; a division of Mestek, Inc.
   c. Construction Specialties, Inc.
   d. Greenheck Fan Corporation.
   e. Ruskin Company; Tomkins PLC.
2. Louver Depth: 6 inches.
3. Frame and Blade Nominal Thickness: Not less than 0.080 inch.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:
   a. Free Area: Not less than 50%.
   b. Point of Beginning Water Penetration: Not less than 900 fpm.
6. 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: Bird screening.

B. Secure screen frames to louver frames with stainless-steel machine screws, 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.
2. Finish: Same finish as louver frames to which louver screens are attached.
3. Type: Non-rewirable frames with a driven spline or insert.

D. Louver Screening for Aluminum Louvers:
1. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inchwire.

2.5 BLANK-OFF PANELS

A. Uninsulated, Blank-Off Panels: Metal sheet attached to back of louver.
1. Aluminum sheet for aluminum louvers, not less than 0.050-inch nominal thickness.
2. Panel Finish: Same finish applied to louvers.
3. Attach blank-off panels with clips or sheet metal screws.

2.6 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5, T-52, or T6.

B. Fasteners: Use types and sizes to suit unit installation conditions.
1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
2. For color-finished louvers, use fasteners with heads that match color of louvers.

C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.7 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. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
   1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern unless horizontal mullions are indicated.
   2. Horizontal Mullions: Provide horizontal mullions at joints unless continuous vertical assemblies are indicated.
C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
D. 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.
E. Include supports, anchorages, and accessories required for complete assembly.
F. 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.
G. Provide subsills made of same material as louvers for recessed louvers.
H. 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.

2.8 ALUMINUM FINISHES
A. Finish louvers after assembly.
B. High-Performance Organic Finish: -coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   1. Color and Gloss: As selected by Architect from manufacturer's full available 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

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
- B. Shop Drawings: For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. UL Listings: Provide UL listing data for Head of Wall conditions.

1.4 INFORMATIONAL SUBMITTALS
- A. Evaluation Reports: For firestop tracks, from ICC-ES.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS
- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Runners: ASTM C 645.
  1. Steel Studs and Runners:
     a. Minimum Base-Metal Thickness: 20 gauge (33mils) unless indicated otherwise on Drawings or below.
        1) Interior Metal Stud/Gypsum Board Assemblies, Typical Locations: Withstand lateral loading (air pressure) of 5 psf with deflection limit not more than L/240 of partition height.
        2) Interior Metal Stud/Gypsum Board Assemblies at Lobbies, Service Corridors, and Exit Corridors: Withstand lateral loading (air pressure) of 7.5 psf with deflection limit not more than L/360 of partition height
        3) Interior Metal Stud/Gypsum Board Assemblies at Locations with Ceramic Tile or Other Hard Surface Finishes: Withstand typical lateral loading (air pressure) with deflection limit not more than L/360 of partition height, minimum 20 gauge (30 mills) studs at 16 inches on center.
        4) Where wall mounted equipment, woodwork, and casework items are indicated or elsewhere as shown on Drawings, provide minimum 16 gage studs
        5) At jambs of openings provide two minimum 20 gage studs.
        6) Ceilings: At ceilings using mold-mildew resistant gypsum framing to be 16 inches o.c. for 5/8 inches gypsum
        7) Refer to Division 5 for stud framing which is exposed to wind loads and for studs carrying heavy vertical loads (cement plaster, manufactured stone masonry, stone tile thicker than 3/4 inch, etc)

b. Where partition heights exceed stud manufacturer's recommended spans, provide one of the following:
1) Heavier stud gage.
2) Closer stud spacing.
3) Deeper stud size (space permitting); As approved by Architect.
4) Above ceiling bracing, anchored to structure above.
c. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide the following:
1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) MBA Building Supplies; FlatSteel Deflection Track Slotted Deflecto Track.
3) Steel Network Inc. (The); VertiClip SLD Series.

D. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
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. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
b. Metal-Lite, Inc.; The System.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.018 inch.

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: 7/8 inch.

H. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical.

I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges.
1. Depth: 3/4 inch.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Hanger Attachments to Concrete:
1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
a. Type: Postinstalled, expansion anchor.
2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

D. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

E. Furring Channels (Furring Members):
1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch- wide flanges, 3/4 inch deep.
2. Steel Studs and Runners: ASTM C 645.
a. Minimum Base-Metal Thickness: 0.018 inch.
b. Depth: 1-5/8 inches.
3. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: 0.018 inch.

4. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
   a. Configuration: Asymmetrical.

F. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   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. Armstrong World Industries, Inc.; Drywall Grid Systems.
      b. Chicago Metallic Corporation; Drywall Grid System.
      c. USG Corporation; Drywall Suspension System.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

B. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

C. Isolation Strip at Exterior Walls: Provide the following:
   1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
   1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

B. Coordination with Sprayed Fire-Resistive Materials:
   1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
   2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
   2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
   3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.
D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
   1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
   2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
      c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
   3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
   4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
      a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
E. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS
A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
   1. Hangers: 48 inches o.c.
   2. Carrying Channels (Main Runners): 48 inches o.c.
   3. Furring Channels (Furring Members): 16 inches o.c.
B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
C. Suspend hangers from building structure as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
      a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
      a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
   3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
   5. Do not attach hangers to steel roof deck.
   6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
   7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
   8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

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SECTION 092900 - 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.
  2. Tile backing panels.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
- B. Samples: For the following products:
  1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE
- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
  1. Install mockups for the following:
     a. Each level of gypsum board finish indicated for use in exposed locations.
  2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
  3. Simulate finished lighting conditions for review of mockups.
  4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 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.

1.6 FIELD CONDITIONS
- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

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.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL
- A. Recycled Content of Gypsum Panel Products: Postconsumer recycled content plus one-half of

preconsumer recycled content not less than 40 percent.

B. Regional Materials: Provide products that meet the definition of regional materials for 90% by weight.

C. 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Gypsum.
   2. CertainTeed Corp.
   3. Georgia-Pacific Gypsum LLC.
   4. National Gypsum Company.
   5. Temple-Inland.
   6. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.
   1. Thickness: 1/4 inch.
   2. Long Edges: Tapered.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. American Gypsum; Firebloc Type C.
      b. CertainTeed Corp.; ProRoc Type C.
      c. Georgia-Pacific Gypsum LLC; Fireguard C.
      d. National Gypsum Company; Gold Bond Fire-Shield C.
      e. Temple-Inland; Type TG-C.
      f. USG Corporation; Firecode C Core.
   2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
   3. Long Edges: Tapered.

B. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Georgia-Pacific Gypsum LLC; DensArmour Plus.
      b. Temple-Inland; GreenGlass Interior Glass-Mat Board.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges
   1. Subject to compliance with requirements, provide one of the following:
      C-Cure; C-Cure Board 990
      CertainTeed Corp.; FiberCement.
      Custom Building Products; Wonderboard.
      James Hardie Building Products, Inc.; Hardiebacker.
      National Gypsum Company, Permabase Cement Board.
      USG Corporation; DUROCK Cement Board.
   2. Thickness: 5/8 inch.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
   2. Shapes:
      a. Cornerbead.
      b. Bullnose bead.
      c. LC-Bead: J-shaped; exposed long flange receives joint compound.
      d. L-Bead: L-shaped; exposed long flange receives joint compound.
      e. U-Bead: J-shaped; exposed short flange does not receive joint compound.

f. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Fry Reglet Corp.
b. Gordon, Inc.
c. Pittcon Industries.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.
4. Acceptable Products: (all by Fry Reglet):
a. Z Reveal Molding: Model DRMZ-625-50
b. F Reveal Molding: Model DRMF-625-50 and VPRF-50-50.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. 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.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:
1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.8 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Laminating adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. 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.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

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:
a. Pecora Corporation; AC-20 FTR or AIS-919.
b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
c. USG Corporation; SHEETROCK Acoustical Sealant.
2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

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.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

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

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. 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.

C. 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.

D. 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.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. 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.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. 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.

G. 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.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. 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.

J. 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. Type X: Vertical surfaces unless otherwise indicated.
2. Flexible Type: Apply in double layer at curved assemblies.
3. Ceiling Type: Ceiling surfaces.
4. Type C: Where required for specific fire-resistance-rated assembly indicated.
5. Cement Board: Behind wall tile.

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.
2. On partitions/walls, apply gypsum panels vertically (parallel 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.
   b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing

members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.

2. 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.
3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. 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

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated . Install with 1/4-inch gap where panels abut other construction or penetrations.
B. Cementitious Backer Units: ANSI A108.11.
C. 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.
B. Control Joints: Install control joints at locations indicated on Drawings according to ASTM C 840 and in specific locations approved by Architect for visual effect.
C. Wall: Control joints shall be installed where a wall or partition runs in an uninterrupted straight plane exceeding 30 linear feet, or 900 sq ft.
    1. Ceiling with Perimeter relief: Control joints in interior ceilings with perimeter relief shall be installed so that linear dimensions between control joints do not exceed 50 ft or 2500 sq. ft
    2. Ceiling, without perimeter relief: Control joints in interior ceilings without perimeter relief shall be installed so that linear dimensions between control joints do not exceed 30 ft
    3. Exterior: Control joints in exterior ceilings and soffits shall be installed so that linear dimensions between control joints do not exceed 30 ft. at acoustical or fire-rated walls: Where a control joint occurs in an acoustical or fire rated system, blocking shall be provided behind the control joint by using a backing material such as 5/8 in. type X gypsum panel products, mineral fiber, or other tested equivalent.
D. Interior Trim: Install in the following locations:
    1. Cornerbead: Use at outside corners unless otherwise indicated.
    2. LC-Bead: Use at exposed panel edges.
    3. L-Bead: Use where indicated.
    4. U-Bead: Use where indicated.
E. Aluminum Trim: Install in locations indicated on Drawings.

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.
B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
D. 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.
    2. Level 2: Panels that are substrate for tile and where indicated on Drawings.
    3. Level 3: Beneath wall coverings.
    4. Level 5: At panel surfaces that will be exposed to view unless otherwise indicated.

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.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. 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.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

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. Ceramic mosaic tile.
   2. Porcelain tile.
   3. Glazed wall tile.
   4. Stone thresholds.
   5. Waterproof membrane.
   6. Crack isolation membrane.
   7. Metal edge strips.

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.

B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Product Data for Credit IEQ 4.1: For adhesives and waterproofing, documentation including printed statement of VOC content.
   2. Product Data for Credit IEQ 4.3: For grout sealers, documentation indicating that products comply with requirements of FloorScore certification.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.
   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. Make samples at least 12 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
   3. Full-size units of each type of trim and accessory for each color and finish required.
   4. Stone thresholds in 6-inch lengths.
   5. Metal edge strips in 6-inch lengths.

1.6 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.

1.7 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.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.8 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.
   2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
   3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

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.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

1.10 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.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
   2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
   1. Stone thresholds.
   2. Waterproof membrane.
   3. Crack isolation membrane.
   4. Cementitious backer units.
   5. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements unless otherwise 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.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
   1. Where tile is indicated for installation on exteriors or in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Tile: Refer to Finish Schedule.

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. Description: Match Architect's sample.

2.5 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
   1. Products: Subject to compliance with requirements, :
      a. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
      b. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
      c. MAPEI Corporation; .

2.6 CRACK ISOLATION MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.12 for high performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030-inch nominal thickness.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Noble Company (The); Nobleseal CIS.

2.7 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
   2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubberliquid-latex additive at Project site.

4. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Medium-Bed, Latex-Portland Cement Mortar (for larger tiles): Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Laticrete International, Inc.
      b. MAPEI Corporation.
   2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   3. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubberliquid-latex additive at Project site.

C. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.
   1. Reinforcing Wire Fabric: Galvanized, welded wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A 185 and ASTM A 82 except for minimum wire size.
   2. 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.

2.8 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout (typical): ANSI A118.6.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation. (Basis of Design: Opticolor Stainfree Grout)

C. Water-Cleanable Epoxy Grout (at Decon Room): ANSI A118.3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Bostik, Inc.
      b. Custom Building Products.
      c. Laticrete International, Inc.
      d. MAPEI Corporation (Basis of Design: Kerapoxy IEG 100% Solids Epoxy Grout)

2.9 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. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product by one of the following:
      a. Ceramic Tool Company, Inc.
      b. Schluter Systems L.P. (Renu U at tile to concrete slab).

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

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 installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. 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. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. 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.

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.
1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
1. Ceramic Mosaic Tile: 1/16 inch.
2. Glazed Wall Tile: 1/16 inch.
3. Porcelain Tile: 1/4 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. 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.

J. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thinset).
2. Do not extend waterproofing or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on waterproofing or crack isolation membrane with elastomeric sealant.

K. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

L. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

B. Allow waterproofing to cure and verify by testing that it is watertight before installing tile or setting materials over it.

3.5 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

B. Allow crack isolation membrane to cure before installing tile or setting materials over it.

3.6 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.

3.7 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.

3.8 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Ceramic Tile Installation : TCNA F113; thinset mortar.
   a. Thinset Mortar: portland cement mortar.
   b. Grout: Standard sanded cement grout.
2. Ceramic Tile Installation : TCNA F122; thinset mortar on waterproof membrane.
   a. Thinset Mortar: portland cement mortar.
   b. Grout: Standard sanded cement grout.
3. Ceramic Tile Installation : TCNA F125A; thinset mortar on crack isolation membrane.
   a. Thinset Mortar: portland cement mortar.
   b. Grout: Standard sanded cement grout.
4. Tile Installation F121: Cement mortar bed (thickset) on waterproof membrane; TCA F121 and ANSI A108.1A.
   a. Thin-Set Mortar for Cured-Bed Method: Latex- portland cement mortar.
   b. Grout: Polymer-modified sanded 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: portland cement mortar.
   b. Grout: Standard unsanded cement .

C. Shower Receptor and Wall Installations, Metal Studs or Furring:

1. Tile Installation B420: Thin-set mortar on coated glass-mat, water-resistant backer board; TCA B420.
   a. Thin-Set Mortar: Latex- portland cement mortar.
   b. Grout: Polymer-modified sanded grount.

END OF SECTION

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for ceilings.

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainability Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
2. Product Data for Credit EQ 4.1: For sealants, documentation including printed statement of VOC content.

C. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

D. Samples for Initial Selection: For components with factory-applied color finishes.

E. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which suspension systems will be attached.
3. Size and location of initial access modules for acoustical panels.
4. Items penetrating finished ceiling including the following:
    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
5. Perimeter moldings.

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 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. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
3. Hold-Down Clips: Equal to 2 percent of quantity installed.
4. Impact Clips: Equal to 2 percent of quantity installed.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 450 or less.

B. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc. (Basis of Design).
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

A. Basis of Design: Refer to Finish Legend.

B. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish.
2. Pattern: Refer to Finish Legend.

C. Thickness: 3/4 inch .

D. Modular Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
   1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
      a. Type: anchors.
      b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
      c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
      d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
   2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

E. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

2.5 METAL SUSPENSION SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc. (Basis of Design: Prelude XL-HRC)
   2. CertainTeed Corp.
   3. Chicago Metallic Corporation.
   4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 02/11-inch- wide metal caps on flanges.
   1. Structural Classification: Intermediate -duty system.

B. End Condition of Cross Runners: Override (stepped) or butt-edge type.
   2. Face Design: Flat, flush.
   3. Cap Material: Steel cold-rolled sheet.
   4. Cap Finish: Painted white.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Chicago Metallic Corporation.
   4. Fry Reglet Corporation.
   5. Gordon, Inc.
   6. USG Interiors, Inc.; Subsidiary of USG Corporation.

2.7 ACOUSTICAL SEALANT

A. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
    a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
    b. USG Corporation; SHEETROCK Acoustical Sealant.
2. Acoustical Sealant for Concealed Joints:
    a. Pecora Corporation; AIS-919.
    b. Tremco, Inc.; Tremco Acoustical Sealant.

B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:
1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns.

Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
   1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
   2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
   3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
   1. Arrange directionally patterned acoustical panels as follows:
      a. As indicated on reflected ceiling plans.
   2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
   3. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   4. For reveal-edged panels on suspension-system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
   5. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
   6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
   7. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 095429 - WOOD PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general conditions of Contract, including General and Supplementary Conditions and Divisions-1 Specification sections apply to work of this section.

1.2 SUMMARY

A. Section Includes:
   1. Wood ceiling grills.
   2. Exposed grid suspension system.
   3. Wire hangers, fasteners, main runners, cross tees, wall angle moldings and accessories.

B. Related Sections:
   1. Section 06 42 00 (06420) Wood Paneling
   2. Section 09 51 00 (09510) - Acoustical Ceilings
   3. Section 09 20 00 (09250) - Plaster and Gypsum Board
   4. Divisions 23 (15) - HVAC
   5. Division 26 (16) Sections - Electrical Work

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM):
   1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
   2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process.
   3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
   4. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   5. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
   6. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
   7. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   8. ASTM E 580 Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Seismic Restraint.
   9. ASTM E 1414 Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum.
   10. ASTM E 1111 Standard Test Method for Measuring the Interzone Attenuation of Ceilings Systems.
   11. ASTM E 1264 Classification for Acoustical Ceiling Products.

1.4 SUBMITTALS

A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.
C. Samples: Minimum 3 inch x 5/8 inch samples of specified acoustical panel; 8 inch long samples of exposed wall molding and suspension system, including main runner and 4 foot cross tees.
D. Shop Drawings: Layout and details of ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
F. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.5 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.
B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
   1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class C products.
      a. Flame Spread: 200 or less
      b. Smoke Developed: 450 or less

2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.

C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.

D. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.

B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.

C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.7 PROJECT CONDITIONS

A. Wood ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation. (Remove plastic wrap to allow panels to climatize).

B. The wood panels should not be installed in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.

C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.8 WARRANTY

A. Wood Grille Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
   1. Ceiling Panels: Defects in materials or factory workmanship.
   2. Grid System: Rusting and manufacturing defects.

B. Warranty Period:
   1. Wood panels: One (1) year from date of installation.
   2. Grid: Ten years from date of installation.

C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.9 MAINTENANCE

A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
   1. Ceiling Units: Furnish quality of full-size units equal to 2.0 percent of amount installed.
   2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Ceiling Panels:
   1. Armstrong World Industries, Inc.

B. Suspension Systems:
   1. Armstrong World Industries, Inc.

2.2. WOOD CEILING UNITS

A. Ceiling Panels:
   1. Surface Texture: Smooth
   2. Composition: Wood
   3. Finish: Clear coating Grille Walnut
   4. Species: Blades and Backers-Poplar; Dowel-Birch
   5. Size: 6 blade, 1 foot X 8 foot X 2 1/4 inch, with acoustic infill panel.
   6. Noise Reduction Coefficient (NRC): ASTM C 423, (0.75with bioacoustic infill panel, item #5823)
   7. Flame Spread: Class C (HPVA)

8. Dimensional Stability: Standard.
9. Acceptable Product: WoodWorks Grille, Item #5665DOGWN, as manufactured by Armstrong World Industries.

B. Accessories:
1. Ledger; 1 inch X 96 inch X1/4 inch, Item #5671
2. Junction 2 1/4 inch: 2 1/4 inch X 96 inch X 2 3/4 inch, Item #5673GWN
3. End Cap 2 1/4 inch; 3/4 inch X 96 inch X 2 3/4 inch, Item #5675
4. WoodWorks Infill Panel (Bioacoustic infill) #5823

2.3 SUSPENSION SYSTEMS

A. Components: All main beams and cross tees shall be commercial quality hot dipped galvanized steel (galvanized steel, aluminum, or stainless steel) as per ASTM A 653. Main beams and cross tees are double-web steel construction with 15/16 inch type exposed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel (aluminum or stainless steel) in baked polyester paint. Main beams and cross tees shall have rotary stitching (exception: extruded aluminum or stainless steel).
1. Structural Classification: ASTM C 635, Intermediate Duty.
2. Color: Black.
3. Acceptable Product: Prelude XL 15/16" Exposed Tee as manufactured by Armstrong World Industries, Inc.

B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

C. Hangers: No Hanger Wire allowed. Provide 3/32” Aircraft Cable.

D. Accessories/Edge Moldings and Trim:
1. Backer Clip; 3/8 inch X 11/16 inch X 7/8 inch
2. Dowel Clip; 3/8 inch X 7/8 inch X 7/8 inch

PART 3 – EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.

B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

A. Install suspension system and panels in compliance with ASTM C636, ASTM E580, with the authorities having jurisdiction, and in accordance with the manufacturer’s installation instructions, WoodWorks Grille Installation Instructions LA-297530.

B. Suspend main beam from overhead construction with hanger wires spaced 4 feet on center along the length of the main runner. Install hanger wires plumb and straight. The suspension system must be leveled to within ¼ inch in 10 feet and must be square to within 1/16 inch in 2 feet.

C. Install main beams 48 inches on center with 48 inch cross tees every 24 inches at 90 degrees to the main beam. Install the 24 inch cross tees at midpoints of the 48 inch cross tees.

D. Install wall moldings at intersection of suspended ceiling and vertical surfaces. Miter corners where wall moldings intersect or install corner caps.

E. Cut panel edges that are exposed to view will have to be treated to look like factory edges. Pre- finished peel and stick edge banding is recommended for this purpose.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken panels.

B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer’s instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

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SECTION 096240 - SPORT FLOORING

PART 1 - GENERAL

1.1 DESCRIPTION
A. Scope: This work comprises furnishing and complete installation of multipurpose sport flooring to include laying, gluing, and welding.

1.2 SUBMITTALS
A. Submit samples of the materials to be furnished for approval and color selections by the Architect.
B. Provide maintenance instruction literature in addition to warranty documentation specified herein.
C. Sustainability Submittals:
    1. Product Data: For adhesives and sealants, documentation including printed statement of VOC content.
    2. Product Data for Credit IEQ 4.3: For adhesives[and chemical-bonding compounds], documentation including printed statement of VOC content.
    3. Recycled material data. Provide for any material with recycled content:
        a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
        b. Material costs for each product having recycled content.
    4. Regional material data. Provide for each product manufactured within 500 miles:
        a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
        b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
        c. Material cost for product.

1.3 QUALITY ASSURANCE
A. The sport flooring installer supply a letter of certification from the flooring materials manufacturer stating that it is a current approved installer.
B. A conference meeting with Construction Manager, Flooring Installer, Flooring Materials Representative and the Architect shall be conducted prior to execution of this work.

1.4 PRODUCT DELIVERY
A. Floor materials shall not be delivered to the job site until the work of other trades in area to receive flooring has been completed.
B. Flooring material shall be stored in up-right position. Never store materials in a horizontal position.

1.5 JOB CONDITIONS
A. Environmental Requirements: The building shall be dry and enclosed. Permanent heat, light and ventilation shall be installed and operable. Flooring installation shall not begin until the installer is familiar with existing subfloor conditions. All work which would cause damage, dirt, dust or interruption of normal installation shall be completed. At least one week prior and during installation the room temperature must be maintained at a minimum of 65 degrees F. The installation area shall be closed to all traffic and activity.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Sport Floor: Shall be Sport Impact 10mm (3/8") thick prefabricated rubber sport flooring with smooth textured pattern as manufactured by Mondo America, Inc. (817/421-7861) or approved equal.
    1. Color: Shall be #008 “Black"
    2. Finish: Shall be "Sealskin"
    3. Roll goods width: 6'-0"
B. Underlayment: Shall be Mondo "Everlay" moisture barrier/underlayment.
C. Reducer: Roppe #26
D. Track and cap Transition: Roppe #154
E. Leveling Compound: Quality grade leveling compound as recommended by flooring manufacturer.
F. Adhesive: Shall be a two part polyurethane adhesive suitable for adherence of a sheet good to concrete substrate. Adhesive to be supplied or approved/recommended by the sport flooring manufacturer.
G. Miscellaneous: Provide incidental items required for complete installation.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas to receive sport flooring for conditions that will adversely affect the execution and quality of work. Do not start this work until unsatisfactory conditions are corrected.

B. Ensure that substrates are dry and exhibit neutral alkalinity. Moisture vapor emission tests (calcium chloride tests in accordance with ADTM F1869-98) are mandatory on various areas of the sub-floor prior to the beginning of installation of sport flooring.

3.2 PREPARATION

A. Surface Preparation: Surfaces shall be completely dry before flooring is laid.
   1. Sweep the surfaces clean and free of dirt and remove oil, grease, paint, dried mortar and curing compound residue.
   2. Fill cracks, grooves, voids and/or construction joints with leveling compound as approved by flooring manufacturer. High spots on the floor shall be removed by grinding down.
   3. Clean floor and apply and float feathering compound to leave smooth, flat, hard surface. Prohibit traffic until the feathering compound has cured.

3.3 INSTALLATION

A. The installation of the sport flooring shall be done in accordance with the manufacturer written instructions.
   1. Seam joints (heat welding method) as recommended by the manufacturer.

3.4 CLEANING

A. Clean sport flooring and replace defective or loose material. Remove any soiling foreign matter.

END OF SECTION

SECTION 096513 - RESILIENT BASE AND 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. Resilient base.
   2. Resilient molding accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Sustainability Submittals:
   1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
   2. Product Data for Credit IEQ 4.3: For adhesives, documentation including printed statement of VOC content.
   3. Product Data for Credit IEQ 4.3: For resilient stair accessories, documentation from an independent testing agency indicating compliance with the FloorScore standard.
   4. Recycled material data. Provide for any material with recycled content:
      a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
      b. Material costs for each product having recycled content.
   5. Regional material data. Provide for each product manufactured within 500 miles:
      a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
      b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
      c. Material cost for product.
C. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
D. Samples for Initial Selection: For each type of product indicated.
E. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
F. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Coordinate mockups in this Section with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg For more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. FloorScore Compliance: Resilient base shall comply with requirements of FloorScore certification.

B. Low-Emitting Materials: Flooring system 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."

2.2 THERMOSET-RUBBER BASE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Burke Mercer Flooring Products, Division of Burke Industries Inc.
   2. Flexco.
   3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
   1. Style and Location:
      a. Style B, Cove: Provide in areas with resilient flooring.

C. Thickness: 0.125 inch.

D. Height: 4 inch.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: Refer to Finish Legend.

2.3 RUBBER MOLDING ACCESSORY

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Roppe Corporation, USA.
   2. VPI, LLC, Floor Products Division.

B. Description: Rubber carpet edge for glue-down applications nosing for resilient flooring reducer strip for resilient flooring joiner for tile and carpet transition strips.

C. Profile and Dimensions: As indicated.

D. Locations: Provide rubber molding accessories in areas indicated.

E. Colors and Patterns: Refer to Finish Legend.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
   1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Miter corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum horizontal surfaces thoroughly.
   3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from resilient stair treads before applying liquid floor polish.
   1. Apply three coat(s).

E. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION

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SECTION 096516 - RESILIENT SHEET FLOORING

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. Sheet floor covering.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For each type of floor covering. Include floor covering layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.
C. Samples for Selection: For each type of floor covering indicated.
D. Product Schedule: For floor coverings. Use same designations indicated on Drawings.
E. Qualification Data: For qualified Installer.
F. Maintenance Data: For each type of floor covering to include in maintenance manuals.
G. Sustainable Submittals:
   1. Product data for adhesives, including printed statement of VOC content.
   2. Product data for for flooring compliant with FloorScore standard.
   3. Product data for products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content
   4. Product certificates for products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor covering installation and seaming method indicated.
   1. Engage an installer who employs workers for this Project who are trained or certified by floor covering manufacturer for installation techniques required.
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 mockups for floor coverings including resilient base and accessories.
      a. Size: Minimum 100 sq. ft. for each type, color and pattern in locations directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store floor coverings and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.6 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive floor coverings during the following time periods:
   1. 48 hours before installation.
   2. During installation.
   3. 48 hours after installation.
B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
C. Close spaces to traffic during floor covering installation.
D. Close spaces to traffic for 48 hours after floor covering installation.
E. Install floor coverings after other finishing operations, including painting, have been completed.

1.7 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. Floor Covering: Furnish quantity not less than 3% [insert value] in roll form and in full roll width for each color, pattern, and type of floor covering installed.

PART 2 - PRODUCTS

2.1 SHEET FLOOR COVERING

A. Products: Subject to compliance with requirements, provide products by one of the following:
   1. Ceres Wels PVC Free Sheet Flooring, in VS914 Slate color.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by manufacturer to suit floor covering and substrate conditions indicated.
   1. Use adhesives that have a VOC content of not more than 50 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
C. Seamless-Installation Accessories:
   1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
      a. Color: Match floor covering.
D. Integral-Flash-Cove-Base Accessories: As indicated in Master Schedule.
   1. Cove Strip: 1-inch radius provided or approved by manufacturer.
   2. Cap Strip: Square metal, vinyl, or rubber cap provided or approved by manufacturer.
   3. Corners: Metal inside and outside corners and end stops provided or approved by manufacturer.
E. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor coverings.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of floor coverings.
B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
   4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
D. Do not install floor coverings until they are same temperature as space where they are to be installed.
   1. Move floor coverings and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
E. Sweep and vacuum clean substrates to be covered by floor coverings immediately before installation.

3.3 FLOOR COVERING INSTALLATION

A. Comply with manufacturer's written instructions for installing floor coverings.

B. Unroll floor coverings and allow them to stabilize before cutting and fitting.

C. Lay out floor coverings as follows:

1. Maintain uniformity of floor covering direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in floor covering substrates.
3. Match edges of floor coverings for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut floor coverings to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend floor coverings into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, or openings that are in place or marked for future cutting by repeating on floor coverings as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor coverings on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of floor coverings installed on covers and adjoining floor covering. Tightly adhere floor covering edges to substrates that abut covers and to cover perimeters.

H. Adhere floor coverings to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and use welding bead to permanently fuse sections into a seamless floor covering. Prepare, weld, and finish seams to produce surfaces flush with adjoining floor covering surfaces.

J. Integral-Flash-Cove Base: Cove floor coverings up vertical surfaces a dimension as indicated. Support floor coverings at horizontal and vertical junction by cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor coverings.

B. Perform the following operations immediately after completing floor covering installation:

1. Remove adhesive and other blemishes from floor covering surfaces.
2. Sweep and vacuum floor coverings thoroughly.
3. Damp-mop floor coverings to remove marks and soil.

C. Protect floor coverings from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor covering before applying liquid floor polish.

1. Apply two coat(s).

E. Cover floor coverings until Substantial Completion.

END OF SECTION

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SECTION 096623

RESIN MATRIX TERRAZZO FLOORING

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. Thin-set epoxy-resin terrazzo flooring and base.

1.3 SUBMITTALS

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

B. Shop Drawings: Include terrazzo installation requirements. Include plans, elevations, sections, component details, and attachments to other work. Show layout of the following:
   1. Divider strips.
   2. Control-joint strips.
   3. Accessory strips.
   4. Abrasive strips.
   5. Terrazzo patterns.

C. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo sample to identify manufacturer's matrix color and marble-chip types, sizes, and proportions. Prepare samples of same thickness and from same material to be used for the Work in size indicated below:
   1. Terrazzo: 12-inch-square Samples.
   2. Accessories: 6-inch-long Samples of each exposed strip item required.

D. Installer Certificates: Signed by manufacturers certifying that installers comply with requirements.

E. Qualification Data: For qualified Installer.

F. Material Certificates: For each type of terrazzo material or product, from manufacturer attesting that materials meet specification requirements and are compatible with system.

G. Maintenance Data: For terrazzo to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Acceptable Supplier:
   1. Materials furnished must meet NTMA Specifications.

B. Installer Qualifications: A qualified installer who is acceptable to terrazzo manufacturer to install manufacturer's products, and a member of NTMA. If not an NTMA member, submit list of representative projects of comparable size and complexity.

C. Engage an installer who is certified in writing by terrazzo manufacturer as qualified to install manufacturer's products and can meet NTMA installation standards.

D. Engage an installer who is a contractor member of NTMA.

E. Source Limitations: Obtain primary terrazzo materials from one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.

F. Source Limitations for Marble Chips: Obtain each color, grade, type, and variety of granular materials from one source with resources to provide materials of consistent quality in appearance and physical properties.

G. NTMA Standards: Comply with NTMA's "Terrazzo Specifications and Design Guide" and with written recommendations for terrazzo type indicated unless more stringent requirements are specified.

H. 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 mockups for terrazzo including accessories.
      a. Size: Minimum 100 sq. ft. of typical poured-in-place flooring [and base] condition for each color and pattern in locations directed by Architect. Install and review with lighting levels comparable to final lighting.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.

B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting terrazzo installation.

B. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.

C. Provide permanent lighting conditions during terrazzo installation.

D. Close spaces to traffic during terrazzo application and for not less than 24 hours after application unless manufacturer recommends a longer period. Provide protective covering after installation to protect final appearance of terrazzo.

E. Control and collect dust produced by grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

1. Provide dustproof partitions and temporary enclosures to limit dust migration and to isolate areas from noise.

PART 2 - PRODUCTS

2.1 EPOXY-RESIN TERRAZZO

A. Products: Subject to compliance with requirements, manufacturers offering products to be incorporated into the Work include, but are not limited to the following:

1. Crossfield Products Corp., Dex-O-Tex Division.
2. General Polymers Corporation; Terrazzo.
3. Key Resin Company; Key Epoxy Terrazzo.

B. Materials:

1. Flexible Reinforcing Membrane: Manufacturer's resinous membrane for substrate crack preparation and reflective crack reduction.
2. Primer: Manufacturer's product recommended for substrate and use indicated.
3. Epoxy-Resin Matrix: Manufacturer's standard recommended for use indicated and in color required for mix indicated.

a. Physical Properties without Marble Chips:

1) Hardness: 60 to 85 per ASTM D 2240, Shore D.
2) Minimum Tensile Strength: 3000 psi per ASTM D 638 for a 2-inch specimen made using a "C" die per ASTM D 412.
3) Minimum Compressive Strength: 10,000 psi per ASTM D 695, Specimen B cylinder.
4) Chemical Resistance: No deleterious effects by contaminants listed below after seven-day immersion at room temperature per ASTM D 1308.
   a) Distilled water
   b) Mineral water.
   c) Isopropanol.
   d) Ethanol.
   e) 0.025 detergent solution.
   f) 1% soap solution.
   g) 10% Sodium Hydroxide.
   h) 10% Hydrochloric acid.
   i) 30% Sulfuric acid.

b. Physical Properties with Marble Chips: For resin blended with Georgia white marble, ground, grouted, and cured per requirements in NTMA's "Terrazzo Specifications and Design Guide," comply with the following:

1) Flammability: Self-extinguishing, maximum extent of burning 0.25 inch per ASTM D 635.
2) Thermal Coefficient of Linear Expansion: 0.0025 inch/inch per deg F for temperature range of minus 12 to plus 140 deg F per ASTM D 696.
3) Bond Strength: 100% concrete failure with 300 psi tensile strength, per ACI 403 Bulletin Title 59-43.

4. Marble Chips: Complying with NTMA gradation standards for mix indicated and containing no deleterious or foreign matter.
    a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C 131.
    b. 24-Hour Absorption Rate: Less than 0.75 percent.
    c. Dust Content: Less than 1.0 percent by weight.
    d. Recycled Content: Provide products with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than [Insert value] percent.
5. Finishing Grout: Resin based.

C. Terrazzo: Comply with NTMA's "Terrazzo Specifications and Design Guide" and manufacturer's written instructions for matrix and marble-chip proportions and mixing.
1. Formulated Mix Color and Pattern: As scheduled.

2.2 STRIP MATERIALS

A. Thin-Set Divider Strips: Straight or L-type angle, as required by terrazzo type indicted in depth required for topping thickness indicated.
1. Material: White-zinc alloy.
2. Top Width: [1/8] [1/4] 3/8] inch.

B. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material, thickness, and color of divider strips and in depth required for topping thickness indicated.

C. Accessory Strips: Match divider strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base-bead strips for exposed top edge of terrazzo base.
2. Edge-bead strips for exposed edges of terrazzo.

D. Abrasive Strips: Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
1. Width: 1/2 inch.
2. Depth: As required by terrazzo thickness.
3. Length: 4 inches 100 mm less than stair width.
4. Color: As selected by Architect from manufacturer's full range.

2.3 MISCELLANEOUS ACCESSORIES

A. Strip Adhesive: Epoxy-resin adhesive recommended by adhesive manufacturer for this use and acceptable to terrazzo manufacturer.
1. Use adhesives that have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Anchoring Devices:
1. Strips: Provide mechanical anchoring devices for strip materials as required for secure attachment to substrate.
2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.

C. Patching and Fill Material: Terrazzo manufacturer's resinous product approved and recommended by manufacturer for application indicated.

D. Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by sealer manufacturer for use on terrazzo type indicated.

E. Sealer: Slip- and stain-resistant penetrating-type sealer that is chemically neutral with pH factor between 7 and 10; does not affect color or physical properties of terrazzo; is recommended by sealer manufacturer; and complies with NTMA's "Terrazzo Specifications and Design Guide" for terrazzo type indicated .

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.

B. Concrete Slabs:
1. Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with terrazzo.
a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
b. Repair damaged and deteriorated concrete according to terrazzo manufacturer's written recommendations.
c. Use patching and fill material to fill holes and depressions in substrates according to terrazzo manufacturer's written instructions.
2. Verify that concrete substrates are visibly dry and free of moisture.
3. Moisture Testing:
a. Test for moisture by anhydrous calcium chloride method according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Test for moisture by relative humidity probe and digital meter method according to ASTM F 2170 or as otherwise recommended by manufacturer. Proceed with installation only after substrates have a maximum relative-humidity-measurement reading of 70 to 75 percent in 24 hours.

C. Protect other work from dust generated by grinding operations. Control dust to prevent air pollution and comply with environmental protection regulations.
1. Erect and maintain temporary enclosures and other suitable methods to limit dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

D. Installation of terrazzo indicates acceptance of surfaces and conditions.

3.3 EPOXY-RESIN TERRAZZO INSTALLATION

A. General:
1. Comply with NTMA's written recommendations for terrazzo and accessory installation.
2. Place, rough grind, grout, cure grout, fine grind, and finish terrazzo according to manufacturer's written instructions and NTMA's "Terrazzo Specifications and Design Guide."
3. Installation Tolerance: Limit variation in terrazzo surface from level to 1/4 inch in 10 feet; non-cumulative.
4. Ensure that matrix components and fluids from grinding operations do not stain terrazzo by reacting with divider and control-joint strips.
5. Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted.

B. Thickness: As recommended by manufacturer, but not less than 3/8 inch9.5 mm nominal.

C. Primer: Apply to terrazzo substrates according to manufacturer's written instructions.

D. Strip Materials:
1. Divider and Control-Joint Strips:
a. Locate divider strips in locations indicated.
b. Install control-joint strips back to back directly above concrete-slab control joints.
c. Install control-joint strips with 1/4-inch gap between strips, and install sealant in gap.
d. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
2. Accessory Strips: Install accessory strips as required to provide a complete installation.
3. Abrasive Strips: Install with surface of abrasive strip positioned 1/16 inch higher than terrazzo surface.

E. Fine Grinding: Grind with stones 120 grit or finer until all grout is removed from surface. Repeat rough grinding, grout coat, and fine grinding if large voids exist after initial fine grinding. Produce surface with a minimum of 70 percent aggregate exposure.

F. Repair: Remove and replace terrazzo areas that evidence lack of bond with substrate. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.4 CLEANING AND PROTECTION

A. Cleaning:
1. Remove grinding dust from installation and adjacent areas.
2. Wash surfaces with cleaner according to NTMA's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow to dry thoroughly.

B. Sealing:

1. Seal surfaces according to NTMA's written recommendations.
2. Apply sealer according to sealer manufacturer's written instructions.

C. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION

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SECTION 096813 - TILE CARPETING

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 modular, carpet tile.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
      a. Review delivery, storage, and handling procedures.
      b. Review ambient conditions and ventilation procedures.
      c. Review subfloor preparation procedures.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:
   1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
   2. Carpet tile type, color, and dye lot.
   3. Type of subfloor.
   4. Type of installation.
   5. Pattern of installation.
   6. Pattern type, location, and direction.
   7. Pile direction.
   8. Type, color, and location of insets and borders.
   9. Type, color, and location of edge, transition, and other accessory strips.
   10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build mockups at locations and in sizes shown on Drawings.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.10 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.11 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
   3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Basis of Design Product: Refer to Finish Legend.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
   1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

2. Subfloor finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
4. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
5. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
6. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
7. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

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

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
B. Installation Method: As recommended in writing by carpet tile manufacturer.
C. Maintain dye lot integrity. Do not mix dye lots in same area.
D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
    1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
    2. Remove yarns that protrude from carpet tile surface.
    3. Vacuum carpet tile using commercial machine with face-beater element with HEPA filter.
B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

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SECTION 098116 - ACOUSTICAL BLANKET INSULATION

PART 1 - GENERAL

1.1 SUMMARY
- A. This Section includes the following:
  1. Concealed building insulation.
- B. Related Sections include the following:
  1. Division 09 Sections "Gypsum Board" for installation in metal-framed assemblies of insulation specified by reference to this Section.

1.2 ACTION SUBMITTALS
- A. Product Data: For each type of product indicated.

1.3 QUALITY ASSURANCE
- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
  1. Surface-Burning Characteristics: ASTM E 84.
  2. Fire-Resistance Ratings: ASTM E 119.
  3. Combustion Characteristics: ASTM E 136.

1.4 DELIVERY, STORAGE, AND HANDLING
- A. Protect insulation materials from physical damage and from deterioration by 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 MANUFACTURERS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Glass-Fiber Insulation:
     a. CertainTeed Corporation.
     b. Johns Manville Corporation.
     c. Owens Corning.
  2. Slag-Wool-/Rock-Wool-Fiber Insulation:
     a. Fibrex Insulations Inc.
     b. Owens Corning.
     c. Thermafiber.

2.2 INSULATING MATERIALS
- A. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
  1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
  2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.
- B. General: Provide insulating materials that comply with requirements and with referenced standards.
  1. Preformed Units: Sizes to fit applications indicated x full thickness of stud; selected from manufacturer's standard thicknesses, widths, and lengths.
- C. Unfaced Mineral-Fiber Blanket Insulation (in walls): ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- D. Unfaced, Flexible Glass-Fiber Board Insulation (above ceilings): ASTM C 612, Type IA; ASTM C 553, Types I, II, and III; or ASTM C 665, Type I; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively; and of the following properties:
  1. Nominal density of 1.0 lb/cu. ft., thermal resistivity of 3.7 deg F x h x sq. ft./Btu x in. at 75 deg F.
  2. Nominal density of not less than 1.5 lb/cu. ft. nor more than 1.7 lb/cu. ft., thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.

3. Combustion Characteristics: Passes ASTM E 136.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

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

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF GENERAL BUILDING INSULATION

A. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

1. Use blanket widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping stapling flanges to flanges of metal studs.

3.5 PROTECTION

A. Protect installed insulation and vapor retarders 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

SECTION 099100 - PAINTING

PART 1 GENERAL

1.1 SUMMARY

A. Related Documents: General and Supplementary Conditions of the Contract, Division 01 General Requirements, and Drawings are applicable to this Section.

B. Section Includes:

1. Complete interior and exterior surface preparation and finishing for field application of latex based coatings, and requirements for field finishing mechanical and electrical equipment.
2. Examine specifications for various other trades and their provisions regarding their painting. Surfaces that are left unfinished by other sections of the specifications shall be painted or finished as a part of this Section.
3. Colors, including deep tones, will be selected by the Architect. Number of colors to be used on job will be determined by Architect.

1.2 SURFACES NOT TO RECEIVE FIELD FINISHING

A. Do not paint copper, bronze, chrome plated items, nickel, stainless steel, Monel metal, lead, face brick, prefinished wall, ceiling, and floor coverings, items with factory applied final finish (except where exposed on roofs and in finished spaces), elevator shafts, crawl spaces, chases, and plenums above suspended ceilings unless otherwise specified or scheduled.

1.3 DEFINITIONS

A. Conform to ASTM D16 for interpretation of terms used in this Section.

1.4 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality paint and finish products with 3 years experience.

B. Applicator: Company specializing in commercial painting and finishing with 2 years experience.

C. Product Labels: Include manufacturer's name, type of paint, stock number, color and label analysis on label of containers.

1.5 REGULATORY REQUIREMENTS

A. Conform to applicable building code for flame spread/fuel contribution/smoke development rating requirements for finishes.

B. Comply with applicable city, county, state, and federal requirements and ordinances regarding maximum VOC (Volatile Organic Compound) content of all coatings.

1.6 TESTS

A. Provide periodic testing with Wet Film Thickness gage to verify that proper thickness of finish coatings are being applied.

1.7 SUBMITTALS

A. Submit product data under provisions of Section 013300.

B. Provide product data describing physical performance criteria and composition on all finishing products.

C. Submit color selection samples under provisions of Section 013300.

D. Submit 2 samples, 12 by 12 inches in size illustrating range of colors and textures selected for each surface finishing product scheduled.

E. Submit manufacturer's application instructions under provisions of Section 013300.

F. Submit certification from manufacturer of coatings listing all products proposed for each. Certify that each product meets current applicable regulations and ordinances regarding maximum VOC content.

G. Sustainable Submittals:

1. For products having recycled content, provide documentation indicating percentages, by weight, of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
2. Identify each regional material along with the location of its harvest, extraction, or manufacture. Include material cost for each item.
3. For paints and coatings, provide printed statement of VOC content confirming compliance with maximum allowable content per Section 013520.

1.8 FIELD SAMPLES

A. Provide field samples under provisions of Section 014500.
B. Provide field sample panel, 96 inches long by 96 inches wide, illustrating each coating color, texture, and finish intended for use.
C. Locate where directed.
D. Accepted sample may remain as part of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Section 016000.
B. Store and protect products under provisions of Section 016000.
C. Deliver products to site in sealed and labeled containers; inspect to verify acceptance.
D. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation, and instructions for mixing and reducing.
E. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in well ventilated area, unless required otherwise by manufacturer's instructions.
F. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the ranges required by paint manufacturer.
B. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees F for 24 hours before, during, and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.
C. Do not apply exterior coatings during rain or snow, or when relative humidity is above 75 percent, unless required otherwise by manufacturer's instructions.
D. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors; 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
E. Minimum Application Temperature for Varnish and Finishes: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.
F. Provide lighting level of 80 ft candles measured mid- height at substrate surface.

1.11 EXTRA STOCK

A. Provide a 5 gallon container of each color to Owner.
B. Label each container with color, color number, texture, and room locations, in addition to the manufacturer's label.
C. Furnish under provisions of Section 017800.

1.12 SCAFFOLDS AND PROTECTION

A. Provide adequate safe ladders, scaffolds, and stages necessary to complete work.
B. Protect completed finish and paint work, and protect adjacent finish surfaces from paint splatter, spills and stains. Use adequate drop cloths and masking procedures during progress of work.

1.13 PRECAUTIONS

A. Do not store paints, oils, thinners and other flammable items inside the building and shall be stored in approved containers when not in actual use during the painting job. The fire hazard shall be kept at a minimum.
B. Precaution shall be taken to protect the public and construction workers during the progress of the work.
C. Furnish a temporary fire extinguisher of suitable chemicals and capacity, located near flammable materials.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements indicated, provide products of one of the following:
   1. Sherwin-Williams.
B. Materials selected for coating systems for each type surface shall be product of a single manufacturer unless otherwise specified. Secondary products such as linseed oil, turpentine and shellacs shall be first quality products of a reputable manufacturer.
C. Products specified in Schedule are those of Glidden Professional as a standard of quality unless otherwise noted.

2.2 MATERIALS

A. Coatings: Ready mixed. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating with good flow and brushing properties; capable of drying or curing free of streaks or sags.

B. Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

C. Patching Materials: Latex filler.

2.3 FINISHES

A. Color: Refer to Finish Legend.

2.4 INTERIOR PAINT SCHEDULE

A. Drywall (Gypsum):
   1. Acrylic Latex:
      a. Sherwin-Williams: 1 coat High Build Latex Primer B28W8601, 2 coats Sherwin-Williams ProMar 200 Zero VOC.

B. Wood Base and Trim (opaque):
   1. Acrylic Latex:
      a. Sherwin-Williams: 1 coat Premium Wall & Wood Primer B28W8111, 2 coats Sherwin-Williams ProMar 200 Zero VOC.

C. Wood Base and Trim (transparent):
   1. Water-Based Varnish:
      a. Sherwin-Williams: 1 coat Wood Classics Oil Stain A49-200 Series, 2 coats Sherwin-Williams Wood Classics Waterborne Polyurethane Varnish A68 Series.

D. CMU, Concrete Block:
      a. Sherwin-Williams: 1 coat Cement-Plex B42W200/B42V201 primer, 2 coats Sherwin-Williams Water Based Catalyzed Epoxy B70 Series.

E. Galvanized Metal:
   1. High Performance Coating, Water Based Acrylic
      a. Sherwin-Williams: Semi-Gloss 2 coats Sherwin-Williams Zero VOC Acrylic Semi-Gloss B66-650 Series.

F. Shop Primed Ferrous Metal:
   1. High Performance Coating, Water-Based Acrylic:
      a. 2 topcoats Sherwin-Williams Zero VOC Acrylic Eg-Shel B66-660 Series.

G. Handrails, Stairs, and Guardrails:
   1. High Performance Coating, Urethane:
      a. Sherwin-Williams: 1 coat Recoatable Epoxy Primer B67A5, 2 coats Sherwin-Williams Hi-Solids Polyurethane, B65W351 Series.

H. Decking (Preprimed/Prefinished), Bar Joists (Shop Primed):
   1. Water-Based Acrylic Dry Fall:
      a. Sherwin-Williams: 2 coats Low VOC Waterborne Acrylic Dryfall Flat B42W81 over Prepared substrate.

2.5 EXTERIOR PAINT SCHEDULE

A. Structural Iron and Ferrous Steel:
   1. Urethane High Performance Coating, :
      a. Sherwin-Williams: 1 coat Waterbased Tile Clad Epoxy Primer B73A200, 2 coats Sherwin-Williams Acrolon 218 HS Acrylic Polyurethane B65-650 topcoat.

B. Shop Primed Metal Doors, Trim, Panels and Miscellaneous Surfaces:
   1. High Performance Coating, Urethane: (rust inhibitive, UV stable)
      a. Sherwin-Williams: 1 coat Recoatable Epoxy Primer B67A5, 2 coats Acrolon 218 HS Polyurethane B65W611.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report to Architect any condition that may potentially affect proper application.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums
   1. Plaster and Gypsum Wallboard: 12 percent.
   2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
   3. Interior Located Wood: 15 percent, measured in accordance with ASTM D2016.
   4. Exterior Located Wood: 15 percent, measured in accordance with ASTM D2016.
   5. Concrete Floors: 8 percent.
D. Test shop applied primers for compatibility with subsequent cover materials.
E. Beginning of installation means acceptance of existing surfaces and substrate.

3.2 PREPARATION

A. Remove electrical plates, hardware, light fixture trim, and fittings prior to preparing surfaces or finishing.
B. Correct minor defects and clean surfaces which affect work of this Section. Remove existing coatings which exhibit loose surface defects.
C. Shellac and seal marks which may bleed through surface finishes.
D. Impervious Surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
E. Aluminum Surfaces Scheduled for Paint Finish: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
F. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
G. Concrete Floors: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
H. Gypsum Board Surfaces: Latex fill minor defects. Spot prime defects after repair.
I. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
J. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
K. Uncoated Steel and Iron Surfaces: Remove grease, scale, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
L. Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
M. Interior Wood Items Schedule to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats.
N. Exterior Wood Scheduled to Receive Transparent Finish: Remove dust, grit, and foreign matter; seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes with tinted exterior caulking compound after sealer has been applied.
O. Shop Finished Items: Finish in accordance with AWI standards and guide lines.
P. Glue-Laminated Beams: Prior to finishing, wash surfaces with solvent, remove grease and dirt.
Q. Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 SURFACE PREPARATION OF PREVIOUSLY COATED SURFACES

A. General:
   1. Remove cracked and deteriorated sealants and calking.
   2. Remove chalk deposits and loose, blistered, peeling, scaling, or crazed finish to bare base material or sound substrate by scraping and sanding.
   3. Wash surfaces with solution of TSP to remove wax, oil, grease, and other foreign material; rinse, and allow to dry. Exercise caution that TSP solution does not soften existing coating.
   4. Abrade glossy surfaces by sanding or wiping with liquid de-glosser.
   5. Remove mildew as specified above.
   6. Test compatibility of existing coatings by applying new coating to small, inconspicuous area. If new coatings lift or blister existing coatings, request recommendation from Architect.
   7. Apply specified primer to surfaces scheduled to receive coatings.
B. Gypsum Wallboard:
   1. Fill cracks and voids with spackling compound.
   2. Apply primer over bare surfaces and newly applied texture coatings.

C. Metal:
   1. Remove rust from surfaces to bare metal in accordance with SP3 "Power Tool Cleaning".
   2. Exercise care not to remove galvanizing.
   3. Complete preparation as specified for new work.
D. Wood:
   1. Fill cracks, crevices and nail holes with putty or wood filler.
   2. Apply primer over bare surfaces and filler material.

3.4 PROTECTION

A. Protect elements surrounding the work of this Section from damage or disfiguration.
B. Repair damage to other surfaces caused by work of this Section.
C. Furnish drop cloths, shields, and protective methods to prevent spray or droppings from disfiguring other surfaces.
D. Remove empty paint containers from site.

3.5 APPLICATION

A. The intent of these Specifications is to produce the highest quality appearance of paint and finish surfaces. Employ skilled mechanics only. The proper preparation of all surfaces will be strictly enforced and wherever finished surfaces show any defects due to improper preparation, workmanship, etc., the defects shall be removed and the work refinished at the expense of the Contractor.
B. Apply products in accordance with manufacturer's instructions. Final finish coats shall have visual evidence of solid hiding and uniform appearance, and shall be free and smooth of brush marks, streaks, sags, runs, laps, or skipped areas.
C. Do not apply finishes to surfaces that are not dry.
D. Apply each coat to uniform finish and thickness.
E. Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
F. Wet sand (or use vacuum sander) lightly between coats on wood and metal items to achieve required finish.
G. Allow applied coat to dry before next coat is applied.
H. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
I. Prime back surfaces of interior and exterior woodwork scheduled to be painted with primer paint.
J. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.
K. Edges of paint adjoining other materials or colors shall be sharp and clean with no overlapping.

3.6 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint all shop primed equipment. Paint shop prefinished items where exposed to view in finished spaces. In mechanical rooms, repair shop pre-finished coatings which have been scratched or otherwise damaged with identical touch-up paint. Sand prior to touching up as required.
B. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
C. Paint all grilles, registers, diffusers, and speaker grilles to match adjacent wall and ceiling surfaces, except that factory pre-finished items need not be painted if installed in a suspended acoustical ceiling system where the acoustical panels match the mechanical or electrical item color.
D. In all finished spaces, prime and paint exposed pipes, conduit, boxes, ducts, hangers, brackets, collars and supports. Paint to match adjacent surfaces.
E. Repair or replace identification markings on mechanical or electrical equipment when painted accidentally.
F. Paint interior surfaces of air ducts and convectors that are visible through grilles and louvers with one coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvers, grilles, and convector to match face panels.
G. Paint all surfaces of plywood backboards for electrical and telephone equipment before installing equipment.
H. Replace electrical plates, hardware, light fixture trim, and fittings removed prior to finishing.
I. Paint exposed air handlers, roof ventilators, goose necks, exhaust fans and other items on the roof with 2 coats exterior enamel. Prepare surfaces in accordance with the base metal or primer as specified herein.
J. Paint concrete support bases with gray floor deck enamel.
K. Pipe hangers and other supports need not be painted except where installed in crawl spaces, where they shall be painted with a thick coat of asphaltic paint.
L. Electrostatically paint air purification units in apparatus bays.

3.7 CLEANING/TOUCH-UP

A. As Work proceeds, promptly remove paint where spilled, splashed, or spattered.

B. During progress of Work maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Collect cotton waste, cloths, and material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

D. Spot painting will be allowed to correct soiled or damaged paint surfaces only when touch-up spot will blend into surrounding finish and is invisible to normal viewing (as determined by the Architect). Otherwise, re-coat entire section to corners or to a visible stopping point.

3.8 V.O.C. (VOLATILE ORGANIC COMPOUND) COMPLIANCE

A. Products listed in following schedule and/or substitutes proposed for use by Contractor must be formulated to meet all applicable ordinances and regulations regarding maximum V.O.C. content. Utilize products which have been specially formulated to need such requirements.

END OF SECTION

SECTION 099450 - DECORATIVE EXTERIOR FINISH SYSTEM

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 surface preparation and field application of elastomeric decorative exterior finish system (DEFS) to the following:
   1. Exterior soffits.

1.3 QUALITY ASSURANCE

A. Factory Mutual Class I Rating.
B. ASTM E 84 Flame spread classification 0 to 10.

1.4 QUALIFICATIONS

A. Installer: Minimum of 5 years experience and manufacturer's written approval on manufacturer's company letterhead.
B. Manufacturer:
   1. Minimum of 5 years experience producing component materials for system installed in this country.
   2. Member of Exterior Insulation Manufacturers Association (EIMA).
C. Single Source Responsibility: Obtain approved DEFS materials from a single manufacturer.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Indicate project specific details identifying transitions to dissimilar materials and other representations to evaluate the proposed system installation requirements.
B. Product Data: Submit copies of manufacturer's product data sheets and printed installation instructions for each product proposed for use in accordance with Section 01300.
C. Samples: Submit three 1'-0" by 1'-0" samples of selected finish color and texture for approval by Architect.
D. Maintenance Kit: Supply maintenance kit, with unopened containers to repair a minimum of 20 square foot area.
E. Test reports certifying entire system has passed ASTM E 84 and ASTM E 108, modified for vertical walls for Class A.

1.6 MOCK-UP

A. Provide under provisions of Section 014000.
B. Construct one field sample panel, of size required to illustrate color and texture of the final coating.
   1. Obtain Architect's acceptance of mock-up's visual qualities before start of final work.

1.7 PRODUCT DELIVERY AND STORAGE

A. Deliver and store products in original unopened packaging with legible manufacturer's identification, in accordance with Section 016000.
B. Store products in a cool (not less than 40 degrees F) dry place out of direct sunlight, protected from the elements and from damage, in accordance with Section 016000.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Weather and Environmental Conditions
   1. Application of the system shall not take place during inclement weather unless appropriate protection is employed.
   2. Installation of wet materials in temperatures less than 40 degrees F shall take place only if supplementary heat is provided and is maintained for a minimum of 24 hours after application of the wet materials.
B. Protection
   1. Protect surrounding areas and surfaces during application of wall system.

1.9 WARRANTY

A. Provide 5 year labor and material warranty.
B. Installer: Provide 2 year warranty on workmanship related to DEFS application.
C. Warranty to cover:
   1. Material defects including but not limited to, peeling, cracking, delamination, flaking, finish degradation or similar failures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:
   1. Dryvit Systems, Inc., West Warwick, RI.
   2. Finestone, Adrian, MI.
   3. Parex Inc., Redan, GA
   4. Pleko Products, Astoria, NY
   5. Senergy Methods, Cranston, RI.
   6. STO Industries, Atlanta, GA.
   7. TEIFS Wall Systems, San Antonio, TX
B. Acceptable Products:
   1. Weatherlastic by Dryvit or as otherwise required to match other EIFS finish coat over cement plaster.
C. Substitutions: Submit in accordance with Section 012500.

2.2 MATERIALS

A. Finish Coat: Factory mixed, 100 percent acrylic with elastomeric binder with texture. Integral color and texture to match existing hospital EIFS.
B. Base Coat: Fiber reinforced 100 percent acrylic-based providing a high-build leveling coat.
   1. Acceptable Product: Dryvit Genesis.
C. Reinforcing Mesh: Balanced, open weave, standard weight, glass fiber reinforcing mesh; twisted multi-end strands treated for compatibility with Direct Finish System components.
D. Portland Cement: ASTM C 150, Type I or II, as approved by DEFS system manufacturer.
E. Primers: As required by the DEFS manufacturer.
F. Water: Clean and potable.
G. Reglets: Refer to Section 092900.

2.3 MIXING AND PREPARATION

A. Perform according to manufacturer's recommendations.
B. Finish Coat: Thoroughly mix factory-prepared finish material with the manufacturer's recommended mixer until a uniform workable consistency is attained.
   1. A small amount of clean, potable water may be added to adjust workability.
   2. Use no additives such as rapid binders, antifreeze, or accelerators.
   3. Finish Coating: Use immediately after mixing. Keep containers closed when not in use.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that conditions are satisfactory for the installation of materials. If unsatisfactory conditions exist, report them in writing to the Architect and do not commence any installation until such conditions have been corrected.
B. Examine surfaces to receive the system for:
   1. Substrates contrary to recommendations of the system manufacturer.
   2. Defects such as coatings on the substrate that will adversely affect the execution and quality of work.
   3. Deviations beyond allowable tolerances for installation of substrate material. The substrate shall have no plan or irregularities greater than 1/8 inch over 10 foot dimension.
   4. Confirm manufacturer's current requirements for control joint placement.

3.2 INSTALLATION

A. General: Install in accordance with system manufacturer's printed instructions.

B. Base Coat: Apply at rate and in manner recommended by system manufacturer. Follow with reinforcing mesh.

C. Finish:

1. Using clean stainless steel trowel, apply light coat of finish material directly to the skim coat.
    a. Apply and level during the same operation to the minimum attainable thickness consistent with uniform coverage.
    b. Apply and texture finish continually over an entire surface.
    c. Work to corners or joints, and do not allow the material to set up within a distinct wall area.
    d. Furnish sufficient staging and workmen to accomplish a uniform appearance.
2. Achieve final texture after veneer finish has jelled so that it does not stick to the trowel.
3. Final Texture: As selected by Architect.
4. Final Thickness: Not greater than diameter of largest aggregate of finish material.

3.3 TOUCH-UP

A. After installation, touch-up areas where finish coat has been damaged with manufacturer's recommended primer compatible with finish coat.

B. Touch-up so that repair is not obvious.

3.4 COMPLETION

A. Exposed surfaces shall be clean and free from scratches, dents, tool marks, stains, discoloration, and other defects and damage.

3.5 CLEANUP

A. Remove extra materials and debris from job site.

B. Clean adjacent materials and surfaces and the work area of foreign materials resulting from the Work.

END OF SECTION

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SECTION 101100 - VISUAL DISPLAY BOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Visual display boards.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.

B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of panel joints.
   2. Show locations of special-purpose graphics for visual display surfaces.
   3. Include sections of typical trim members.

C. Sustainable Submittals:
   1. Product data and certification letter indicating percentages by weight of post-consumer and pre-consumer recycled content for products having recycled content.
   2. Product data for products containing composite wood or agrifiber products or wood adhesives indicating that they do not contain urea-formaldehyde resin.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, pre-fit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display surfaces vertically with packing materials between each unit.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings 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.

B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
   1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.5 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Surfaces lose original writing and erasing qualities.
      b. Surfaces exhibit crazing, cracking, or flaking.
   2. Warranty Period: . 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Claridge Products and Equipment, Inc.
      b. PolyVision Corporation; a Steelcase company.
      c. Best-Rite Manufacturing.
      d. Egan Visual Inc.
   2. Gloss Finish: Gloss as indicated; dry-erase markers wipe clean with dry cloth or standard eraser.

B. Hardboard: ANSI A135.4, tempered.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.
D. Board Color: White.
E. Acceptable Product: LCS-II Series 5 Unit as manufactured by Claridge, or approved equal,
1. Face sheet finish shall be Low Gloss #75
2. Cork: #1100 Tan cork tack strip
3. Trim Finish: Shall be Satin anodized aluminum
4. Provide map rail hook
5. Installation Locations: Refer to Drawings.

2.2 MARKERBOARD ASSEMBLIES
A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch- thick, porcelain-enamel face sheet with high-gloss finish.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Best-Rite Manufacturing.
b. Claridge Products and Equipment, Inc.
c. PolyVision Corporation; a Steelcase company.
d. Egan Visual Inc.
2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

2.3 MARKERBOARD ACCESSORIES
A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; standard size and shape.
1. Factory-Applied Trim: Manufacturer's standard.
B. Chalktray: Manufacturer's standard, continuous.
1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
C. Map Rail: Provide the following accessories:
1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
2. End Stops: Located at each end of map rail.
3. Map Hooks: Two map hooks for every 48 inches of map rail or fraction thereof.

2.4 FABRICATION
A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
B. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints,.
2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
3. Provide manufacturer's standard mullion trim at joints between markerboards and tackboards of combination units.
4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim [as indicated] or [as selected by Architect] from manufacturer's standard structural support accessories to suit conditions indicated.
C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.5 ALUMINUM FINISHES
A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 INSTALLATION,

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Visual Display Boards: Attach visual display boards to wall surfaces with adhesive gobs at 16 inches o.c., horizontally and vertically.

END OF SECTION

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SECTION 101400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Related Documents: Provisions established in Conditions of the Contract, Division 01 - General Requirements, and the Drawings are collectively applicable to this Section.

B. Section Includes

1. Identifying devices where shown on the Drawings complete and as specified including the following:
   a. Parking signs indicating accessible spaces.
   b. Pin mounted building identification signs.
   c. Interior code required signs.
   d. Cast bronze dedication plaque.
2. Coordination for installation of signage provided by others.

1.2 SUBMITTALS

A. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

B. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, accessories, layout, and installation details.

C. Samples for Verification:

1. Physical: Submit samples of one competed sign for review and approval. Approved sample may be incorporated into Project.
2. Color: Submit manufacturer's standard color selection chart. Do not proceed until colors have been selected.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: For each separate type of sign required, obtain signs from one source from a single manufacturer.

B. Manufacturer shall have a minimum of five years experience in the manufacturing of signs specified.

C. Codes and Standards:

1. Panel signs shall have 1/32-inch raised copy and grade 2 Braille, and shall comply with all existing federal, state, and local accessibility standards.
2. Code and Standards: Comply with American with Disabilities Act of 1990, Title 3 Provisions, Public Accommodations and Commercial Facilities. Updated March 15, 2012.
3. Comply with the State of Texas Accessibility Standards, 2012 edition, as administered by the Texas Department of Licensing and Regulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with requirements herein, provide products from one of the following:

1. Best Manufacturing Company, Montrose, Colorado.
2. Mohawk Sign Systems, Schenectady, New York.
3. Nelson-Harkins, Chicago, Illinois.
4. ASI Signs, Dallas, Texas.

B. Substitutions: Under provisions of Section 012500.

2.2 HANDICAPPED PARKING

A. Screen Printed Signs:

1. 18 gauge bonderized steel with blue baked enamel finish and white screen printed copy.
2. Copy and Size:
   a. "Handicapped Parking Only" - 12 inches by 18 inches.
   b. "Van Accessible" - 12 inches by 6 inches.
3. Acceptable Product: Best Traffic Signs No. SS04 with SS52 as required.

B. Post: Galvanized pipe column minimum 9 feet long.

2.3 BUILDING IDENTIFICATION SIGNAGE

A. Aluminum Sign: Shall be aluminum reverse channel numeral as manufactured by Butner Brothers (405-321-2322).
B. Color shall be selected from full range of manufacturer's selection. Refer to plans for details and electrical requirements.
C. .125" thick Aluminum Face and 0.63" Thick Aluminum Return
D. Spot weld with NO visible welds
E. Provide 3/16" Clear Polycarbonate "Bird Guard"
F. Powdercoat Finish.
G. "Calisto" font.
H. LED Lighting shall be "thin LED" LED lighting as manufactured by Sloan LED (888-747-4533).

2.4 ROOM SIGNAGE SYSTEMS

A. Acceptable Manufacturers:
   1. ASI Sign Systems, 3890 W. Northwest Highway, Suite 102, Dallas, TX 75220; (214) 352 9140 telephone; (214) 352 9741 facsimile; (800) ASI-SPEC (274-7446).
   2. Substitutions: Submit in accordance with Section 016000.
B. Plastic Signs: Shall be nominal 11.375" x 8.375" plastic sign with raised text and Grade 2 Braille as distributed by Just Bathroom Signs Model SE-2031 or approved equal.
C. Plaque color to be S34 Slate with white letters and trim. Letter style to be selected by Architect from full range of available fonts.
D. Names: Name signs shall be installed on the outside face of doors. Furnish a name sign for each of the following doors.
E. Sign Legend Door Number

2.5 BUILDING PLAQUE

A. Plaque shall be as manufactured by The Southwell Company, P.O. Box 299, San Antonio, Texas 78291 or approved equal. Tablet shall be cast of virgin ingots (85-5-5-5 Standard U. S. bronze alloy). Casting shall be free of pits and gas holes and all letters shall be sharp and hand tooled. Border and faces of raised letters shall be satin/brushed finish and background shall be leatherette finish. Plaque shall be chemically cleaned and etched and treated with Alodine and sprayed with two coats of Clear Acrylic Lacquer.
B. Size: To be determined.
C. Border Design: Raised, satin/brushed finish.
D. Letter style: "Helvetica" satin/brushed finish.
E. Background: Leatherette finish, Oxidized-Dark Bronze.
F. Text: Include Project Name, Year Contract Awarded, Names of City Council at time of award of General Contract, and Names of Architect and General Contractor, etc.
G. Refer to Section 012100 for allowance.

PART 3 - EXECUTION

3.1 DELIVERY AND STORAGE

A. Deliver and store identifying devices in protective wrappings until ready for installation. Install letters in protective wrappings and remove wrappings just prior to substantial completion.

3.2 INSTALLATION

A. Install signs plumb, level and square and in proper planes with other work, at heights required by accessibility codes and standards.
B. Anchor each plastic laminate sign with adhesive.
C. Install signs with sufficient amount of foam tape for proper installation.
D. Attach as recommended by sign manufacturer.
E. Anchor each sign with adhesive.
F. Coordinate arrival and installation of graphic signs with hardware installation. Graphic signs function as and are coordinated with the hardware as shown on the Drawings.
G. Room name signs shall be placed on the public side of the door except where noted otherwise.
H. Single Door Sign: Provide one sign as specified above, mounted to wall adjacent to door on knob side.
I. Pair of Doors: Provide one sign as specified above, mounted to adjacent wall closest to active leaf of door. Do not install sign where it will be obstructed by door when door is in the 'open' position.
J. Attachment: Mounting to surfaces shall be done by pressure sensitive frame double-faced tape. Signs shall be delivered to the project site with the tape in place and trimmed on each sign, but with the protective paper layer not removed. Paper layer shall be removed just prior to installation of signs.

3.3 EXTERIOR INSTALLATION - PARKING AND DIRECTIONAL SIGNS

A. Mount posts in 12 inch round by 2'-6" deep concrete footing.

B. Handicapped Signs: Mount signs at height to comply with accessibility codes.

3.4 COORDINATION

A. Coordinate the installation of the identifying devices with the hardware manufacturer for lockset and knob leave outs as detailed and scheduled.

3.5 DAMAGE

A. Any identifying device which is scratched or defaced will be rejected.

3.6 CLEANING

A. Remove protective materials and clean all signs. Clean surfaces with plain water or water with soap or household detergent.

END OF SECTION

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SECTION 102600 - WALL AND DOOR PROTECTION

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. Corner guards.
   2. End-wall guards.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.

B. Sustainability Submittals:
   1. Product Data for Credit IEQ 4.1: For adhesives, documentation including printed statement of VOC content.
   2. Recycled material data. Provide for any material with recycled content:
      a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
      b. Material costs for each product having recycled content.
   3. Regional material data. Provide for each product manufactured within 500 miles:
      a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
      b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
      c. Material cost for product.
   4.

C. Shop Drawings: For each impact-resistant wall protection unit showing locations and extent. Include sections, details, and attachments to other work.

D. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated. Refer to Section 014000 "Quality Requirements."

D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

E. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store impact-resistant wall protection units in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
   1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
   2. Store plastic wall protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
      a. Store corner-guard covers in a vertical position.
      b. Store covers in a horizontal position.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install impact-resistant wall protection units until building is enclosed and weatherproof, wet work is complete and dry, and HVAC system is operating and maintaining temperature at 70 deg F for not less than 72 hours before beginning installation and for the remainder of the construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall protection units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures.
      b. Deterioration of plastic and other materials beyond normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240, no. 4 brushed finish.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 CORNER GUARDS

A. Flush-Mounted, Stainless Steel Cover Corner Guards: Manufacturer's standard assembly consisting of snap-on, stainless steelcover that is flush with adjacent wall surface, installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition; full wall height.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Construction Specialties, Inc.
      b. InPro Corporation (IPC).
      c. Nystrom, Inc.
      d. Pawling Corporation.

B. Provide corner guards in configurations indicated by full height.

2.3 END-WALL GUARDS

A. Surface-Mounted, Metal, End-Wall Guards: Fabricated from one-piece, formed or extruded metal that covers entire end of wall; with formed edges.
   1. Material: Stainless-steel sheet, Type 304.
      a. Finish: Directional satin, No. 4.
   2. Wing Size: Nominal 2-1/2 inches.
   3. Corner Radius: 1/8 inch.
   4. Mounting: Adhesive.

B. Provide end wall guards in configurations indicated by full height.

C. Acceptable Product: Inpro Stainless Steel Flush Mount End Wall Protector.

2.4 FABRICATION

A. Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

B. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.5 METAL FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Remove tool and die marks and stretch lines, or blend into finish.
   2. Grind and polish surfaces to produce uniform finish, free of cross scratches.
   3. Run grain of directional finishes with long dimension of each piece.

4. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

B. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

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

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
    a. Provide anchoring devices to withstand imposed loads.
    b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
    c. Adjust caps as required to ensure tight seams.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION

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SECTION 102800 - 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.
   2. Underlavatory guards.
   3. Custodial accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.
   4. Features that will be included for Project.
   5. 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.
   2. 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.

1.7 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. 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.

E. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 BATHROOM AND RESTROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. American Specialties, Inc.
2. Bobrick Washroom Equipment, Inc.
3. Bradley Corporation.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.

B. Accessory Schedule:
1. Toilet Tissue Holder: Surface mounted roll type of 18 gauge plated steel with satin chrome finish, Bobrick No. 265 or approved equal. Provide one in each Toilet and Bathroom.
2. Grab Bars: 1-1/2" dia. x 18 gage stainless steel grab bars, Bobrick No. B-6806 x 48 and B-6806 x 36 or approved equal for exposed mounting. The bars shall be supported by flanges at both ends. Center line of each grab bar shall be 2-1/4" from the face of the wall. Mounting screws shall be stainless steel with interrupted slot head. Furnish one pair of bars 48" and 36" at each ADA accessible toilet.
3. Soap Dispenser: DermaPro 9033-12 hand wash soap dispenser with a push-bar dispensing system as manufactured by Gojo Industries. Provide one (1) at each Decon and Laundry Rooms.
4. Paper Towel Dispenser: Bobrick No. B-3639 surface mounted, 22 gauge stainless steel, C-fold paper towel dispenser. Provide one at each at Toilet, Decon, and Laundry room.
5. Paper Towel Dispenser: Bobrick No. B-36903 TrimLine series recessed paper towel/waste receptacle, 22 gauge stainless steel, C-fold paper towel dispenser. Provide one at Restroom.
6. Mop and Broom Holder: Stainless steel unit 36" long with 4 vinyl coated mop holders having spring loaded rubber cams, Bobrick B-223 or approved equal. One each in Decon & Laundry.
7. Shower Curtain Rod: Bobrick No. B-207 heavy duty curtain rod or approved equal. 1" O.D. x 20 gauge stainless steel tubing with 1/8" thick, one piece die-formed stainless steel flanges. Provide one at each shower stall.
8. Handicap Shower Bench: Bobrick No. B-5181 reversible folding shower bench complying with barrier free accessibility guidelines. Water resistant solid phenolic bench; type 304 stainless steel frame and mounting bracket; self-locking mechanism. Provide one at each ADA accessible shower and at locations indicated on the drawings.
9. Surface Mounted Hooks: Bobrick No. B-6827, type 304, 22 gauge stainless steel with satin finish. Provide three hooks in each bathroom, 2 in ADA accessible bathrooms, and seven each at Corridor.

2.3 UNDERLAVATORY GUARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Plumberex Specialty Products, Inc.
2. Truebro by IPS Corporation.

B. Underlavatory Guard:
1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
2. Material and Finish: Antimicrobial, molded plastic, white.
a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
b. Rod: Approximately 1/4-inch- diameter stainless steel.

2.4 FABRICATION

C. 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.
D. 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

E. 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.

3.2 ADJUSTING AND CLEANING

F. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

G. Remove temporary labels and protective coatings.

H. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION

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SECTION 104413 - FIRE PROTECTION CABINETS

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. Fire-protection cabinets for the following:
     a. Portable fire extinguishers.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
- B. Shop Drawings: For fire-protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Verification: For each type of exposed finish required, prepared on Samples 6 by 6 inches square.

1.4 COORDINATION
- A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

1.5 SEQUENCING
- A. Apply vinyl lettering on field-painted fire-protection cabinets after painting is complete.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
- A. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 FIRE-PROTECTION CABINET
- A. Cabinet Type: Suitable for fire extinguisher.
  1. Products: Subject to compliance with requirements, provide products by one of the following:
     a. JL Industries, Inc.; a division of the Activar Construction Products Group.
     b. Larsens Manufacturing Company.
     c. Potter Roemer LLC.
- B. Cabinet Construction: Non-rated in non-rated walls; 1or 2 hour fire rated in rated walls to match rating of wall.
  1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.043-inch-thick cold-rolled steel sheet lined with minimum 5/8-inch- thick fire-barrier material. Provide factory-drilled mounting holes.
- C. Corridors 168 and 105 : Furnish semi-recessed cabinet equal to Larsen AL 2409-5R Fire Extinguisher Cabinet.
  1. Size: 9 ½” x 24" x 5" deep
  2. Material: Aluminum
  3. Trim: 1 1/2" square trim, semi-recessed
  4. Door: Full DSA glass panel
- 2. Kitchen: Furnish semi-recessed cabinet equal to Larsen AL 2712-RL Fire Extinguisher Cabinet.

a. Size: 12" x 27" x 8" deep
b. Material: Aluminum
c. Trim: 1 1/2" square trim, semi-recessed
d. Door: Full DSA glass panel

2.3 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.
   3. Prepare doors and frames to receive locks.
   4. Install door locks at factory.
B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Miter and weld perimeter door frames.
C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.
B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
C. Finish fire-protection cabinets after assembly.
D. 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 roughing-in for cabinets to verify actual locations of piping connections before cabinet installation.
B. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.
B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
   2. Provide inside latch and lock for break-glass panels.
   3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.
   4. Fire-Rated Cabinets:
      a. Install cabinet with not more than 1/16-inch tolerance between pipe OD and knockout OD. Center pipe within knockout.
      b. Seal through penetrations with firestopping sealant as specified in Section 078413 "Penetration Firestopping."
C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

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SECTION 104416 - 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.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS
- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS
- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

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.
  1. Failures include, but are not limited to, the following:
     a. Failure of hydrostatic test according to NFPA 10.
     b. Faulty operation of valves or release levers.
  2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
- 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.
  1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS
- A. Fire Extinguishers: Type, size, and capacity for each and indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
     a. JL Industries, Inc.; a division of the Activar Construction Products Group.
     b. Larsens Manufacturing Company.
     c. Potter Roemer LLC.
  2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
- C. Purple-K Dry-Chemical Type in Aluminum Container (for use in kitchen): UL-rated 10-B:C, 2.5-lb nominal capacity, with potassium bicarbonate-based dry chemical in enameled-aluminum container.

2.3 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 red baked-enamel finish.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. JL Industries, Inc.; a division of the Activar Construction Products Group.
      b. Larsens Manufacturing Company.
      c. Potter Roemer LLC.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.
   1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
      a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. 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.
   1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION

SECTION 105510 - TURN-OUT GEAR LOCKERS

PART 1 - GENERAL

1.1 DESCRIPTION
- A. Scope: This work comprises furnishing and installing turn-out gear lockers.

1.2 SUBMITTALS
- A. Shop Drawings: Submit shop drawings to the Architect for review before fabricating the lockers.
  1. Provide plan indicating locker layout and sequential colors.
- B. In addition to the requirements outlined under Paragraph 3.12 of the General Conditions and under Section 01300, submit the following for each type of product provided under work of this Section:
  1. Recycled Content:
     a. Indicate recycled content; indicate percentage of post-consumer and post-industrial recycled content per unit of product.

PART 2 - PRODUCTS

2.1 LOCKERS
- A. Lockers: Shall be Geargrid Wall Mount Lockers 24"w x 20"d x 72"h as manufactured by Mid Minnesota Wire & Mfg., Inc. (888-643-6694) or approved equal. Provide 40 lockers at Turn Out Gear 155.
  1. Alternate Products: Subject to compliance with requirements.
- B. Configuration: 2-tier.
- C. Dimensions: 24 inches wide by 84 inches high.
- D. Frame: Heavy-duty 1 1/4" tubing.
- E. Side & Back Grids: High strength 1/4" wire.
- F. Mounting Brackets: 11 ga. steel
- G. Shelves/Hooks: Two shelves and three apparel hooks per locker.
- H. Hanging Rod: Provide one (1) Gearhanger horizontal rod at each locker.
- I. Color: Red.

PART 3 - EXECUTION

3.1 INSTALLATION
- A. Install lockers to wall and structures provided in configurations indicated on drawings.

3.2 ADJUST & CLEAN
- A. Clean exposed surfaces and leave free of defects.

END OF SECTION

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SECTION 107516 - GROUND-SET FLAGPOLES

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 ground-set flagpoles made from aluminum.
- B. Owner-Furnished Material: Flags.

1.3 ACTION SUBMITTALS
- A. Product Data: For each type of product.
  1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.
- B. Shop Drawings: For flagpoles.
  1. Include plans, elevations, and attachment details. Show general arrangement, jointing, fittings, accessories, grounding, anchoring, and support.
  2. Include section, and details of foundation system.

1.4 DELIVERY, STORAGE, AND HANDLING
- A. Spiral wrap flagpoles with heavy paper and enclose in a hard fiber tube or other protective container.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
- A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS
- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.
- B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand design loads indicated within limits and under conditions indicated.
  1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 90 mph.

2.3 ALUMINUM FLAGPOLES
- A. Aluminum Flagpoles: Tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, with a minimum wall thickness of 3/16 inch.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
     a. American Flagpole; a Kearney-National Inc. company.
     b. Baartol Company.
     c. Concord Industries, Inc.
- B. Exposed Height: 30 feet. 2 at 30’ and 1 at 35’
- C. Construct flagpoles in one piece if possible. If more than one piece is necessary, comply with the following:
  1. Fabricate shop and field joints without using fasteners, screw collars, or lead calking.
  2. Provide flush hairline joints using self-aligning, snug-fitting, internal sleeves.
- D. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch wall thickness with 3/16-inch steel bottom plate and support plate; 3/4-inch- diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.
  1. Flashing Collar: Same material and finish as flagpole.
- E. Sleeve for Aluminum Flagpole: Fiberglass foundation sleeve, made to fit flagpole, for casting into concrete

foundation.
1. Flashing Collar: Same material and finish as flagpole.

F. Cast-Metal Shoe Base: Made from aluminum with same finish and color as flagpoles for anchor-bolt mounting; furnish with anchor bolts.
1. Furnish ground spike.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
1. 0.063-inch spun aluminum, finished to match flagpole[with gold anodic finish].

B. External Halyard, Cam Cleat System: 5/16-inch- diameter, braided polypropylene halyard; cam cleat; and concealed revolving truck assembly with plastic-coated counterweight and sling. Furnish flush access door secured with cylinder lock. Finish truck assembly to match flagpole.
1. Halyard Flag Snaps: Stainless-steel swivel snap hooks. Furnish two per halyard.
2. Plastic Halyard Flag Clips: Made from injection-molded, UV-stabilized, acetal resin (Delrin). Clips attach to flag and have two eyes for inserting both runs of halyards. Furnish two per halyard.
a. Product: Subject to compliance with requirements, provide "Quiet Halyard" flag clasp by Acme/Lingo Flagpoles LLC.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, clear anodized, 0.7 mil thickness.

PART 3 - EXECUTION

3.1 PREPARATION

A. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

B. Provide forms where required due to unstable soil conditions and for perimeter of flagpole base at grade. Secure and brace forms to prevent displacement during concreting.

C. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

D. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

E. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

C. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

END OF SECTION

SECTION 109900 - MISCELLANEOUS SPECIALTIES

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. Miscellaneous specialty items as listed herein.

1.3 ACTION SUBMITTALS
- A. Product Data: Including all pertinent performance characteristics and criteria.
- B. Shop Drawings: Indicate materials, construction, sizes, quantities, finishes, and installation details.

PART 2 - PRODUCTS

2.1 PRODUCTS
- A. Mobile Hose Storage Rack: Ready Rack model HC-64-2T.
- B. Stainless Steel Wash Table: At Decon, provide 14 gauge stainless steel table with formed 8" splash, integrally welded coved sink, stainless steel leg tubing, stainless steel billet feet and associated connections and miscellaneous items required for complete installation.
- C. Shower Stall: Shall be Ancor Solid Surface an manufactured by Athenian Marble Corp. (405-787-1300) Surface shall be "GP45"
- D. Mail Box: Shall be "The Titan Mailbox" as manufactured by Steel Mailbox Company, 10 gauge steel, 21 ½" D x 10 ½" H x 8 ¼" W; color shall be "Gun Metal"
- E. Bicycle Rack: Dero Hoop Rack Heavy Duty in ground, schedule 40 galvanized pipe bike rack as manufactured by Dero Bike Racks (800-298-4915). Provide two hoops with all accessories required for complete in ground installation.
- F. Air Compressor: Quincy model QT-54.
- G. T.A.S. Compliant Bench and Brackets for Bathroom 118, 124, 140, 144, 146: 42"W x 20"D x 1 ½" T Hardwood ADA Bench Top with pair of Stainless Steel Wall Mount Brackets, manufactured by Wisconsin Bench

PART 3 - EXECUTION

3.1 EXAMINATION
- A. Verify that surfaces and conditions are ready to receive work of this Section.
- B. Notify Architect of any existing conditions which will adversely affect execution.
- C. Beginning of execution will constitute acceptance of existing conditions.

3.2 PREPARATION
- A. Prepare substrate surfaces as recommended by manufacturer.

3.3 INSTALLATION
- A. Install using skilled workers in accordance with manufacturer's published instructions and recommendations.

3.4 ADJUSTING
- A. Adjust and fit items to be flush with adjacent construction.
- B. Fasten or adhere for tight connections and joints.

END OF SECTION

SECTION 113100 - RESIDENTIAL APPLIANCES

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. Cooking appliances.
   2. Refrigeration appliances.
   3. Cleaning appliances.

1.3 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. Sustainability Submittals:
   1. Product Data for Credit EA 1.4: For appliances indicated, documentation that products are ENERGY STAR rated.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's standard size.

D. Product Schedule: For appliances. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and manufacturer.

B. Product Certificates: For each type of appliance, from manufacturer.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintains, within <Insert number> miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

C. Source Limitations: Obtain each type of residential appliance from single manufacturer.

D. 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.

E. 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 and Texas Accessibility Standards (TAS).

F. Preinstallation Conference: Conduct conference at Project site.

1.7 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.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 APPLIANCES

A. Apparatus Bays:
   1. Extractor: UniMac model UWN065K1L (add extended warranty).
   2. Ice Maker: Hoishizaki model F-801MWH-C.
   3. Ice Bin: Hoshizake model B-500SF.

B. Kitchen/Living Quarters:
   1. Range: Wolfe model C60SS-6B-24G-N with extra oven rack, casters, disconnect.
   2. Dishwasher: KitchenAid #KDFE204ESS (add extended warranty)

2.2 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

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.

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, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Utilities: Comply with 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.
   2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   3. Operational Test: After installation, start units to confirm proper operation.
   4. 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.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

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

END OF SECTION

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SECTION 122112 - HORIZONTAL LOUVER BLINDS - ALUMINUM

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. This Section includes the following:
   1. Horizontal louver blinds with aluminum.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Show fabrication and installation details for horizontal louver blinds.
C. Samples for Initial Selection: For each type and color of horizontal louver blind indicated.
   1. Include similar Samples of accessories involving color selection.
D. Window Treatment Schedule: For horizontal louver blinds. Use same designations indicated on Drawings.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain horizontal louver blinds through one source from a single manufacturer.
B. Fire-Test-Response Characteristics: Provide horizontal louver blinds with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
   1. Flame-Resistance Ratings: Passes NFPA 701.
C. Product Standard: Provide horizontal louver blinds complying with WCSC A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver horizontal louver blinds in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install horizontal louver blinds until construction and wet and dirty 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 horizontal louver blinds 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 operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Horizontal Louver Blinds: Before installation begins, for each size, color, texture, pattern, and gloss indicated, full-size units equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 HORIZONTAL LOUVER BLINDS, ALUMINUM SLATS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
   1. Hunter Douglas.
   2. Levolor, Levolor Contract;
   3. Springs Window Fashions Division, Inc.

B. Slats: Aluminum; alloy and temper recommended by producer for type of use and finish indicated; with crowned profile.
   1. Width: 1 inch .
   2. Thickness: Not less than 0.008 inch.
   3. Finish: One color.
      a. Reflective Coating: Manufacturer's special coating enhancing the reflection of solar energy on the outside-facing slat surface.

C. Headrail: Formed steel or extruded aluminum; long edges returned or rolled; fully enclosing operating mechanisms on three sides and end plugs and the following:
   1. Capacity: One blind per headrail.
   2. Integrated Headrail/Valance: Curved face.
   3. Light-blocking lower back lip.
   4. Tilt limiter with preselected degree settings.

D. Bottom Rail: Formed-steel or extruded-aluminum tube, with plastic or metal capped ends top contoured to match crowned shape of slat; with enclosed ladders and tapes to prevent contact with sill.

E. Ladders: Evenly spaced to prevent long-term slat sag.
   1. For Blinds with Nominal Slat Width 1 Inch or Less: Braided string.

F. Lift Cords: Manufacturer's standard.

G. Tilt Control: Enclosed worm-gear mechanism and linkage rod, and the following:
   1. Tilt Operation: Manual with clear plastic wand.
   2. Length of Tilt Control: Length required to make operation convenient from floor level.
   3. Tilt: Full.

H. Lift Operation: Manual, cord lock; locks pull cord to stop blind at any position in ascending or descending travel.

I. Tilt-Control and Cord-Lock Position: Right and left side of headrail, respectively, unless otherwise indicated.

J. Valance: Two slats.
   1. Finish Color Characteristics: Match color, texture, pattern, and gloss of slats.

K. Mounting: Wall mounting, permitting easy removal and replacement without damaging blind or adjacent surfaces and finishes; with spacers and shims required for blind placement and alignment indicated.
   1. Provide intermediate support brackets if end support spacing exceeds spacing recommended by manufacturer for weight and size of blind.

L. Colors, Textures, Patterns, and Gloss: As selected by Architect from manufacturer's full range.

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

3.2 INSTALLATION

A. Install horizontal louver blinds level and plumb and aligned with adjacent units according to manufacturer's written instructions, and located so exterior slat edges in any position are not closer than 1 inch to interior face of glass. Install intermediate support as required to prevent deflection in headrail. Allow clearances between adjacent blinds and for operating glazed opening's operation hardware if any.

B. Head Mounted: Install headrail on face of opening head.

C. Connections: Connect motorized operators to building electrical system.

3.3 ADJUSTING

A. Adjust horizontal louver blinds to operate smoothly, easily, safely, and free of binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean horizontal louver blind 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 horizontal louver blinds are without damage or deterioration at time of Substantial Completion.

C. Replace damaged horizontal louver blinds that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION

SECTION 122113 - HORIZONTAL LOUVER BLINDS - WOOD

PART 1 GENERAL

1.1 SECTION INCLUDES
- A. Horizontal slat louver blinds.
- B. Operating hardware.

1.2 SUBMITTALS
- A. Product Data: Provide data indicating physical and dimensional characteristics.
- B. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation.
- C. LEED Submittals:
  1. Product Certificates for Credit MR 5: For products and materials required to comply with requirements for regional materials, certificates indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating distance to Project, cost for each regional material, and fraction by weight that is considered regional.
  2. Certificates for Credit MR 6: Chain-of-custody certificates indicating that composite wood products comply with forest certification requirements. Include documentation that manufacturer is certified for chain of custody by an FSC-accredited certification body. Include statement indicating cost for each certified wood product.

1.3 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 MANUFACTURERS
- A. Horizontal Louver Blinds:
  1. Hunter Douglas: www.hunterdouglas.com. (Basis of Design: Parkland Genuine Wood Blinds)
  2. Levolor Contract: www.levolorcontract.com.
  3. Graber, division of Springs Window Fashions: www.graberblinds.com.
  4. Bali Blinds.
  5. Substitutions: See Section 016000 - Product Requirements.

2.2 BLINDS AND BLIND COMPONENTS
- A. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by control wand; complying with WCMA A100.1.
- B. Wood Slats: Solid wood, radiused slat corners.
  1. Width: 2 inch.
  2. Color: Selected from manufacturer's complete line.
  3. Texture: Smooth.
- C. Slat Support: Woven polypropylene cord, ladder configuration.
- D. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats
- E. Bottom Rail: Pre-finished, formed PVC with top side shaped to match slat curvature; with end caps. Color: Same as headrail.
- F. Lift Cord: Braided nylon; continuous loop.
- G. Control Wand: Extruded hollow plastic; hexagonal shape.
- H. Headrail Attachment: Wall brackets.
- I. Accessory Hardware: Type recommended by blind manufacturer.

2.3 FABRICATION
- A. Determine sizes by field measurement.
- B. Fabricate blinds to fit within openings with uniform edge clearance of 1/8 inch.

PART 3 EXECUTION

3.1 EXAMINATION
- A. Verify that openings are ready to receive the work.
- B. Ensure structural blocking and supports are correctly placed.

3.2 INSTALLATION
- A. Install blinds in accordance with manufacturer's instructions.
- B. Secure in place with flush countersunk fasteners.

3.3 INSTALLATION TOLERANCES
- A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

3.4 ADJUSTING
- A. Adjust blinds for smooth operation.

3.5 CLEANING
- A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Motorized interior solar roller shades.
   2. Shade accessories.
   3. Control systems.

B. Related Sections:
   1. Section 061000 - Rough Carpentry: Blocking for support of window shade brackets and pocket assemblies.
   2. Section 092100 – Plaster and Gypsum Board Assemblies: Gypsum board substrate for window shade systems.
   3. Section 095100 - Acoustical Ceilings: Shade pockets, pocket closures, and accessories.
   4. Section 260000 - Electrical: Connections to electrical motor control system and lighting control system components.

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE) (www.ansi.org and www.ieee.org):
   1. C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
   2. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.

B. Association of Electrical and Medical Imaging Equipment Manufacturers (NEMA) (www.nema.org) WD1-1999 (R2005) - General Color requirements for Wiring Devices.

C. ASTM International (ASTM) (www.astm.org):
   1. D4674-89 - Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
   2. G21-96 (2002) - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
   3. G22-76 (1996) - Standard Practice for Determining Resistance of Plastics to Bacteria.

D. National Fire Protection Association (NFPA) (www.nfpa.org) 701 (2004) - Standard Methods of Fire Tests for Flame Propagation.

E. Underwriters Laboratories, Inc. (UL):
   1. 1310 – Class 2 Power Units.
   2. 508 – Industrial Control Equipment.

1.3 SYSTEM DESCRIPTION

A. Roller Shade System: Ultra-quiet, precision-controlled electronic drive unit contained within head tube, controlling shade movement.

B. Controls: Wall mounted.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings; include:
      a. Shade schedule indicating room number, opening sizes, quantities and key to details.
      b. Head, jamb and sill details, and mounting dimension requirements for each product and mounting condition.
      c. One-line wiring system diagrams including connection details and overall arrangement of shades and control locations.
   2. Samples:
      a. Fabric samples showing each specified color.
      b. Samples showing available color and finish selections for controls.
   3. Product Data; include:
      a. Descriptive literature and details for each product type including materials, finishes, construction, and dimensions of individual components, profiles, and mounting requirements.

b. Wiring diagrams, details on integration to lighting control systems, AV systems, and building management systems, installation instructions, and operating instructions.
c. Current certificates showing that line voltage components of system are either UL Listed or UL recognized.

B. Quality Control Submittals:
1. Test Reports: Indicating compliance with specified fabric properties.
2. Certification: Morton International Laboratory Report for PVC coated fabrics and bacterial and mildew resistance.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Minimum 5 years' experience in manufacture of precision-engineered, low-voltage motorized shading systems.
2. Assign responsibility for design, engineering, installation, and performance of window shade system to single manufacturer and their qualified dealers and installers.
3. Furnish shading system and electrical control equipment for complete installation.
4. Qualified to supply specified products and to honor claims against product presented in accordance with warranty.

B. Installer Qualifications: Qualified to install and commission specified products by prior factory training, experience, demonstrated performance, and acceptance of any requirement of the manufacturer, subsidiary of the manufacturer, or licensed agent.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.
B. Do not deliver shades until concrete, masonry, plaster, painting, and other wet work is complete and dry.
C. Deliver shades to project in protective packaging, labeled to identify each shade for each opening.
D. Include installation, programming, and maintenance instructions.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions in installation areas within manufacturer's recommended limits:
1. Ambient operating temperature: 32 to 104 degrees F.
2. Humidity: 0 to 90 percent, non-condensing

B. Do not install products under environmental conditions outside manufacturer's absolute limits.
C. Do not install shade system until building is operating at ambient temperature and humidity ranges that are consistent with those intended for buildings ultimate use.

1.8 COORDINATION

A. Coordinate pre-wiring of system utilizing manufacturer's approved low voltage wiring to each shade drive location.
B. Fabricate shades after obtaining field dimensions for each opening.
C. Coordinate construction of surrounding conditions to allow for timely field dimension verification.

1.9 WARRANTY

A. Provide manufacturer's 2 year parts and labor and 8 years limited parts warranty for defective equipment.

1.10 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to qualified dealer or installer.
B. Make replacement parts available for minimum of ten years after date of manufacture.
C. Provide 24-hour, 7-day a week technical support to troubleshoot system wiring and aid in system programming.
D. Provide on-site service support within 24 hours anywhere in continental United States and within 72 hours worldwide except where special visas are required.
E. Offer renewable service contract on yearly basis to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system startup completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Contract Documents are based on Sivoia QS by Lutron Electronics Co., Inc.; 7200 Suter Road, Coopersburg, PA 18036-1299 Telephone (800) 523-9466, http://www.lutron.com.

B. Substitutions: Under provisions of Section 013300.

1. Any substitutions provided by the contractor shall be reviewed at the contractor's expense by the architect/interior designer at a rate of $200.00 per hour.
2. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
3. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

2.2 SYSTEM REQUIREMENTS

A. System Description:

1. Ultra-quiet, precision-controlled electronic drive unit housed inside roller tube, controlling shade movement.
2. Audible noise: Maximum 44 dBA measured 3 feet from electronic drive unit. No audible clicks when motor starts or stops.
3. Allow for maximum of 100 devices including roller shades, skylight shades, drapery tracks, keypads, lighting controls, and power supplies.
4. Allow for 100 zones including roller shades.
5. Operate independently, without use of external group controllers.
6. Control shade speed for tracking within plus or minus 0.0625 inch throughout entire travel.
7. Include 10 year power failure memory for preset stops, open and close limits, shade grouping and subgrouping, and system configuration.
8. Integrate directly with skylight shades, roman shades and drapery tracks incorporating electronic drive units.
9. Systems with multiple electronic drive units electronically synchronized to start, stop, and move in unison.

B. Grouping:

1. Keypads and contact closure inputs can control any electronic drive unit without separate group controller.
2. System groups and subgroups configured at point of control without rewiring and without access to electronic drive unit.
3. System may contain multiple electronic drive units.
4. Keypads and interfaces able to operate any group or subgroup of electronic drive units.

C. Integration:

1. Electronic drive units integrate with lighting controls by same manufacturer without interfaces.

D. System Controls:

1. Shades controlled by built-in shade columns on lighting control or by keypad.
2. Electronic drive units, keypads, and lighting controls contain microprocessors, allowing high level programming from any source.
3. System devices, including shades and lighting controls, connected through common communication link.

E. System Performance:

1. One-touch control of shades by means of keypad, lighting control, or infrared remote.
2. Capable of stopping within accuracy of 0.125 inch at any point between open and close limits.
3. Store over 250 programmable stop points, including open, close, and any other position.
4. Presets set by 5-second button push and hold from keypad, lighting control, or handheld remote control.
5. Presets recalled by keypad, contact closure input, infrared receiver, or other lighting control system interface.
6. Open and close limits programmable from electronic drive unit, lighting control, wall-mounted keypad, or handheld remote control.
7. System components electro static discharge protected.

2.3 ROLLER SHADES

A. Mounting:
   1. Brackets to provide symmetrical light gaps of 0.75 inch on each side of shade.
   2. Roller shade leveling adjustment allowing leveling adjustment while roller shades are mounted to brackets.
   3. Allow side-to-side adjustment up to 0.375 inch on each side while shade is mounted to bracket.
   4. Projection adjustment up to 0.50 inch.
   5. Provide universal mounting brackets for wall, ceiling, and jamb mounting.

B. Shade Tube: Fabric connected to tube using double-sided adhesive strip with minimum of one turn of fabric on roller before working section of fabric starts.

C. Fabric:
   1. Pass NFPA 701 large and small scale tests.
   2. Where applicable, seal shade fabric or treat PVC-coated fabric edges to prevent fraying.
   3. Minimum 5 mm “No Growth Contact Area”, tested to ASTM G22 for ATCC6538 (Staphylococcus aureus) and ATCC13388 (Pseudomonas aeroginosa).
   4. No growth, tested to ASTM G21 for ATCC9642, ATCC9348, and ATCC9645.
   5. Fabric selection: Light-filtering type, color to be selected from manufacturer’s standards.
   6. Full wrap, with fabric wrapped around bottom bar.

D. Bottom Bar: 1 inch wide x 0.1875 inch thick extruded aluminum enclosed on all sides in thermally sealed pocket across bottom of shading fabric.

2.4 ACCESSORIES

A. Wall Mounted Controls:
   1. Low voltage keypads with faceplates attached without visible means of attachments, product color to match NEMA WD1, with backlit buttons.
   2. Visible parts ultraviolet color stabilized, tested to ASTM D4674.
   3. Type: Five button with raise/lower.

B. Power Supplies:
   1. Electronic drive units powered with 24 VDC from approved power supply; power supply via NEC Class 2 power source.
   2. Provide individual transformer for each electronic drive unit.

2.5 SOURCE QUALITY CONTROL

A. Perform full-function testing on completed assemblies prior to shipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
B. Install shades to provide smooth operation.
C. Locate controls where directed.
D. Connect to power supply and control wiring.
E. Connect to lighting control

3.2 ADJUSTING

A. Adjust level, projection, and shade centering from mounting brackets.
B. Adjust fabric on tube if visibly telescoping.

3.3 DEMONSTRATION

A. Demonstrate proper operation and maintenance of window shade system to Owner.

3.4 SCHEDULE

A. Shade Type 1:
   1. Description: Motorized interior solar control shade.
   2. Color: To be selected from manufacturer’s standards.

END OF SECTION

SECTION 122414 – BLACKOUT WINDOW SHADES

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. This Section includes manual black-out roller shades.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension system members and attachment to building structure.
2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
3. Shade mounting assembly and attachment.
4. Size and location of access to shade operator, motor, and adjustable components.
5. Minimum Drawing Scale: 1/4 inch = 1 foot.

D. Samples for Initial Selection: For each colored component of each type of shade indicated.

1. Include similar Samples of accessories involving color selection.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Resistance Ratings: Passes NFPA 701.

D. Product Standard: Provide roller shades complying with WCMA A 100.1.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete 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 operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Rollers Shades: Before installation begins, for each size, color, texture, and pattern indicated, full-size units equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following
   1. MechoShade Systems, Inc.
      a. Basis-of-Design Product: UrbanShade.
   2. Hunter Douglas, Inc.; Hunter Douglas Window Fashions Division.
   3. Levolor; Levolor-Kirsch Window Fashions; a Newell Rubbermaid Company.
   4. Lutron Shading Solutions by VIMCO.MechoShade Systems, Inc.
   5. Shading Systems Ltd. Nysan
   6. Sol-R-Veil.

B. Basis-of-Design Shade Cloth Product:
   1. Manufacturer Phifer
   2. Screen fabric shall be Sheer Weave Series SW7000-V39 “Graphite”

C. Shade Band Material: PVC-coated fiberglass.
   1. Pattern, Style, Color, openness: As selected by Architect.
   2. Bottom Hem: Straight.

D. Rollers: Electro-galvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide capacity for two roller shade band(s) per roller, unless otherwise indicated on Drawings.

E. Direction of Roll: Regular, from back of roller.

F. Mounting Brackets: Fascia end caps, fabricated from steel finished to match fascia or headbox.

G. Fascia: L-shaped, formed-steel sheet or extruded aluminum; long edges returned or rolled; continuous panel concealing front and bottom of shade roller, brackets, and operating hardware and operators; length as indicated; removable design for access.

H. Top/Back Cover: L-shaped; material and finish to match fascia; combining with fascia and end caps to form a six-sided headbox enclosure sized to fit shade roller and operating hardware inside.

I. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

J. Audiovisual Light-Blocking Shades: Designed for eliminating all visible light gaps when shades are fully closed; fabricated from blackout shade band material with fascia headbox pocket and bottom bar extended and formed for light-tight joints among shade components and between shade components and adjacent construction.
   1. Side Channels, Light Seal Hembar, and Perimeter Seals: Manufacturer's standard design, including sill light seal attached to bottom bar, for eliminating light gaps when shades are closed.
   2. Shade Band Retention System: Manufacturer's standard design for guiding shade band material through range of travel and holding shade band flat with edges of material within side channels.

K. Mounting: Inside Recessed in ceiling pocket mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.

L. Hold-Down Brackets and Hooks or Pins : Manufacturer's standard for fixing shade in place, keeping shade band material taut, and reducing light gaps when shades are closed.

M. Shade Operation: Manual; with continuous-loop bead-chain, clutch, and cord tensioner and bracket lift operator.
   1. Pull: Manufacturer's standard hand-grip engaged pull. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
   2. Lift-Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
   3. Loop Length: Length required to make operation convenient from floor level.
   4. Bead Chain: Nickel-plated metal or stainless steel.

N. Shade Operation: Manual.

2.2 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Non-corrodible or corrosion-resistant-coated materials.
   1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F:
   1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
   2. Shade Units Installed Outside Jambs: 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.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal non-corrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.

F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.

G. Colors of Metal and Plastic Components Exposed to View: As indicated by manufacturer's designations, unless otherwise indicated.

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.
   1. 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, and located so shade band is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

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.

END OF SECTION

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SECTION 123616 - METAL COUNTERTOPS

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 stainless-steel countertops, shelves, and sinks.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.

C. Sustainable Submittals:

1. Recycled material data. Provide for any material with recycled content:
    a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
    b. Material costs for each product having recycled content.
2. Regional material data. Provide for each product manufactured within 500 miles:
    a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
    b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
    c. Material cost for product.
3. Product Data for Credit IEQ 4.1: For sealants and sealant primers used inside the weatherproofing system, documentation including printed statement of VOC content.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal countertops only after casework has been completed in installation areas.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction to receive metal countertops by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

B. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants."

1. Mildew-Resistant Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, silicone.
2. Joint Sealant: Single component, nonsag, neutral curing, silicone; Class 25.
3. Color: Clear.
4. Sealant shall have a VOC content of 250 g/L or less.

2.2 STAINLESS-STEEL COUNTERTOPS SHELVES AND SINKS

A. Countertops: Fabricate from 0.062-inch- thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch over the base cabinets.
   1. Joints: Fabricate countertops without field-made joints in sections for joining in field, with joints at locations indicated.
   2. Weld shop-made joints.
   3. Sound deaden the undersurface with heavy-build mastic coating.
   4. Extend the top down to provide a 1-inch- thick edge with a 1/2-inchreturn flange.
   5. Form the backsplash coved to and integral with top surface, with a 1/2-inch-thick top edge and 1/2-inch return flange.
   6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.
   7. Where stainless-steel sinks occur in stainless-steel tops, factory weld into one integral unit.

B. Wall-Mounted Shelves: Fabricate from stainless-steel sheet, not less than 0.050-inch nominal thickness. Weld shop-made joints. Fold down up the front edge a minimum of 3/4 inch; fold up the back edge a minimum of 3 inches. Provide integral stiffening brackets, formed by folding up ends a minimum of 3/4 inch and by welding to upturned front and back edges.

C. Stainless-Steel Sinks: Fabricate from stainless-steel sheet, not less than 0.050-inchnominal thickness. Fabricate with corners rounded and coved to at least 5/8-inchradius. Slope the sink bottoms to outlet without channeling or grooving. Provide continuous butt-welded joints.
   1. Provide sizes indicated or manufacturer's closest standard size of equal or greater volume, as approved by Architect.
   2. Provide double-wall construction for sink partitions with top edge rounded to at least 1/2-inch diameter.
   3. Factory punch holes for fittings.
   4. Provide sinks with stainless-steel strainers and tailpieces.
   5. Provide sinks with integral rims except where located in stainless-steel countertops.
   6. Apply 1/8-inch- thick coating of heat-resistant, sound-deadening mastic to undersink surfaces.

2.3 STAINLESS-STEEL FINISH

A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.

B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

C. Secure tops to cabinets with Z- or L-type fasteners or equivalent; use two or more fasteners at each front, end, and back.

D. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

F. Wall-Mounted Shelves: Fasten to masonry, partition framing, blocking, or reinforcements in partitions. Fasten each shelf through upturned back edge at not less than 24 incheso.c.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protection: Provide 6-mil plastic or other suitable water-resistant covering over the countertop surfaces. Tape to underside of countertop at a minimum of 48 incheso.c. Remove protection at Substantial Completion.

END OF SECTION

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SECTION 123661 - SIMULATED STONE COUNTERTOPS

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. Solid-surface-material countertops and backsplashes.
   2. Quartz agglomerate countertops and backsplashes.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials and sinks.

B. Sustainability Submittals:
   1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
   2. Product Data for Credit IEQ 4.4: For adhesives and composite wood products, documentation indicating that product contains no urea formaldehyde.
   3. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
   4. Recycled material data. Provide for any material with recycled content:
      a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
      b. Material costs for each product having recycled content.

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

D. Samples for Initial Selection: For each type of material exposed to view.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:
   1. Front: Straight, slightly eased at top.
   2. Backsplash: Straight, slightly eased at corner
   3. Endsplash: Matching backsplash.

B. Countertops: 1/2-inch- thick, solid surface material.

C. Backsplashes: 3/4-inch- thick, solid surface material.

D. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.

2.2 QUARTZ AGGLOMERATE COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:
   1. Front: Straight, slightly eased at top.
   2. Backsplash: Straight, slightly eased at corner.
   3. Endsplash: Matching backsplash.
B. Countertops: thick, quartz agglomerate – ½ inch
C. Backsplashes: 3/4-inch- thick, quartz agglomerate.
D. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.

2.3 COUNTERTOP MATERIALS

A. Particleboard: ANSI A208.1, Grade M-2.
B. Adhesives: Adhesives shall not contain urea formaldehyde.
C. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
D. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. E. I. du Pont de Nemours and Company (Corian).
   2. Type: Provide Standard Type unless Special Purpose Type is indicated.
   3. Integral Sink Bowls: Corian Cameo White, model 810.
   4. Colors and Patterns: As selected by Architect from manufacturer's full range.
E. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Caesarstone.
   2. Colors and Patterns: Refer to Finish Legend.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet.
B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   1. Install [backsplashes] [and] [endsplashes] to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   2. Seal edges of cutouts in particleboard subtops by saturating with varnish.

END OF SECTION

SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

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. This Section includes the following:
   1. Entrance mats in recessed surface-mounted frames.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For each type of product indicated, not less than 6 inch square sections of grate material and 6 inch length of frame material.

C. Maintenance Data: For floor mats and frames to include in maintenance manuals.

D. Shop Drawings: Show layout and types of grates and frames not less than half-scale sections of typical installations, details of patterns or designs, anchors, and accessories, and field measurements of slab recess to receive frames grates (if applicable).

E. Sustainable Submittals:
   1. Recycled material data. Provide for any material with recycled content:
      a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
      b. Material costs for each product having recycled content.
   2. Regional material data. Provide for each product manufactured within 500 miles:
      a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
      b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
      c. Material cost for product.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.

B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

1.5 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.6 COORDINATION

A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

1.7 EXTRA MATERIALS

A. Furnish extra materials not less than 2% of installed, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 WARRANTY

A. Floor mats and frames shall be fabricated free of defects in materials and workmanship in accordance with the General Conditions, and the manufacturer shall offer a 5 year warranty against defects in materials and workmanship

PART 2 - PRODUCTS

2.1 ENTRANCE MATS

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:
   1. ARDEN Architectural Specialties, Inc.
   2. Balco, Inc.
   3. C/S Group.
   4. Durable Corporation.
   5. Musson, R. C. Rubber Co.

B. Basis of Design:
   1. F2: Shall be Pedimat M1 as manufactured by C/S Entrance Flooring Systems.
      a. Rail shall be mill finished aluminum made from 70%-90% recycled material.
      b. Carpet shall be 100% nylon #9305 "Espresso".
      c. Vinyl shall be #8502 "Brown".

2.2 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
   1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

2.3 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: non-specular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Products must be placed on a flat and level substrate, not more than 1/8 inch in 10 feet out of plumb, per ACI 302.

B. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install recessed mat frames to comply with manufacturer's written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.
   1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
   2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.
   3. Install frames and treads flush, level and tightly fitted together to prevent tread units from bowing, warping, moving or slipping. Final installation should provide a tightly fitted mat that does not produce excessive movement when being walked on

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

B. Install product when no further wheeled construction traffic will occur and wet type operations, including painting, are complete.

END OF SECTION

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SECTION 133429 - ALUMINUM CORNICES

PART 1 - GENERAL

1.1 SUMMARY
- A. Provide aluminum cornice work shown on the drawings, as specified herein, and as needed for a complete and proper installation.
- B. Coordinate cornice work of this section with General Conditions and Supplementary Conditions.

1.2 SUBMITTALS
- A. Submit shop drawings in accordance with drawing requirements.
- B. Submit 18" long physical sample of each cornice profile after approval of shop drawings. Upon approval of shop drawings and samples, general contractor shall send to field or job-site superintendent copy of final approved shop drawing.
- C. Submit color samples of exterior covering.
- D. Submit close-out documents, warranties, and manuals.

1.3 QUALITY ASSURANCE
- A. Use adequate number of skilled workmen who are thoroughly trained and experienced in the necessary crafts, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. Use materials which shall be free from defects impairing strength, durability, and appearance; shall be of best commercial quality for purpose required; and shall comply with approved drawings.
- C. Use manufacturer who has had ten (10) years of experience in the manufacture of specified product.

1.4 WARRANTY
- A. Warrant the product for one year after date of delivery of product installed by others.

PART 2 - PRODUCTS

2.1 MANUFACTURER
- A. Use aluminum cornice as manufactured by Campbellsville Industries, Inc., P.O. Box 278, 440 Taylor Blvd., Campbellsville, KY 42719, Phone: 800/467-8135, Fax: 270/465-6839. Website: http://cvilleindustries.com. E-mail: steeple@cvilleindustries.com.
- B. Use aluminum cornice design as shown on drawings.
- C. Use aluminum cornice stock design no. 215.

2.2 MATERIALS
- A. Use .032" aluminum sheet, 3003-H14 alloy, with available stock finishes for cornice profiles.
- B. Use correct aluminum alloys for castings, stampings, spinnings, and/or forming.

2.3 ACCESSORIES
- A. Form cornice mouldings in accordance with approved drawings.
- B. Cast, stamp, form, and/or spin special ornaments in accordance with good and acceptable practices, and in accordance with approved drawings.

2.4 FABRICATION
- A. Form true to profile from .032" aluminum.
- B. Furnish in maximum 12'-0" lengths, and with minimum bends of 5/8".
- C. Preassemble cornice sections in shop to greatest extent possible to minimize field splicing.
- D. Furnish miter patterns and reassembly instructions properly marked for each cornice profile.

2.5 FINISHES
- A. Use aluminum skin with Kynar 500 finishes, from manufacturer's stock colors of white, sandstone, medium bronze, cream, colonial white, ivory, and/or patina green.
- B. Shop finish all aluminum castings, stampings, spinnings, and accessories. Units shall be caustic etched, primed with 2 heavy coats of primer, and finished with 2 heavy coats minimum of industrial vinyl or enamel finish electrostatically applied and air dried.

2.6 CAULKING

A. Clean and dry all surfaces to be caulked.
B. Apply with caulking gun, using nozzle of proper size to fit the joint width.
C. Use silicone caulking by Dow Corning, or approved equal.

PART 3 - EXECUTION

3.1 PROJECT SITE CONDITIONS

A. Verify that site conditions are suitable and accessible for delivery and installation.
B. Confirm that all preparatory work is in place in accordance with approved shop drawings before delivery and installation.
C. Provide for proper storage after delivery of cornice
D. Report any discrepancies in writing.

3.2 INSTALLATION

A. Use skilled and experienced installation craftsmen familiar with metalwork.
B. Miter all inside and outside corners in accordance with manufacturer's miter patterns.
C. Lap joints minimum 2".
D. Apply bead of caulking ½" from ends of inner and outer cornice sections.
E. Drill all holes; do not punch.
F. Secure overlapped joints with coated aluminum screws, nails, and/or fasteners.

3.3 CLEAN-UP

A. Clean up all debris caused by work of this section
B. Keep the premises clean and neat at all times.

END OF SECTION

SECTION 21 00 10 - SUBMITTAL PROCESS

PART 1 – GENERAL

1.1 SUBMITTALS

A. Comply with all submittal provisions of Division 1.

B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 21 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to **"mdengca@md-eng.com".** Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications.

C. Contractor is responsible to separate submittals per specification section. Unseparated submittals are subject to rejection without review.

D. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.

E. Submittals that have been reviewed and marked as REJECTED (REJ) or REVISE & RESUBMIT (RES) should be resubmitted within 10 days to be reviewed again by engineer.

F. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.

G. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).

1.2 REQUIRED SPECIFICATIONS (Project specific)

A. The chart below are the submittals required for the project.

1. Submittals marked with an "**X**" are required for this project.
2. Submittals without an "**X**" are not required for this project.

See required specifications on next page

Required X	Submittal Name	Spec Reference
X	**Common Work Results** *-Shop Drawings, Access Doors*	21 05 00
X	**Meters & Gauges** *-Pressure gauges, Gage attachments, Test plugs* *-Sight flow indicators*	21 05 19
X	**General Duty Valves** *-Valves, Cocks & Specialties*	21 05 23
X	**Hangers and Supports** *-Pipe hangers and supports, Hanger rods* *-Sleeves, Trapezes, Concrete supports*	21 05 29
X	**Vibration & Seismic Controls** *-Isolation material and Support units*	21 05 48
X	**Identification for Fire Suppression Piping** *-Valve tags, Pipe markers, Equipment plates* *-Conceals devices, Manufacturers*	21 05 53
	Fire Protection Systems *-Piping, Backflow Preventers, FD connections*	21 10 00
X	**Wet-Pipe Sprinkler Systems** *-Piping, Backflow Preventers, FD connections* *-Standpipes, Valves, Switches, Sprinklers*	21 13 00
	Fire Detection & Alarm Systems *-Equipment, Control panel, Wiring, Devices* *-Communicator, contacts, Detectors, dampers* *-Operation, testing, etc.*	28 31 10

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included: Provide complete fire suppression systems where shown on the drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to the following summary of work:

1. Furnish and install a complete fire sprinkler and wet standpipe system as shown on drawings and described herein.
2. Other items and services required to complete the systems.

A. Any Alternate Proposals are summarized in Division 01 of the Specifications. The Contractor is directed to refer to all Sections of the Specifications and Drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.2 GENERAL REQUIREMENTS

A. Unless otherwise specified, materials are to be new and of current U.S. manufacture, free from defects and of the best quality of their respective kinds.

B. Equipment and/or materials damaged in shipment or handling, or otherwise damaged before installation, shall be replaced with new equipment and/or materials. Damaged equipment and/or materials shall not be repaired at the jobsite.

C. Furnishing of the proper equipment and/or materials and to see that it is installed as recommended by the manufacturer is entirely the responsibility of the Contractor. If required for proper installation, the Contractor shall obtain advice and supervisory assistance from a representative of the specific manufacturer of the equipment being installed.

D. Materials and adhesives to conform to Federal Standard Flame-Spread Properties, Inc., with composite fire and smoke hazard ratings, maximum 25 for flame spread and 50 for smoke developed. Adhesives to be waterproof.

E. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

F. Belts, pulleys, chains, gears, couplings, projecting screws, keys or other rotating parts which are located so that a person can come in close proximity thereto shall be fully enclosed properly provided with a guard.

1.3 QUALITY ASSURANCE AND APPLICABLE STANDARDS

A. Use adequate numbers of skilled workers that are thoroughly trained and experienced in the necessary crafts and are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation. **The contractor must support all pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support pipe, equipment, and all other items furnished under this scope from the metal deck.**

C. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

D. Codes: Perform all work in accordance with the latest edition of the following codes:
   1. State and city building, fire, plumbing and mechanical codes.
   2. International Fire Code (NMFC)
   3. Uniform Mechanical Code (NMMC)
   4. Uniform Plumbing Code (NMPC)
   5. National Electrical Code (NMEC)
   6. Energy Conservation Code (NMECC)
   7. National Fire Protection Association (NFPA)
   8. American with Disabilities Act (ADA)
   9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities.
   10. All authorities having jurisdiction.
   11. Architectural code review drawing.
   12. Dallas Green Building Program

E. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

F. Where conflicts occur between drawings, specifications or code requirements, the most stringent requirement shall take precedence.

G. Standards: The specifications and standards of the following organizations are by reference made a part of these specifications. All work, unless otherwise indicated, shall comply with the requirements and recommendations wherever applicable:
   1. American National Standards Institute (ANSI).
   2. Air Conditioning, Heating and Refrigeration Institute.
   3. American Gas Association (AGA).
   4. American Society for Testing and Materials (ASTM).
   5. American Society of Mechanical Engineers (ASME).
   6. American Society of Refrigeration, Heating and Air Conditioning Engineers (ASHRAE).
   7. Electrical Testing Laboratories (ETL).
   8. National Bureau of Standards (NBS).
   9. National Electrical Manufacturer's Association (NEMA).
   10. National Fire Protection Association (NFPA).
   11. Sheet Metal and Air Conditioning National Association (SMACNA).
   12. Underwriters Laboratories, Inc. (UL).

H. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. ASME Boiler and Pressure Vessel Code: Section IX.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. The requirements and recommendations of the latest edition of the Occupational Safety and Health Administration (OSHA) Act are by reference made a part of these specifications. All work shall comply with the requirements and recommendations wherever applicable.

1.5 SUBMITTALS

A. Comply with all submittal provisions of Division 1.

B. General: Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 01 and 26 submittal requirements. Architects and consultants are then to submit all documents and RFI's to the Mechanical Engineer electronically. Send to mdengca@md-eng.com. Submittals shall be labeled by their project specification section.

C. Product Data: Submit the following:
   1. Materials list of items proposed to be provided under Division 21.
   2. Manufacturer's specifications and other data needed to prove compliance with the

specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in the following paragraph.

3. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in a clear and concise format. All substitutions shall be approved in writing by Architect. The Architect's decision shall be final.
4. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.
5. Submittals that have been reviewed and marked as REJECTED (REJ) or MAKE CORRETCIONS NOTED (MCN) should be resubmitted with-in 10 days to be reviewed again by engineer.
6. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.
7. Manufacturer's recommended installation procedures which, when reviewed by the Architect, shall become the basis for accepting or rejecting actual installation procedures used on the work.
8. Sign the submittal as an indication of compliance with the contract documents. Any deviations from the contract documents shall be indicated on the submittal prior to signing. Any deviations not indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

D. Submittals required of materials and equipment under this section include the following:
1. Piping and Accessories Materials:
   a. **Clearly marked** up manufacturer's data showing compliance with the specifications for: **(Include model numbers and highlight or circle products)**
      1) Piping material proposed for each system.
      2) Valves, cocks, and specialties.
         a. RPZ's, Double back flow preventers, Vacuum breakers.
      3) Flexible connectors for piping.
      4) Flanges.
      5) Pumps, and circulators
      6) Compressors.
   b. l/8" scale (minimum) fire suppression piping shop drawings showing coordinated piping routing and arrangements with all equipment, accessories and system expansion and contraction compensation methods.
2. Vibration Isolation and Sound Control Materials:
   a. **Submit shop drawings** showing the structural design and details of inertia bases, steel beam bases, and other custom-fabricated work not covered by manufacturer's submitted data.
   b. Furnish layouts of templates to be furnished to fabricators of equipment bases, foundations, and other support systems, as needed for coordination of vibration isolation units with other work.
   c. Submit shop drawings indicating the scope of vibration isolation work, locations of units and flexible connections. Include support isolation points for piping, pumps, etc.
   d. Include schedule of isolation units, showing size or manufacturer's part number, the weight supported and resulting deflection of each unit.
   e. For spring isolation units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.

f. For spring-and-pad type isolation units, show the basis of spring rate selection for the range of loading weights.

3. Mechanical Identification Materials:
   a. **Clearly marked-up** product literature or samples showing compliance with specified materials for:
      1) Valve tagging.
      2) Pipe marking.
      3) Equipment marking.
4. Insulation:
   a. Manufacturer's certified data on thermal performance.
   b. Details, when required, of methods to be used in providing for unusual piping expansion and contraction.
   c. Manufacturer's data on any alternate insulation material of reduced thickness, including pre-insulated pipe.
   d. Manufacturer's data on all jacketing materials, sealants and fasteners.
5. Fire Protection System:
   a. Provide hydraulic calculations for all areas.
   b. Provide clearly marked-up manufacturer's data showing compliance with the specifications for:
      1) All required system valves and switches.
      2) Sprinkler heads for all areas and sprinkler cabinet.
      3) Fire hoses, hose valves and cabinets.
      4) Fire department connection.
   c. Provide all electrical characteristics.
   d. Submit all hydraulic calculations and drawings to be submitted to the Authority Having Jurisdiction and obtain stamp of approval prior to submission to the Architect/Engineer.
6. Record Documents: Reference the requirements detailed in this section.
7. **Operation and Maintenance Manual Requirements.**

E. **Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).**

1.6 SUBSTITUTIONS

A. Comply with all provisions of Division 1.

B. The use of manufacturers' names and catalog numbers followed by the phrase "or equal" is generally used to establish a standard of quality and utility for the specified items and to provide a dimensional reference for construction documents that are drawn to scale.

C. Submittals for "equal" items shall, where applicable, include the following data that are not necessarily required for specified items:
1. Performance characteristics.
2. Materials.
3. Finish.
4. Certification of conformance with specified codes and standards
5. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in Paragraph 6 below.
6. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Architect/ Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Include shop drawings for all piping and ductwork

equipment per Paragraph 1.5 Submittals. Organize in a clear and concise format.

D. Submittals of "equal" components or systems may be rejected if:
   1. The material or equipment would necessitate the alteration of any portion of the mechanical, electrical, architectural or structural design.
   2. Dimensions vary from the specified material or equipment in such a manner that accessibility or clearances are impaired or the work of other trades is adversely affected.

E. Proposed substitutions for materials or equipment must be submitted ten (10) days prior to final bid date for consideration as approved equals. Otherwise, such substitutions will not be permitted. Proposals for substitutions shall be made only by the prime bidders. Manufacturers, distributors, and sub-contractors shall not make proposals to the Architect for substitutions.

F. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts

G. No substitution shall be made unless authorized in writing by the Architect. Should a substitution be accepted, and should the substitute material prove defective or otherwise unsatisfactory for the service intended, and within the guarantee period, the Contractor shall replace this material or equipment with material or equipment specified, at his own expense, and to the satisfaction of the Architect.

H. Contractors submitting bids on substitute materials and equipment must also provide a written performance guarantee certifying that the substitute materials and equipment will produce the specified effects and meet the approval of the Architect.

1.7 ORDINANCES, PERMITS, METERS, UTILITIES AND ROYALTIES

A. Procure all permits and licenses necessary for completion of this project and pay all lawful fees required and necessary pursuant in obtaining said permits and licenses. All required certificates of approvals and inspections by local governing and regulating authorities shall be obtained and paid for by the Contractor.

B. Pay all fees required for the connection of water to utility mains, and any meter fees if required.

C. Pay any royalty payments required or fees for the use of patented equipment or systems. Defend all law suits or claims for infringement of any patent rights and shall hold the Owner and/or Architect/Engineer harmless from loss as a result of said suits or claims.

1.8 COMPATIBILITY OF EQUIPMENT

A. Assume full responsibility for satisfactory operation of all component parts of the fire protection systems to assure compatibility of all equipment and performance of the integrated systems in accordance with the requirements of the specifications. Should the Contractor consider any part of the specifications or drawings as rendering his acceptance of such responsibility impossible, prohibitive, or restrictive, he shall notify the Engineer before submitting his bid, and the bid shall be accompanied by a written statement of any objections or exceptions to the specifications and drawings.

B. The size of fire protection equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.

C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.9 CONSTRUCTION REQUIREMENTS

A. The drawings show the arrangements of work. Should project conditions necessitate rearrangement, or if the materials or equipment can be installed to a better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit five copies of Drawings of the proposed arrangement for the Architect’s review. Allow a minimum of ten (10) working days for review.

B. Should the Contractor propose to install equipment requiring space conditions other than those shown, or rearrange the equipment, he shall assume responsibility for the rearrangement of the space and shall have the Architect review the change before proceeding with the work. The

request for such changes shall be accompanied by shop drawings of the space in question. Identify monetary credits proposed or other benefits of the change. Allow a minimum of ten (10) working days for review.

C. The Contractor shall be responsible for the proper location and size of all slots, holes or openings in the building structure pertaining to his work and for the correct location of pipe sleeves.

1.10 CONNECTIONS FOR OTHERS

A. The Contractor shall rough in for and make all water, etc. connections to all equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

C. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve.

1.11 PROJECT RECORD DOCUMENTS

A. Provide the record documents associated with the work of Division 21 in strict accordance with the provisions of these specifications.

B. Throughout progress of the Division 21 Work, maintain an accurate record of changes in the Contract Documents that apply to work of Division 21. Changes shall include all addendums issued during bidding. Maintain an accurate record of the location of mechanical service lines and outlets and all outside utilities.

C. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved by the Architect.

D. Accuracy of Records

1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of drawings and other documents where such entry is required to show the change properly. Match the symbology and format of the base documents.
2. Accuracy of records shall be such that a future verification of items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.

E. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work and transfer of all recorded data to the final Project Record Documents.

F. Making Entries on Drawings

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
2. Date all entries.
3. Call attention to the entry by a "cloud" drawn around the area or areas affected.
4. In the event of overlapping changes, use different colors for the overlapping changes.
5. Make entries within 24 hours after receipt of information that the change has occurred.
6. Maintain the base drawing format and use the same symbology.
7. Convert field mark-ups to finished CADD record drawings when required in this section.

G. Conversion of Schematic Layouts

1. In some cases on the drawings, arrangements of ductwork and piping and similar items are shown schematically and are not intended to portray precise physical layout. Determine final physical arrangement subject to the Architect's approval. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the drawings.

2. Show on the job set of record drawings, by dimension accurate to within one inch, the centerline of each run of items such as all sleeves and piping, etc., below grade, in walls, or in the concrete slab. A surface mounted device indicates the exact location:
    a. Clearly identify the item by accurate note such as "Sanitary Sewer" and the like.
    b. Show, by symbol or note, the vertical location of the item "under slab,"

"in ceiling plenum," "exposed," and the like.

c. Make all identification sufficiently descriptive that it may be related reliably to the specifications.

H. Final Project Record Documents

1. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.
2. Provide CAD electronic files in .dwg format using AutoCAD software. Upon written request, completion of a release form, and payment of the Engineer's standard fee of $200 plus applicable sales tax for a set-up charge and $50 per drawing plus applicable sales tax for copies of such files, Engineer will provide AutoCAD electronic files of base Contract Drawings in dwg format on compact discs. 3. Provide completed record drawings on CD-R and one full size hard copy of each drawing.
4. Refer to Division 1 for additional requirements.

1.12 OPERATION AND MAINTENANCE DATA

A. Submit two copies of a preliminary draft of the proposed manual or manuals to the Architect for review and comments. Allow a minimum of ten (10) working days for review.

B. Submit specified number copies of the approved manual to the Architect prior to indoctrination of operation and maintenance personnel.

C. Prepare in accordance with the following standards:

Format:

Size: 8½" x 11"

Paper: White bond, at least 20 lb. weight

Text: Neatly written or printed

Drawings: 11" in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within the Manual and provide a drawing pocket inside rear cover or bind in with text.

Flysheets: Separate each section of the Manual with neatly prepared flysheets briefly describing contents of the ensuing section; flysheets may be in color.

Binding: Use heavy-duty plastic or fiber-board covers with binding mechanism concealed inside the manual; 3-ring binders will be acceptable; all binding is subject to the Architect's approval.

Measurements: Provide all measurements in U.S. standard units such as feet-and-inches, lbs, and cfm. Where items may be expected to be measured within ten years in accordance with metric formulae, provide additional measurements in the "International System of Units" (SI).

D. Provide front and back covers for each manual, using durable material approved by the Architect, and clearly identified on or through the cover with at least the following information:

OPERATING AND MAINTENANCE MANUAL (Required layout)

SEE NEXT PAGE

- Title Page
  - Job Name
  - Site Address
  - Include Contact information of prime contractor.
- Table of contents
- Warranty Information.
  - Include all contractor warranties
    - Signed and dated documents
- Permits-Inspections
- Subcontractor list
  - Include all subcontractors.
    - Company name, Contact info.
    - Trade Responsibility.
- Vendor list
  - Include name and addresses of vendors
    - Warranty information
    - Replaceable parts
- Approved submittals
  - Include all approved product submittals
- Reports/Certificates/Redlines
  - Engineers Observation Reports
  - Engineer/Manufacturer Start-up Report
  - Contractor Start-up Report
  - As-builts for FS,
  - Fire Marshal Approval
  - Owners Training Report
- O&M Manuals
- Equipment Information.
  - Include Model, Serial and location.
- Signed Approval
  - Page for approval signature of the engineer and approval date.

E. Contents: Include at least the following:

2. Neatly typewritten index near the front of the manual, giving immediate information as to location within the manual of all emergency information regarding the installation.
3. Complete instructions regarding operation and maintenance of all equipment provided including lubrication, disassembly, and reassembly.
4. Complete nomenclature of all parts of all equipment.
5. Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
6. Copy of all guarantees and warranties issued.
7. Manufacturer's bulletins, drawings, and descriptive data, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.

8. Such other data as required in other sections of these specifications.
9. Signed warranty documents

1.13 WARRANTY

A. Contractor shall warranty all equipment and workmanship for a period of at least one year after date of substantial completion and replace or repair any faulty equipment or installation at no cost to the Owner for such service during this period, all in accordance with requirements of Division 1.

B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

C. Warranties shall be in writing in a form satisfactory to the Owner, and shall be delivered to the Owner before final payment is made.

D. Upon completion of the work of Division 21, thoroughly clean all exposed portions of the mechanical installation, removing all traces of soil, labels, grease, oil and other foreign material and using only the type cleaner recommended by the manufacturer of the item being cleaned.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

A. Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacturer, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be a minimum of 18" x 18" in size.

PART 3 - EXECUTION

3.1 ACCCESS DOORS

A. In fire-rated walls, access door shall be fire rated same as wall.

3.2 TESTING AND INSPECTION

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. Make written notice to the Architect adequately in advance of each of the following stages of construction:
1. When all rough-in is complete, but not covered.
2. As specified in all Division 21 sections.
3. At the completion of the work of Division 21.

C. When material or workmanship is found to not comply with the specified requirements, remove the noncomplying items from the job site and replace them with items complying with the specified requirements at no additional cost to the Owner. This shall be performed within 3 days after receipt of written notice of noncompliance.

3.3 INSTALLATION METHODS

A. Unless noted otherwise, piping may be run exposed in mechanical rooms and janitor's closets. Piping exposed in mechanical rooms and janitor's closets shall be run tight against the structure, as required by the Architect, allowing for expansion.

B. Conceal piping to be installed as hereinbefore specified.

C. Piping suspended from the structure shall be adequately and properly supported on hanger rods or clamps as specified in Section 21 0529 “Hangers and Supports for Fire Suppression Piping and Equipment”. Perforated strap hangers will not be permitted. **The contractor must support all pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support pipe, equipment, and all other items furnished under this scope from the metal deck.**

D. Where space is limited above ceilings, below concrete beams or other concrete projections, piping shall be sleeved through the beam or projection, rather than hung below. Provide sleeves where required and locate where approved by the Architect.

E. Cut pipe accurately to measurements established at the building and install into position without springing or forcing. All open ends of pipes shall be capped or otherwise closed until the systems are closed with final connections.

F. No pipe joints nearer than 12" to a wall, ceiling or floor penetration will be permitted, unless joint is of the welded type.

G. Piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Piping shall be graded for proper drainage.

H. Piping shall follow as closely as possible the routes shown on plans, which take into consideration conditions to be met at the site and in the building. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval from the Architect.

I. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping and in connections to equipment.

J. All piping shall be clean when it is installed; rust and/or dirt shall be removed.

K. Screw joints shall be made with taper threads, properly cut. Threads shall be cut using graphite and oil applied to the pipe only. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Pipe shall be up-ended and hammered to remove all shavings and foreign material, before installing.

L. Requirements for assembling joints in cast iron and copper lines are set forth elsewhere in these specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

M. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of the fire suppression system.

N. Install roof pipe penetrations through sleeves, and flash with membrane flashing and roofing mastic compatible with roofing system. Roofing Supplier/Contractor shall approve roof penetration and flashing.

O. For additional installation requirements, refer to individual sections in Division 21.

3.4 CUTTING AND PATCHING

A. Perform cutting and patching associated with the work in strict accordance with the provisions of Division 1 of these Specifications and the following:

1. Coordinate work to minimize cutting and patching work. Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction. If cutting and patching is required, it shall be performed by trades specializing in that type work.
2. Perform Architect-approved cutting and demolition by methods which will prevent damage to other portions of the work and provide proper surfaces to receive installation of new work and/or repair.
    a. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect. Impact-type equipment will not be used except where specifically acceptable to the Architect.
    b. Openings in precast concrete slabs or walls for pipes, etc., shall be core drilled to exact size. Oversize the hole to allow for link seals, and to deter pipe corrosion condensation from forming.
    c. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.
    d. Openings cut through plaster or drywall shall be cut prior to plaster finish coat or texture coat on drywall. Cutting of the finish coat of plaster or texture coat of drywall will not be permitted unless written approval of the Architect is obtained.
    e. Openings shall be restored and/or repaired as required to replace the cut

surface to an "as-new" and/or "as original" condition. Refer to the appropriate section of the specifications for the material involved.

3. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.
4. Provide all core drilling of holes. Where sleeves and/or blockouts are required, they shall be cut or provided at locations required. On completion of this work or as work progresses, make all repairs and do all patching required as a result of work under this Contract. All patching shall be performed in a manner that will restore the surrounding work to its original condition to the satisfaction of the Architect.
5. Assume responsibility for the proper size of all sleeves and/or blockouts in the building structure pertaining to the work and for providing the correct location of pipe sleeves and/or blockouts.
6. No cutting, boring or excavating which will weaken the structure will be permitted.

3.5 EXISTING UTILITIES AND TEMPORARY SERVICES FOR CONSTRUCTION

A. Verify the location and capacity of existing utility services pertaining to work of Division 21. Relocate existing utilities unearthed by excavation as directed by the utility service companies affected.
   1. Temporary Services for Construction
   2. Provide temporary services in strict accordance with the provisions of these specifications.

B. When any piece of fire suppression equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Architect's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.

C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

3.6 EXCAVATION AND BACKFILLING

A. Perform all excavation and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them in dry condition until the work has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

B. Perform excavation and backfilling in strict accordance with the provisions of these specifications including trench safety requirements.

C. All excavations shall be made to the proper depth, with allowances made for floor slabs, forms, beams, etc. Ground under piping shall be well compacted before piping is installed.

D. Backfilling shall be made with selected soil, free from rocks and debris and shall be pneumatically tamped with 6 inch layers to secure a field density ratio of 95 percent as defined by ASTM Designation D698-57T (Proctor Soil Compaction Test).

E. Excavated materials not suitable and not used in the backfill shall be removed from the site.

F. Field check and verify the locations of all underground utilities. Avoid disturbing these as far as possible. In the event existing utilities are damaged, they shall be repaired at no cost to Owner.

G. In a lime stabilized area, the lime stabilization shall be fully restored after the excavation is complete.

H. Replace concrete, curbs, paving and other surface improvements cut during excavation to their original condition.

3.7 JOBSITE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Include required work to correct conditions detrimental to the timely and proper completion of all Division 21 Work. Do not proceed until unsatisfactory conditions are corrected.

B. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building

with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

C. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.

D. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

3.8 STORAGE AND PROTECTION

A. Contractor shall provide the required protection of equipment and materials from the time of delivery until the completion of the Work. Protect from damage, rust, rain, humidity and dust.

B. Do not receive equipment or materials on the jobsite until adequate space has been provided for storage.

C. Provide adequate supports for protection from the ground and erect required shelters for items stored in the open.

D. Items stored within the building are to be adequately protected and covered with tarpaulins or other protective covering.

E. Protect the building at all times during construction from damage by workmen, their tools and/or equipment. Protect floors, steps, wall, ceilings, doors, windows and other finish surfaces.

F. Equipment and materials found in a rusty condition at completion of the work will be thoroughly cleaned of rust and refinished as required to its original condition.

3.9 PREPARATION AND COORDINATION

A. Perform coordination work in strict accordance with provisions of these specifications and the following:

2. Coordinate as necessary with other trades to assure proper and adequate interface with all work.

3. Where pipes or other fire suppression items are shown in conflict with locations of structural members and other equipment, include labor and materials required for extensions, offsets and supports to clear the encroachment.

4. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of the fire suppression system.

5. Coordinate accepted equipment changes from those scheduled or specified with other trades affected. Additional compensation to other trades for equipment changes is the responsibility of the Contractor making the change.

B. The Mechanical, Electrical, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

D. The general installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".

Building lines
Structural Members
Soil and Drain Piping
Condensate Drains
Vent Piping
Supply, Return, and Outside Air Ductwork
Exhaust Ductwork
Fire Protection Piping
Gas Piping
Domestic Water (Cold and Hot)
Electrical Conduit

E. Where items such as diffusers, thermostats, switches, and control panels are not specifically located on the Drawings, locate as determined in the field by the Architect. Where such items are installed without such specific direction, relocate as directed by the Architect and at no additional cost to the Owner.

F. Verify all dimensions and distances. No additional compensation will be allowed because of differences between work shown on the Drawings and actual dimensions and distances at the jobsite.

3.10 PAINTING

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be damaged in transit or during the installation, it shall be finished to match appearance of original finish. All work shall be subject to approval by Architect.

B. All equipment, piping, conduit, insulation, etc., furnished and installed in exposed areas under Divisions 21 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 21 work

C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

END OF SECTION

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SECTION 21 05 19 - METERS AND GAGES FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY
- A. Section Includes:
  1. Dial-type pressure gages.
  2. Gage attachments.
  3. Test plugs.
  4. Test-plug kits.
  5. Sight flow indicators.

1.2 QUALITY ASSURANCE
- A. ASME B40.1: Gages, Pressure Indicating Dial Type, Elastic Element

1.4 SUBMITTALS
- A. **Provide submittals as required in section 210010, "Submittal Process."**

PART 2 - PRODUCTS

2.1 PRESSURE GAGES
- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
     a. Dwyer Instruments, Inc.
     b. Trerice, H. O. Co.
     c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
     d. Weiss Instruments, Inc.
  2. Standard: ASME B40.100.
  3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  5. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
  8. Pointer: Dark-colored metal.
  9. Window: Glass.
  10. Ring: Metal.
  11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.2 GAGE ATTACHMENTS
- A. Snubbers: ASME B40.100, brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Siphons: Loop-shaped section of brass pipe with NPS 1/2 pipe threads.
- C. Valves: Brass or stainless-steel needle, with NPS 1/2, ASME B1.20.1 pipe threads.

2.3 TEST PLUGS
- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Trerice, H. O. Co.
  2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  3. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.
E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.4 TEST-PLUG KITS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flow Design, Inc.
   2. Trerice, H. O. Co.
   3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   4. Weiss Instruments, Inc.
B. Furnish one test-plug kit(s) containing one pressure gage and adapter, and carrying case. Pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
C. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
D. Carrying Case: Metal or plastic, with formed instrument padding.

2.5 SIGHT FLOW INDICATORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Archon Industries, Inc.
   2. Dwyer Instruments, Inc.
   3. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
B. Description: Piping inline-installation device for visual verification of flow.
C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
D. Minimum Pressure Rating: 125 psig.
E. Minimum Temperature Rating: 200 deg F.
F. End Connections for NPS 2 and Smaller: Threaded.
G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
B. Install remote-mounted pressure gages on panel.
C. Install valve and snubber in piping for each pressure gage for fluids.
D. Install test plugs in piping tees.
E. Install flow indicators in piping systems in accessible positions for easy viewing.
F. Install permanent indicators on walls or brackets in accessible and readable positions.
G. Install connection fittings in accessible locations for attachment to portable indicators.
H. Install pressure gages in the following locations:
   1. Discharge of each alarm valve.
   2. As indicated in the Drawings.

3.2 CONNECTIONS

A. Install gages adjacent to machines and equipment to allow service and maintenance of gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of gages to proper angle for best visibility.

END OF SECTION

SECTION 21 05 23 - GENERAL DUTY VALVES FOR WATER BASED FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Work included:

a. General duty valves.

C. Submittals: **Provide submittals as required in Section 210010 "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer's certifications shall be submitted to the Engineer on all such materials used.

PART 2 - PRODUCTS

2.1 VALVES, COCKS AND SPECIALTIES

A. Materials: Bronze, ductile iron, or cast iron per local codes with screwed, Vic-Press 304™, grooved, or flanged ends for steel pipe and Permalynx push-to-connect, grooved, or solder ends for copper pipe.

B. Gate Valves: Rated for 200 PSIG WOG:

1. 2-1/2" and below – Nibco T-113 for steel pipe and Nibco S-113, for copper pipe, or approved equal.

2. 3" and above – Victaulic Series 771 (cold water service), Nibco F-619 or engineer approved equal.

C. Ball Valves: Rated for 200 psig WOG.

1. 2-1/2" and below – Nibco T-595-Y for steel pipe and NVent PL-200 or Nibco S-595-Y for copper pipe or engineer approved equal.

D. Backflow Preventer:

1. Double check valve assembly consisting of two independently operating, spring loaded check valves, two gate valves, and four test cocks for field testing, Wilkins Model 950 or approved equal.

2. Provide reduced pressure type if required by local codes.

E. Butterfly Valves:

1. Butterfly valves may be used in lieu of gate valves on chilled water and hot water heating lines rated to 150 psig: 2" - 12", with stem shall be offset from the disc centerline to provide full 360-degree circumferential seating, Victaulic Vic-300 MasterSeal™ or " Crane 21-BRZ (21-BRB under 150 Deg. F). 14" - 24" Victaulic Series W706 or Crane 22F-BRZ (22F-BRB under 150 Deg. F) or engineer approved equal as manufactured by Jenkins, Centerline or Victaulic.

F. Gauge Cocks and Manual Air Vents:
   1. Provide brass, lever handle cock, 1/4" FPT, as shown on the drawings or as specified herein.

G. Dielectric Unions or Waterway Fittings:
   1. Provide dielectric unions or waterway fittings at all piping connections (except to valves) between dissimilar metals, Watts No. 3000 series, Victaulic Style 47, or engineer approved equal.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

END OF SECTION

SECTION 21 05 29 - HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Work included:

1. Pipe hangers and supports.
2. Concrete supports for equipment.
3. Sleeving for fire suppression equipment.

C. Submittals**: Provide submittals as required in Section 210010 "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.3 REFERENCE STANDARDS

A. Automatic Sprinkler Pipe Supports: NFPA 13, Standard for the Installation of Sprinkler Systems.

B. Standpipe System Supports: NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Supports, hangers, anchors, guides and supplementary steel shall be provided for horizontal and vertical piping and shall meet or exceed the ASA Code for Pressure Piping.

B. Rod sizes noted are minimum sizes. The structural integrity of the supports is the responsibility of the Contractor.

C. Supports for Vertical Riser Piping:

1. Provide Grinnell Fig. 261 double bolt riser clamps at each floor. Bear on structure.
2. At 8 feet o.c., 2-hole rigid clamps. Kindorf channels and C-105 straps. Support from vertical surfaces.

D. Supports for Vertical and Horizontal Piping in Chases and Partitions:

1. Supports shall be steel plate, angles or unistruts mounted vertically or horizontally with unistrut clamps P2426, P2008 or P1109.
2. Attach supports to wall or floor construction with clip angles, brackets or other approved anchoring devices.

2.2 HANGER RODS

A. Provide steel hanger rods, threaded both ends, threaded one end or continuous threaded.

B. Size hanger rods as follows:

Pipe Size	Rod Diameter
4" & Smaller	3/8"
5" thru 8"	1/2"

10" & 12"	5/8"
14" & 16"	3/4"

2.3 SLEEVES

A. Provide sleeves where pipes penetrate floors, walls, foundations, fireproofing, etc.

B. Size sleeves large enough to allow for movement due to expansion and to provide for continuous movement. Provide a bead of sealant in space between pipe and sleeve. Use link-seal to seal between pipe and sleeve for all slab on grade floor penetrations.

C. Use Schedule 40 galvanized steel pipe sleeves for all floor and foundation penetrations. Sleeves shall extend minimum of 2" above finished floor and flush with vertical wall surface.

2.4 TRAPEZES

A. Trapezes of Kindorf, Elcen or approved equal may be provided where multiple lines run horizontally at the same elevation.

2.5 CONCRETE SUPPORTS FOR EQUIPMENT

A. Provide concrete pad foundations for the support of equipment such as floor-mounted pumps, etc.

B. Unless otherwise noted, concrete pads shall be constructed of not less than 3,000 lb. concrete and not less than 4" high and shall extend on all sides a minimum of 8 inches beyond the limits of the mounted equipment. Pads shall be poured in forms built of new-dressed lumber. All corners of the foundations shall be neatly chamfered 3/4" wide by means of sheet metal of triangular wood strips nailed to the form. Reinforce with No. 4 rebar 6" on center.

C. Foundation bolts, 3/4" round-hooked, shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of size to provide 1/2" clearance around bolt. Allow 1" below the equipment bases for alignment and grouting. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with carborundum.

D. Foundation pads for equipment located on the exterior of the building shall be provided as indicated.

E. Submit shop drawings of concrete pads for review by the Architect.

2.6 STRAP HANGERS

A. Under no circumstances will perforated strap iron or wire be acceptable for hangers on this project.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTS

A. All pipe supports shall be designed and installed to avoid interferences with other piping, hangers, ducts, electrical conduit, supports, building structure, equipment, etc. All piping shall be installed with due regard to expansion and contraction. The type of hanger, method of support, location of support, etc., shall be governed in part by this specification.

B. Pipe hangers shall be attached to the structure as follows:

1. Poured-in-Place Concrete: Each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters' Laboratories, Inc., listed universal concrete insert placed in the formwork before concrete is poured.
2. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods shall be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size. Each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently affixed thereto.
3. Steel Beams: Pipes and loads supported under steel beams shall be installed using approved beam clamps.

3.2 SPACING

A. Install hangers for steel piping with the following maximum spacing and minimum rod sizes according to MSS SP 69 Tables 3 and 4:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 1/2 inch.
9. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
10. NPS 5: Maximum span, 16 feet; minimum rod size, 5/8 inch.
11. NPS 6: Maximum span, 17 feet; minimum rod size, 3/4 inch.
12. NPS 8: Maximum span, 19 feet; minimum rod size, 3/4 inch.
13. NPS 10: Maximum span, 22 feet; minimum rod size, 7/8 inch.
14. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
15. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
16. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
17. NPS 18: Maximum span, 28 feet; minimum rod size, 1 inch.
18. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 5 feet; minimum rod size, 3/8 inch.
2. NPS 5/8: Maximum span, 5 feet; minimum rod size, 3/8 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

C. Spacing and rod sizes for other piping materials shall be as recommended by the manufacturer.

3.3 TRAPEZES

A. Trapeze members, including suspension rods, shall be properly sized for the number, size and loaded weight of the lines they are to support. Install as noted above.

3.4 HANGERS AND SUPPORTS

A. All hangers and supports for fire standpipe systems and fire sprinkler systems shall be Underwriters' Laboratories, Inc. approved types.

3.5 EQUIPMENT FOUNDATIONS

A. Provide equipment foundations associated with the work in accordance with the provisions of these specifications.

B. Provide concrete bases for all pad or floor mounted equipment.

3.6 MISCELLANEOUS

A. Install any other special foundations, hangers and supports indicated on the drawings, specified elsewhere, or required by installation conditions.

END OF SECTION

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SECTION 21 05 48 - VIBRATION AND SEISMIC CONTROLS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of vibration isolation work is indicated by drawings and schedules, and by the requirements of this section.

B. The types of vibration isolation work specified in this section include the following:

1. Support isolation for motor-driven mechanical equipment.
2. Isolation including support isolation for piping risers.
3. Support isolation of piping.
4. Flexible connections for piping at equipment.

C. Refer to other sections of these specifications for equipment foundations, hangers, sealants, gaskets, flexible connections for piping, and other work related to vibration isolation work.

D. Submittals: **Provide submittals as required in section 210010, “Submittal Process.”**

1.2 QUALITY ASSURANCE

A. Product Qualification: Provide each type of vibration isolation unit produced by a specialized manufacturer, with not less than 5 years' successful experience in the production of units similar to those for the project.

1. Except as otherwise indicated obtain support isolation units from a single manufacturer.
2. Engage the manufacturer to provide technical supervision of the installation of support isolation units produced by him, and of associated inertia bases (if any).

B. Manufacturer: Acceptable vibration isolation support unit manufacturers are as follows:

1. Mason Industries, Inc.
2. Vibration Mountings and Controls, Inc.
3. Amber Booth
4. Peabody Kinetics

C. Manufacturer Certification: Where vibration isolation support units are indicated for a minimum static deflection, provide manufacturer's certification that units have been tested and comply with the indicated requirements.

D. All items of equipment, whether suspended, floor mounted or otherwise supported, which are capable of producing vibration, shall be installed with vibration isolation. The isolation shall prevent the transmission of objectionable noise or vibration to the building structure.

E. Submit for approval data showing disturbing frequency, supported weight, static deflection or natural frequency, and calculations supporting same for each isolator.

1.4 SUBMITTALS

A. Manufacturer's Data, Vibration Isolation:

1. For information, only, submit 2 copies of manufacturer's specifications, detailed drawings, performance characteristics data and installation instructions for each type of unit required.
2. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.
3. Where required, include independent test agencies certified report of test results for each type of unit.
4. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.
5. For spring-and-pad-type units show basis of spring-rate selection for range of loading weights.
6. Include performance certifications where required.

PART 2 - PRODUCTS

2.1 ISOLATION MATERIALS AND SUPPORT UNITS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided where bolting is required. On equipment, such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang.

B. Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short-circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

C. Vibration hangers shall be as described above, but they shall be precompressed to the rated deflection to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be indicated by a scale.

D. Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short-circuiting. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hole sizes shall be large enough to permit the hanger rod to spring through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have as minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eyebolt on the spring end and provision to attach the housing to the flat iron duct straps.

E. Vibration isolator shall be steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment.

F. Flexible neoprene connectors shall be used on all equipment as indicated on the drawings. They shall be manufactured of multiple plies of nylon tire cord fabric and neoprene. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Neoprene elbows shall have a single sphere forming the corner of the joint itself. Connectors up to and including 2" diameter may have threaded ends. Connectors 2-1/2" and larger shall have floating steel flanges. All connectors shall be rated a minimum of 150 psi at 200 degrees F. All sizes operating at pressures above 100 psi shall employ control cables with end fittings isolated from the anchoring plates by means of 1/2" thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

G. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Lengths shall be as tabulated:

Flanges		Male Nipples	
3 x 14	10 x 26	1/2 x 9	1-1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2-1/2 x 18
6 x 20	16 x 32	1-1/4 x 12	
8 x 22			

H. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS.

I. Where piping passes through equipment walls, floors or ceilings, the vibration isolator shall be a split seal consisting of two bolted pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240 degrees F., 10# density fiberglass may be used in lieu of the sponge.

J. Isolator pads shall be neoprene waffle rated for 60#/sq. in.
K. Pipe Riser Isolators: Provide manufacturer's standard pad-type isolator bonded to steel plate, formed for welding to pipe sleeve extension.

PART 3 - EXECUTION

3.1 PERFORMANCE OF ISOLATORS
A. General: Comply with the minimum static deflections recommended by the manufacturer, including the definitions of critical and non-critical locations, for the selection and application of vibration isolation materials and units as indicated.
B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.2 APPLICATIONS
A. General: Apply the types of vibration isolation materials and units indicated at the locations shown or scheduled. Selection is Contractor's option where more than one type is indicated.
B. Provide Neoprene Pads at the following locations/items of equipment:
1. Where shown on drawings.
C. Provide Vibration Isolation Springs for the following items of equipment:
1. Where shown on drawings.
D. Provide Spring Isolator, housed at the following items of equipment:
1. Where shown on drawings.
E. Provide Isolation Hangers for the following:
1. Piping connected to machinery.

3.3 INSTALLATION
A. General:
1. Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units.
2. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points.
3. Remove spacer blocks and similar devices (if any) intended for temporary protection during shipping or against overloading during installation.
4. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.
5. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
6. Install inertia base frames on isolator units as indicated, so that a minimum of 2" clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.
7. Locate isolation hangers as near the overhead support structure as possible.
8. Weld riser isolator units in place as required preventing displacement from loading and operations.

3.4 EXAMINATION OF RELATED WORK
A. Installer of vibration isolation work shall observe the installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish a written report to the Contractor listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:
1. Equipment installations (performed as work of other sections) on vibration isolators.
2. Piping connections including flexible connections.
3. Passage of piping which is to be isolated through walls and floors.
B. Do not start-up equipment until inadequacies have been corrected in a manner acceptable to the vibration isolation Installer.

C.

3.5 DEFLECTION MEASUREMENTS

A. Upon completion of vibration isolation work, take measurements and prepare a report showing measured equipment deflections for each item of equipment.

END OF SECTON

SECTION 21 05 53 - IDENTIFICATION FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

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. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Work included:

1. Valve tagging
2. Pipe marking
3. Equipment marking

C. Submittals: **Provide submittals as required in Section 210010, "Submittal Process".**

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified. Marking system shall conform to ASME 13.1, latest edition and OSHA 29 CFR 1910.261 requirements.

PART 2 - PRODUCTS

2.1 VALVE TAGS

A. Provide a tag for each valve in main and branch piping of fire suppression piping systems.

1. Tags shall be 1-1/2" diameter of solid brass with blacked filled stamped characters of 1/4" height above and 1/2" height below.
2. Provide 8" long meter seals for use with valve tags.

B. Provide a valve chart with a schedule and location plans for all identified equipment, both in a frame with an acrylic cover to be located as directed by the Architect.

2.2 PIPE MARKERS

A. Provide pipe markers for pipes that provide 360 degree visibility with ANSI approved color coded background, color of legend in relation to background color, legend letter size, and length of color field. Additionally, direction of flow arrows shall be printed on the same markers, and words shall be repeated and reversed for use with flow in either direction.

1. Each marker shall be formed with a clear acrylic covering suitable for use outdoors.

B. For diameters 3/4" to 6", marker shall be formed in order to snap on and completely surround the pipe. For diameters 6" and larger, provide radius formed markers of same material.

2.3 EQUIPMENT PLATES

A. Plate shall be black with white letters that appear when the plate is engraved.

B. Plate material shall be specifically suited for conditions surrounding the equipment. Outdoor equipment shall require special plate material for outdoor use.

C. Plate size shall be as required with lettering size appropriate for the information shown but in no case less than 1/8" high. Lettering style shall match existing facility standards.

D. Nomenclature for plates shall be based on the equipment designations shown on the equipment schedules and as approved by the Architect.

2.4 CONCEALED DEVICES

A. Operable devices and equipment located above ceilings shall be marked with color coded W. H. Brady "Tack" type markers.

2.5 MANUFACTURERS

A. Provide marking system as manufactured by W. H. Brady Company, Seton, Craftmark, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Place all markers and plates in such locations that they are easily read by a person without assuming awkward or hazardous positions.

3.2 VALVE TAGS

A. Secure one valve tag to each valve.

3.3 PIPE MARKERS

A. Markers shall not require taping or the use of any adhesive material or fasteners to permanently secure them to the pipe. For diameters 6" and larger, secure with stainless steel spring fasteners.

B. Install sufficient quantities of markers that tracing of pipe systems can be readily accomplished. Install within three feet before and/or after penetrations through walls, floors, ceilings, underground or other non-accessible enclosures; at access doors, manholes or other access points which permit view of concealed piping; and when there is a change in direction of the concealed pipe. Locations in major mechanical rooms shall be labeled at a maximum spacing of every 20 feet. Other piping shall have labels at a maximum spacing of every 30 feet and at least once in every area that the pipe passes over or through. Install additional markers where directed by the Architect.

3.4 EQUIPMENT PLATES

A. Provide engraved plates for all fire suppression equipment.

B. Secure all plates with two self-tapping metal screws with round heads. Alternately, plates may be fastened with "pop" rivets provided no cracking or injury occurs to the plate. Plates attached with adhesives shall not be permitted.

END OF SECTION

SECTION 21 13 00 - FIRE PROTECTION SYSTEM

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. Provide a complete fire protection system for the building as specified, as indicated on the drawings, and as required by all authorities having jurisdiction and Texas Commission on Jail Standards. The drawings show the general arrangement of plumbing, air conditioning, piping, ductwork, and other apparatus. The Contractor shall coordinate this work with all other construction so that there shall be no conflict as to space required. The mechanical and electrical work shall, in general, take precedence over sprinkler work, except where it is absolutely necessary to maintain required coverage.

B. Work Included:

1. Complete fire protection sprinkler system with city approved piping, valves, and accessories for a complete system. The existing system shall remain operational during all phases of construction.
2. The requirement that the entire fire protection installation shall be as required by and subject to the approval of all approving authorities, shall govern the installation for this project. The drawings are intended as a guide for the system arrangement; omission of specific indication of any item shall not relieve the Contractor of the responsibility of furnishing and installing that item if it is required by the approving authorities.
3. Upon completion of the work, the Contractor shall be responsible for obtaining from the approving authorities, a certificate of approval or other indication of such approval and acceptance by said Authorities.
4. The system shall be hydraulically designed, based on a flow data obtained from local authorities. **Contractor shall be responsible for the design and obtaining this information and incorporating it into his bid and the design.**

C. Design Responsibility and Certification: The designer of the fire protection systems shall be responsible for all design, coordination and approval of each system in order to assure compliance with drawings, specifications, codes and authorities having jurisdiction. Drawings, calculations and other supporting evidence of this design shall be provided to the proper reviewing agencies and to the Architect and shall bear appropriate professional certification that the Designer has met the Quality Assurance requirements stated herein. Certification shall be indicative that the Designer acknowledges and accepts full design responsibility. Descriptions and limitations set forth in these specifications must be followed unless more stringent requirements are established by the reviewing agency.

1.3 FIRE PROTECTION DESIGN CRITERIA

A. Sprinkler systems shall be designed for the densities shown on the drawings. Hydraulic calculations shall be based on simultaneous operation of heads in the designated area plus flows in the standpipes in accordance with NFPA 13.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. The Contractor shall be licensed to sell, install and service the types of systems required by these specifications.

D. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed in the State of Texas. The designer of the fire protection systems shall be certified by the National Institute for Certification in Engineering Technologies (NICET) for Automatic Sprinkler System Design, Level III. The installer shall have on their staff a full-time Responsible Managing Employee (RME) licensed by the State Fire Marshall, to install and service fire protection systems. The RME shall assure that each fire protection system as installed meets the standards as provided by the applicable publications referenced herein and the requirements of these specifications. All design submittal documents and shop drawings shall bear the responsible engineers signed and dated seal.

E. All parts of fire protection piping systems shall conform to all provisions of Underwriters' Laboratories requirements. All equipment shall bear the Underwriters' Laboratories label of approval.

F. Determine volume and pressure of incoming water supply from residual pressure water flow test.

G. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

H. All aspects of design, securing approval of design and construction, shall be in accordance with the latest edition of the National Fire Protection Association Standards, including but not limited to NFPA - 10, 13, 14, 20 and 24, and shall conform in all respects to the rules and regulations of the Building Code and Fire Code of the City in which this project is located, all Factory Mutual requirements and all other approving authorities having jurisdiction.

I. Installation shall be in accordance with manufacturer’s recommendations and Factory Mutual standards.

1.5 SUBMITTALS

A. Provide submittals as required in Section 21 00 10, “Submittal Process”.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, and floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, components and accessories. Indicate system controls.

C. Product Data: Provide data on sprinkler heads, valves, and specialties, including manufacturer’s catalogue information. Submit performance ratings rough-in details, weights, support requirements, and piping connections. Submit two of each style of sprinkler head specified

D. Manufacturer's Certificate: Certify that system has been tested and meets or exceeds

requirements specified, and suggested by listed codes.

E. Provide certificate of compliance from authority have jurisdiction indicating approval of field acceptance tests.

PART 2 - PRODUCTS

2.1 PIPING

A. Underground pipe to the inside of the building shall be cement lined cast iron or PVC Class 150 (SDR 17) with cast iron Class 250 fittings.

B. All sprinkler piping within the building shall be per NFPA schedules with approved compatible fittings and valve connections. Piping may be joined by welding, and/or the use of grooved, flanged or threaded joints and connections.

2.2 BACKFLOW PREVENTERS

A. Backflow preventers (BFP) shall be reduced pressure type, Febco 825, or approved equal. A BFP shall be installed to isolate all non-potable water requirements from the building domestic water system. (All BFP's shall be installed within the building, unless otherwise dictated by code authorities.)

2.3 FIRE DEPARTMENT CONNECTIONS

A. At the points designated on the Contract Drawings, install Fire Department Connections (Siamese fittings) required for fire protection purposes. From a point on the incoming water supply line, this Contractor shall extend water line for fire protection purposes to Fire Department Connections (Siamese fittings).

B. Wall type Fire Department Connections (Siamese fittings) shall be equal to Potter Roemer double clapper flush type Siamese connections having threads complying with the requirements of the City Fire Department. They shall have proper caps with pin type lugs attached to the body of the Fire Department Connections (Siamese fittings) with substantial chains. The plate fitting against the building shall have raised letters reading "AUTOMATIC SPRINKLER" or "STANDPIPE". All external surfaces shall be chromium plated polished surfaces or as directed by Architect.

C. Sidewalk type Fire Department Connections (Siamese fittings having threads complying with the requirements of the City Fire Department) shall be equal to Potter Roemer free standing fire department cast brass body and escutcheon. They shall have proper caps with pin type lugs attached to the body of connection with substantial chains. "STANDPIPE" or "AUTOMATIC SPRINKLER" to be cast on head of connection. All external surfaces shall be chromium plated polished surfaces or as directed by Architect.

D. Fire department connection shall be Factory Mutual approved.

2.4 STANDPIPES

A. Install at each floor level on each standpipe not more than 5'-0" from finished floor an indicating control valve, and a 2-1/2" fire department connection with a 2-1/2" x 1-1/2" reducer with cap and chain. Threads shall conform to the local fire protection district standards.

2.5 VALVES

A. Control valves inside buildings shall be listed 175-pound W.O.G. approved indicating type valve.

B. Check valves shall be listed, 175-pound W.O.G. horizontal swing check valves or approved equivalent such as wafer check valves.

C. Drain and test valves shall be 175-pound W.O.G., bronze threaded globe valves with renewable composition disc.

2.6 WATER FLOW SWITCHES

A. Vane-type waterflow detectors shall be installed on the sprinkler mains. Detector shall be designed for mounting on either vertical or horizontal piping, but shall not be mounted in a fitting or within 12 inches of any fitting that changes the direction of water flow, and shall have a sensitivity setting to signal any flow of water that equals or exceeds 10 gpm.

B. Detector switch mechanisms shall incorporate an instantly recycling pneumatic retard element with an adjustable range of 0 to 60 second. Switches shall be suitable for operation on 24-volt D.C., and shall be actuated by a vane extended into the waterway of the piping. Detectors shall be of dust tight construction. Detector switch enclosures shall be secured with a tamper proof bolt that requires the use of a special wrench for removal. Vane-type waterflow detectors shall be Underwriters' Laboratories listed. The detector shall be furnished and installed under this section and wired completely under Division 26.

C. Water flow switches shall be Factory Mutual approved.

2.7 TAMPER SWITCHES

A. Tamper switches shall be installed on each valve inside the building. Switches shall be mounted so as not to interfere with the normal operation of the valve control or when the stem has moved no more than one-fifth (1/5) of the distance from its normal position. The mechanism shall be contained in a weather-proof die cast aluminum housing which shall provide a 3/4 inch tapped conduit entrance and incorporate the necessary facilities for attachment to the valve. Switch housings shall be furnished in red baked enamel. The switch mechanism shall have a minimum rated capacity of one amp, 125 A.C. - 0.25 amp, 24 volt D.C. The entire installed assembly shall be tamper proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting. Supervisory switches and gate valve switches shall be Underwriters' Laboratories listed. Supervisory switches shall be furnished and installed under this section and wired completely under Division 26.

B. Tamper switches shall be Factory Mutual approved.

2.8 SPRINKLER SYSTEM

A. Automatic Sprinklers: Sprinkler heads of proper temperature rating shall be installed throughout the building as required by approving authorities. Where furred or finished ceilings occur, the piping shall be installed above the ceilings with the sprinkler heads nippled through the ceiling and set in metal escutcheon plates. Where lay-in ceilings occur, center the sprinkler heads on each tile. Sprinkler heads shall be, in general, provided as follows:

Area Served	Type Head Trim
Fully finished area with gypsum board and/or lay-in ceilings	Fully concealed head with painted cover (color by Architect)
Semi-finished areas	Semi-recessed head with chrome escutcheon
Non-finished areas cover	Pendant heads, with cage cover where head is less than 7' AFF and in janitor closets.
Detention areas, cells, day room, etc.	Institutional sprinkler heads equal to Tyco Model Raven.

At the Owner's option, the above may be revised per specific building requirements. Contractor shall price per the above but must verify all final requirements with Architect prior to placing orders.

B. Sprinkler Cabinet: One cabinet with spare sprinklers and a head wrench per NFPA. Install as directed by the Architect.

C. Provide spare heads equal to one percent (1%) of the total number of heads installed under the Contract, but not less than ten (10). The heads shall be packed in a suitable wall mounted sprinkler cabinet and shall be representative of, and in proportion to, the number of each type and temperature rating heads installed. In addition to the spare heads, the Contractor shall provide not less than one special sprinkler head wrench for each type of head. The cabinet shall be located where directed by the Architect.

D. Sprinkler Risers: Shall be equipped with a variable pressure alarm valve including retarding chamber, drain valve, standard trim, and gauges.

E. Water Alarm: A water motor alarm shall be connected to each alarm valve and shall discharge to a brass alarm gong located on the exterior of the building as directed by the Architect. Alarm gong finish to be selected by the Architect. The alarm valves shall be Underwriters' Laboratories approved, wet type, connected to water supply and indicated on the Shop Drawings. Each alarm valve shall be provided with a circuit closer. Valves shall conform to the equipment of NFPA Standard No. 13, complete with retarding chamber and pressure switch.

F. Water Flow Alarm Switch: Provide, where indicated on the Drawings, McDonnell UL approved line size flow switches. See Division 28 for electrical signal connection by others to these flow switches.

G. Drains: Shall be piped to the outside of buildings as part of this work, except in locations where a drain is provided by the plumbing design, specifically for sprinkler system use.

H. Piping System Valves: Shall be approved for fire protection piping systems and shall be installed as required by the NFPA.

I. Hangers: Shall be installed as required and shall be listed by the Underwriters' Laboratories for use in a sprinkler system.

2.9 SIGNS

A. Approved enameled metal signs shall be securely attached at all main drains, auxiliary drains, inspectors' test connections and control valves.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

A. All pipe trenches shall be dug to a line and the bottom cleaned and shaped to provide support of the pipe through its entire length.

B. For all requirements for above grade or underground fire main, comply with NFPA-24 Private Fire Service Mains.

C. Where plastic pipe (PVC) is installed underground, manufacturer's instructions shall be strictly followed in regard to cover and backfilling materials and procedures.

3.2 SPRINKLER PIPING

A. Install per NFPA-13 and insofar as possible, all sprinkler system mains and branches shall be installed as close as possible below structural concrete slabs.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient All piping for all systems shall be coordinated with lighting fixtures, air conditioning ducts, piping, air handling units, and all other obstructions to minimize obstructions with other work prior to installation.

C. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

D. Provide drain valves at main shut-off valves, low points of piping and apparatus. Provide Fire Department test station, piped to drain.

E. Center heads in two directions in ceiling tile and provide piping offsets as required in areas with accessible ceiling tiles.

F. Apply paper cover to ensure concealed sprinkler head and cover plates do not receive field paint finish.

3.3 HANGERS AND SLEEVES

A. All hangers shall be installed and spaced in accordance with NFPA No. 13.

B. Sleeves shall be set for all pipes passing through concrete floors and masonry walls.

C. Provide chrome plated escutcheon plates at all wall penetrations.

3.4 AUXILIARY DRAINS

A. Auxiliary drains consisting of plugs or globe valves and plugs where the capacity of a trapped pipe section exceeds 5 gallons, shall be provided to drain all points in the system that cannot be drained back to a main riser. Field conditions may dictate additional drains which could not be determined for bidding purposes which shall be provided as required by NFPA No. 13.

3.5 INSPECTORS' TEST CONNECTIONS

A. Furnish and install inspectors' test connections per NFPA No. 13.

3.6 CONCEALED WORK

A. No work shall be concealed unless first inspected and approved by the authority having jurisdiction.

3.7 TESTING

A. Hydrostatically test entire standpipe system in accordance with NFPA 14 and sprinkler in accordance with NFPA 13. All piping shall be tested in the presence of the Owner's representative and other approving authority and shall be proved tight. Unsatisfactory workmanship shall be corrected to the satisfaction of the above mentioned persons. Defective materials shall be replaced with new materials and the defective materials removed from the premises.

B. Provide certificates to the Owner indicating all testing has been appropriately conducted for each fire protection system.

END OF SECTION

SECTION 22 00 10 - SUBMITTAL PROCESS

PART 1 – GENERAL

1.1 SUBMITTALS

A. Comply with all submittal provisions of Division 1.

B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 22 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to **"mdengca@md-eng.com".** Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications.

C. Contractor is responsible to separate submittals per specification section. Unseparated submittals are subject to rejection without review.

D. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.

E. Submittals that have been reviewed and marked as REJECTED (REJ) or REVISE & RESUBMIT (RES) should be resubmitted within 10 days to be reviewed again by engineer.

F. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.

G. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).

1.2 REQUIRED SPECIFICATIONS (Project specific)

A. The chart below are the submittals required for the project.

1. Submittals marked with an "**X**" are required for this project.
2. Submittals without an "**X**" are not required for this project.

See required specifications on next page

Required X	Submittal Name	Spec Reference
X	**Common Work Requirements for Plumbing** *-Polyphase motors, Single phase motors* *-Motor Starters, Shop Drawings, O&M manual*	22 05 00
X	**Expansion Fittings and Loops for Plumbing Piping** *-All Expansion joints*	22 05 16
X	**Meters and Gauges for Plumbing Piping** *-Thermometers, Thermowells, Pressure gauges* *-Gage attachments, Test plugs, Sight flow*	22 05 19
X	**General Duty Valves for Plumbing Piping** *-Valves, Cocks, Specialties, Trap primers* *-Trap guards, Flanges*	22 05 23
X	**Hangers and Supports for Plumbing Piping** *-Pipe hangers and supports, Inserts, Hanger rods* *-Sleeves, Trapezes, Concrete supports*	22 05 29
	Heat Tracing for Plumbing Piping *-Heating cables, Controls, Accessories*	22 05 33
X	**Vibration and Seismic Controls for Plumbing Piping** *-Isolation material and support units*	22 05 48
X	**Identification for Plumbing Piping and Equipment** *-Valve tags, Pipe markers, Equipment plates*	22 05 53
X	**Piping Insulation** *-Pipe insulation, Adhesives, Covers, Thickness*	22 07 00
X	**Facility Water Distribution** *-Pipe and fittings, Valves, Cocks, Specialties* *-Trap Guards & Primers, Flanges*	22 11 00
X	**Domestic Water Pumps** *-In-Line Circulators*	22 11 23
X	**Facility Sanitary Sewerage** *-Pipe & Fittings*	22 13 00

Required X	Submittal Name	Spec Reference
	Sanitary Waste Interceptors *-Hair interceptor, Grease/Oil traps*	22 13 23
	Sanitary Sewerage Pumps *-Sewerage pumps, Grinder pumps,*	22 13 29
	Packaged Submersible Sewerage Pumps *-Submersible sewerage pumps*	22 13 33
	Packaged Wastewater Pump Units *-Waste water pumps*	22 13 36
X	**Facility Storm Drainage** *-Pipe & Fittings*	22 14 00
	Sump Pumps *-Sump Pumps*	22 14 29
	Packaged, Submersible, Drainage Pumps *-Submersible drainage pumps*	22 14 36
	General Service Compressed-Air Systems *-Air Compressor, Reducing valves, Gages* *-Piping, Valves*	22 15 00
X	**Commercial Gas Domestic Water Heater** *-Gas boilers, Flues, Expansion Tanks*	22 34 36
	Commercial Electric Water Heaters *-Tankless water heaters*	22 34 37
	Plumbing Fixtures *-Stops, Escutcheons, Flow control devices* *-Carriers, Water closets, Urinals, Bathtubs,* *-Lavatories, Sinks, Showers, Hose bibs*	22 40 00
X	**Commercial Plumbing Fixtures** *-Fixtures, Trim, drain body, hydrants, valves*	22 42 00
	Security Plumbing Fixtures *-Fixtures, Trim, drain body, hydrants, valves*	22 46 00

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 SUMMARY

A. Work Included: Provide complete plumbing systems where shown on the drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to the following summary of work:

1. Furnish and install a complete sanitary waste and vent system as shown on drawings and described herein.
2. Furnish and install a complete domestic cold and hot water piping to all plumbing fixtures and equipment.
3. Other items and services required to complete the systems.

A. Any Alternate Proposals are summarized in Division 01 of the Specifications. The Contractor is directed to refer to all Sections of the Specifications and Drawings for this project to determine the exact extent and scope of the various Alternate Proposals as each pertains to the work of all trades.

1.2 GENERAL REQUIREMENTS

A. Unless otherwise specified, materials are to be new and of current U.S. manufacture, free from defects and of the best quality of their respective kinds.

B. Equipment and/or materials damaged in shipment or handling, or otherwise damaged before installation, shall be replaced with new equipment and/or materials. Damaged equipment and/or materials shall not be repaired at the jobsite.

C. Furnishing of the proper equipment and/or materials and to see that it is installed as recommended by the manufacturer is entirely the responsibility of the Contractor. If required for proper installation, the Contractor shall obtain advice and supervisory assistance from a representative of the specific manufacturer of the equipment being installed.

D. Materials and adhesives to conform to Federal Standard Flame-Spread Properties, Inc., with composite fire and smoke hazard ratings, maximum 25 for flame spread and 50 for smoke developed. Adhesives to be waterproof.

E. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

F. Belts, pulleys, chains, gears, couplings, projecting screws, keys or other rotating parts which are located so that a person can come in close proximity thereto shall be fully enclosed properly provided with a guard.

1.3 QUALITY ASSURANCE AND APPLICABLE STANDARDS

A. Use adequate numbers of skilled workers that are thoroughly trained and experienced in the necessary crafts and are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation. **The contractor must support all pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support pipe, equipment, and all other items furnished under this scope from the metal deck.**

C. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

D. Codes: Perform all work in accordance with the latest edition of the following codes:

1. State and city building, fire, plumbing and mechanical codes.

2. International Fire Code
3. Uniform Mechanical Code
4. Uniform Plumbing Code
5. National Electrical Code
6. International Energy Conservation Code
7. National Fire Protection Association (NFPA)
8. American with Disabilities Act (ADA)
9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities.
10. All authorities having jurisdiction.
11. Architectural code review drawing.
12. City of Dallas Green Building Program

E. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

F. Where conflicts occur between drawings, specifications or code requirements, the most stringent requirement shall take precedence.

G. Standards: The specifications and standards of the following organizations are by reference made a part of these specifications. All work, unless otherwise indicated, shall comply with the requirements and recommendations wherever applicable:
1. American National Standards Institute (ANSI).
2. Air Conditioning Heating and Refrigeration Institute (AHRI).
3. American Gas Association (AGA).
4. American Society for Testing and Materials (ASTM).
5. American Society of Mechanical Engineers (ASME).
6. American Society of Refrigeration, Heating and Air Conditioning Engineers (ASHRAE).
7. Electrical Testing Laboratories (ETL).
8. National Bureau of Standards (NBS).
9. National Electrical Manufacturer's Association (NEMA).
10. National Fire Protection Association (NFPA).
11. Sheet Metal and Air Conditioning National Association (SMACNA).
12. Underwriters Laboratories, Inc. (UL).

H. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. The requirements and recommendations of the latest edition of the Occupational Safety and Health Administration (OSHA) Act are by reference made a part of these specifications. All work shall comply with the requirements and recommendations wherever applicable.

1.5 SUBMITTALS

A. Comply with all submittal provisions of Division 1.

B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 22 submittal requirements. Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications

C. Product Data: Submit the following:
1. Materials list of items proposed to be provided under Division 22.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in the following paragraph.
3. Identify the difference between the specified item or function and the proposed. Explain

with enough detail so that the Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in a clear and concise format. All substitutions shall be approved in writing by Architect. The Architect's decision shall be final.

4. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.
5. Submittals that have been reviewed and marked as REJECTED (REJ) or MAKE CORRECTIONS NOTED (MCN) should be resubmitted within 10 days to be reviewed again by engineer.
6. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.
7. Manufacturer's recommended installation procedures which, when reviewed by the Architect, shall become the basis for accepting or rejecting actual installation procedures used on the work.
8. Sign the submittal as an indication of compliance with the contract documents. Any deviations from the contract documents shall be indicated on the submittal prior to signing. Any deviations not indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

D. Submittals required of materials and equipment under this section include the following:

1. Piping and Accessories Materials:
    1. **Clearly marke**d up manufacturer's data showing compliance with the specifications for: **(Include model numbers and highlight or circle products)**
        1) Piping material proposed for each system.
        2) Valves, cocks, and specialties.
        3) Flexible connectors for piping.
        4) Flanges.
        5) Pumps and circulators
    2. l/8" scale (minimum) sanitary sewer, storm water, domestic hot and cold water piping shop drawings showing coordinated piping routing and arrangements with all equipment, accessories and system expansion and contraction compensation methods.
2. Vibration Isolation and Sound Control Materials:
    1. **Submit shop drawings** showing the structural design and details of inertia bases, steel beam bases, and other custom-fabricated work not covered by manufacturer's submitted data.
    2. Furnish layouts of templates to be furnished to fabricators of equipment bases, foundations, and other support systems, as needed for coordination of vibration isolation units with other work.
    3. Submit shop drawings indicating the scope of vibration isolation work, locations of units and flexible connections. Include support isolation points for piping, motor driven equipment, inertia bases, etc.
    4. Include schedule of isolation units, showing size or manufacturer's part number, the weight supported and resulting deflection of each unit.
    5. For spring isolation units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.
    6. For spring-and-pad type isolation units, show the basis of spring rate selection for the range of loading weights.
3. Mechanical Identification Materials:
    1. **Clearly marked-up** product literature or samples showing compliance with specified materials for: **(Include model numbers and highlight or circle products)**

1) Valve tagging.
2) Pipe marking.
3) Equipment marking.

4. Insulation:
   1. Manufacturer's certified data on thermal performance.
   2. Details, when required, of methods to be used in providing for unusual piping expansion and contraction.
   3. Manufacturer's data on any alternate insulation material of reduced thickness, including pre-insulated pipe.
   4. Manufacturer's data on all jacketing materials, sealants and fasteners.
5. Plumbing Materials:
   1. **Clearly marked-up** manufacturer's data showing compliance with the specifications on: **(Include model numbers and highlight or circle products)**
      1) Fixtures, carriers and all accessories.
      2) Plumbing equipment.
      3) Water hammer arresters.
      4) Backflow preventers.
      5) Trap primers
      6) Trapguards
      7) Tempering valves.
      8) Gas regulators.
6. Heating:
   1. **Provide clearly marked-up** manufacturer's data showing compliance with scheduled values and specifications for: **(Include model numbers and highlight or circle products)**
      1) Flue pipe and accessories.
      2) Water Heaters
   2. Provide all electrical characteristics.
7. Record Documents: Reference the requirements detailed in this section.
8. **Operation and Maintenance Data: Reference the requirements detailed in this section.**

E. **Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).**

1.6 SUBSTITUTIONS

A. The use of manufacturers' names and catalog numbers followed by the phrase "or equal" is generally used to establish a standard of quality and utility for the specified items and to provide a dimensional reference for construction documents that are drawn to scale.

B. Submittals for "equal" items shall, where applicable, include the following data that are not necessarily required for specified items:
   1. Performance characteristics.
   2. Materials.
   3. Finish.
   4. Certification of conformance with specified codes and standards.
   5. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in Paragraph 6 below.
   6. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Architect/ Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures

and diagrams to support and clarify. Include shop drawings for all piping and ductwork equipment per Paragraph 1.5 Submittals. Organize in a clear and concise format.

C. Submittals of "equal" components or systems may be rejected if:
   1. The material or equipment would necessitate the alteration of any portion of the mechanical, electrical, architectural or structural design.
   2. Dimensions vary from the specified material or equipment in such a manner that accessibility or clearances are impaired or the work of other trades is adversely affected.

D. Proposed substitutions for materials or equipment must be submitted ten (10) days prior to final bid date for consideration as approved equals. Otherwise, such substitutions will not be permitted. Proposals for substitutions shall be made only by the prime bidders. Manufacturers, distributors, and sub-contractors shall not make proposals to the Architect for substitutions.

E. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts

F. No substitution shall be made unless authorized in writing by the Architect. Should a substitution be accepted, and should the substitute material prove defective or otherwise unsatisfactory for the service intended, and within the guarantee period, the Contractor shall replace this material or equipment with material or equipment specified, at his own expense, and to the satisfaction of the Architect.

G. Contractors submitting bids on substitute materials and equipment must also provide a written performance guarantee certifying that the substitute materials and equipment will produce the specified effects and meet the approval of the Architect.

1.7 ORDINANCES, PERMITS, METERS, UTILITIES AND ROYALTIES

A. Procure all permits and licenses necessary for completion of this project and pay all lawful fees required and necessary pursuant in obtaining said permits and licenses. All required certificates of approvals and inspections by local governing and regulating authorities shall be obtained and paid for by the Contractor.

B. Pay all fees required for the connection of water, and sewer to utility mains, and any meter fees if required.

C. Pay any royalty payments required or fees for the use of patented equipment or systems. Defend all law suits or claims for infringement of any patent rights and shall hold the Owner and/or Architect/Engineer harmless from loss as a result of said suits or claims.

1.8 COMPATIBILITY OF EQUIPMENT

A. Assume full responsibility for satisfactory operation of all component parts of the plumbing systems to assure compatibility of all equipment and performance of the integrated systems in accordance with the requirements of the specifications. Should the Contractor consider any part of the specifications or drawings as rendering his acceptance of such responsibility impossible, prohibitive, or restrictive, he shall notify the Engineer before submitting his bid, and the bid shall be accompanied by a written statement of any objections or exceptions to the specifications and drawings.

B. The size of plumbing equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.

C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.9 CONSTRUCTION REQUIREMENTS

A. The drawings show the arrangements of work. Should project conditions necessitate rearrangement, or if the materials or equipment can be installed to a better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit five copies of Drawings of the proposed arrangement for the Architect's review. Allow a minimum of ten (10) working days for review.

B. Should the Contractor propose to install equipment requiring space conditions other than those shown, or rearrange the equipment, he shall assume responsibility for the rearrangement of the space and shall have the Architect review the change before proceeding with the work. The

request for such changes shall be accompanied by shop drawings of the space in question. Identify monetary credits proposed or other benefits of the change. Allow a minimum of ten (10) working days for review.

C. The Contractor shall be responsible for the proper location and size of all slots, holes or openings in the building structure pertaining to his work and for the correct location of pipe sleeves.

1.10 CONNECTIONS FOR OTHERS

A. The Plumbing Contractor shall rough in for and make all water, sewer, etc. connections to all fixtures, equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

C. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.

D. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.

E. Provide all galvanized sheet metal ductwork, transition pieces, etc., required for a complete installation. Exposed sheet metal shall be paint-grip type.

1.11 PROJECT RECORD DOCUMENTS

A. Provide the record documents associated with the work of Division 22 in strict accordance with the provisions of these specifications.

B. Throughout progress of the Division 22 Work, maintain an accurate record of changes in the Contract Documents that apply to work of Division 22. Changes shall include all addendums issued during bidding. Maintain an accurate record of the location of mechanical service lines and outlets and all outside utilities.

C. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved by the Architect.

D. Accuracy of Records

1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of drawings and other documents where such entry is required to show the change properly. Match the symbology and format of the base documents.
2. Accuracy of records shall be such that a future verification of items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.

E. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work and transfer of all recorded data to the final Project Record Documents.

F. Making Entries on Drawings

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
2. Date all entries.
3. Call attention to the entry by a "cloud" drawn around the area or areas affected.
4. In the event of overlapping changes, use different colors for the overlapping changes.
5. Make entries within 24 hours after receipt of information that the change has occurred.
6. Maintain the base drawing format and use the same symbology.
7. Convert field mark-ups to finished CADD record drawings when required in this section.

G. Conversion of Schematic Layouts

1. **In some cases on the drawings, arrangements of ductwork and piping and similar items are shown schematically and are not intended to portray precise physical layout. Determine final physical arrangement subject to the Architect's approval. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the drawings.**
2. Show on the job set of record drawings, by dimension accurate to within one inch, the centerline of each run of items such as all sleeves and piping, etc., below grade, in walls,

or in the concrete slab. A surface mounted device indicates the exact location:

1. Clearly identify the item by accurate note such as "Sanitary Sewer" and the like.
2. Show, by symbol or note, the vertical location of the item "under slab," "in ceiling plenum," "exposed," and the like.
3. Make all identification sufficiently descriptive that it may be related reliably to the specifications.

H. Final Project Record Documents

1. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.
2. Provide CAD electronic files in .dwg format using AutoCAD software. Upon written request, completion of a release form, and payment of the Engineer's standard fee of $200 plus applicable sales tax for a set-up charge and $50 per drawing plus applicable sales tax for copies of such files, Engineer will provide AutoCAD electronic files of base Contract Drawings in dwg format on compact discs. Engineer will also provide a list of drawing layers and names that shall be maintained.
3. Provide completed record drawings on CD-R and one full size hard copy of each drawing.
4. Refer to Division 1 for additional requirements.

1.12 OPERATION AND MAINTENANCE DATA

A. Submit two copies of a preliminary draft of the proposed manual or manuals to the Architect for review and comments. Allow a minimum of ten (10) working days for review.

B. Submit specified number copies of the approved manual to the Architect prior to indoctrination of operation and maintenance personnel.

C. Prepare in accordance with the following standards:

Format:
- Size: 8½" x 11"
- Paper: White bond, at least 20 lb. weight
- Text: Neatly written or printed
- Drawings: 11" in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within the Manual and provide a drawing pocket inside rear cover or bind in with text.
- Flysheets: Separate each section of the Manual with neatly prepared flysheets briefly describing contents of the ensuing section; flysheets may be in color.
- Binding: Use heavy-duty plastic or fiber-board covers with binding mechanism concealed inside the manual; 3-ring binders will be acceptable; all binding is subject to the Architect's approval.
- Measurements: Provide all measurements in U.S. standard units such as feet-and-inches, lbs, and cfm. Where items may be expected to be measured within ten years in accordance with metric formulae, provide additional measurements in the "International System of Units" (SI).

D. Provide front and back covers for each manual, using durable material approved by the Architect, and clearly identified on or through the cover with at least the following information:

OPERATING AND MAINTENANCE MANUAL (Required Layout)

- Title Page
  - Job Name
  - Site Address
  - Include Contact information of prime contractor.
- Table of contents
- Warranty Information.
  - Include all contractor warranties
    - Signed and dated documents
- Permits-Inspections
- Subcontractor list
  - Include all subcontractors.
    - Company name, Contact info.
    - Trade Responsibility.
- Vendor list
  - Include name and addresses of vendors
    - Warranty information
    - Replaceable parts
- Approved submittals
  - Include all approved product submittals
- Reports/Certificates/Redlines
  - Engineers Observation Reports
  - Engineer/Manufacturer Start-up Report
  - Contractor Start-up Report
  - As-builts
  - RPZ Certifications
  - Owners Training Report
- O&M Manuals
- Equipment Information.
  - Include Model, Serial and location.
- Signed Approval
  - Page for approval signature of the engineer and approval date.

E. Contents: Include at least the following:

2. Neatly typewritten index near the front of the manual, giving immediate information as to location within the manual of all emergency information regarding the installation.
3. Complete instructions regarding operation and maintenance of all equipment provided including lubrication, disassembly, and reassembly.
4. Complete nomenclature of all parts of all equipment.
5. Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
6. Copy of all guarantees and warranties issued.
7. Manufacturer's bulletins, drawings, and descriptive data, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.
8. Such other data as required in other sections of these specifications.

1.13 WARRANTY

A. Contractor shall warranty all equipment and workmanship for a period of at least one year after date of substantial completion and replace or repair any faulty equipment or installation at no cost to the Owner for such service during this period, all in accordance with requirements of Division 1.

B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

C. Warranties shall be in writing in a form satisfactory to the Owner, and shall be delivered to the Owner before final payment is made.

D. Upon completion of the work of Division 22, thoroughly clean all exposed portions of the mechanical installation, removing all traces of soil, labels, grease, oil and other foreign material and using only the type cleaner recommended by the manufacturer of the item being cleaned.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

A. Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacturer, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be a minimum of 18" x 18" in size.

PART 3 - EXECUTION

3.1 ACCCESS DOORS

A. In fire-rated walls, access door shall be fire rated same as wall.

3.2 TESTING AND INSPECTION

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. Make written notice to the Architect adequately in advance of each of the following stages of construction:

1. When all rough-in is complete, but not covered.
2. As specified in all Division 22 sections.
3. At the completion of the work of Division 22.

C. When material or workmanship is found to not comply with the specified requirements, remove the noncomplying items from the job site and replace them with items complying with the specified requirements at no additional cost to the Owner. This shall be performed within 3 days after receipt of written notice of noncompliance.

3.3 INSTALLATION METHODS

A. Unless noted otherwise, piping may be run exposed in mechanical rooms and janitor's closets. Piping exposed in mechanical rooms and janitor's closets shall be run tight against the structure, as required by the Architect, allowing for expansion.

B. Conceal piping to be installed as hereinbefore specified.

C. Piping suspended from the structure shall be adequately and properly supported on hanger rods or clamps as specified in Section 22 0529 “Hangers and Supports for Plumbing Piping and Equipment”. Perforated strap hangers will not be permitted. **The contractor must support all pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support pipe, equipment, and all other items furnished under this scope from the metal deck.**

D. Where space is limited above ceilings, below concrete beams or other concrete projections, piping shall be sleeved through the beam or projection, rather than hung below. Provide sleeves where required and locate where approved by the Architect.

E. Cut pipe accurately to measurements established at the building and install into position without springing or forcing. All open ends of pipes shall be capped or otherwise closed until the systems are closed with final connections.

F. No pipe joints nearer than 12" to a wall, ceiling or floor penetration will be permitted, unless joint is of the welded type.

G. Piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Piping shall be graded for proper drainage.

H. Piping shall follow as closely as possible the routes shown on plans, which take into consideration conditions to be met at the site and in the building. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval from the Architect.

I. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping and in connections to equipment.

J. All piping shall be clean when it is installed; rust and/or dirt shall be removed.

K. Screw joints shall be made with taper threads, properly cut. Threads shall be cut using graphite and oil applied to the pipe only. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Pipe shall be up-ended and hammered to remove all shavings and foreign material, before installing.

L. Requirements for assembling joints in cast iron and copper lines are set forth elsewhere in these specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

M. Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of the fire suppression system.

N. Install roof pipe penetrations through sleeves, and flash with membrane flashing and roofing mastic compatible with roofing system. Roofing Supplier/Contractor shall approve roof penetration and flashing.

O. Properly cap or plug all open ends of pipes and equipment to keep dirt and other foreign materials out of the system.

P. Arrangement:

1. All piping shall be run parallel to building lines and shall be arranged so as not to interfere with removal of other equipment or devices nor to block access to doors, windows, manholes or other access openings.
2. Piping shall be arranged so as to facilitate removal of tube bundles.
3. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc.
4. All piping shall be installed to ensure noiseless circulation.
5. All valves and specialties shall be placed to permit easy operation and access.
6. All piping shall be erected and pitched to ensure proper draining.
7. Piping shall be installed so as to avoid liquid or air pockets throughout the piping system.
8. Eccentric reducers with flat side up shall be used wherever changes in pipe size would cause an air trap.
9. Expansion and contraction of piping shall be provided by expansion loops, bends or expansion joints to prevent injury to connections, piping, equipment or the building.

Q. Connections for Removal:

1. Install flanged connections, Victaulic couplings, or unions on all bypasses, ahead of all traps and at all connections to equipment, where shown on the drawings and where required to facilitate convenient removal of equipment. Piping connections to equipment shall include valves to allow isolating equipment for easy removal.

R. Sleeves

1. Provide sleeves around all pipes passing through walls, floors, ceiling, partitions, structural members or other building parts. Sleeves shall be per Section 22 0548, “Vibration and Seismic Controls for Plumbing Piping and Equipment”.

S. Plates

1. Provide spring clamp plates (escutcheons) where pipes are exposed in finished locations of the building and run through walls, floors or ceilings. Plates shall be chrome plated brass and shall be set tight on the pipe and to the building surface.

T. Flashing

1. Refer to Architectural Drawings and Specifications for flashing requirements.

U. For additional installation requirements, refer to individual sections in Division 22.

3.4 CUTTING AND PATCHING

A. Perform cutting and patching associated with the work in strict accordance with the provisions of Division 1 of these Specifications and the following:

1. Coordinate work to minimize cutting and patching work. Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction. If cutting and patching is required, it shall be performed by trades specializing in that type work.
2. Perform Architect-approved cutting and demolition by methods which will prevent damage to other portions of the work and provide proper surfaces to receive installation of new work and/or repair.
    a. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect. Impact-type equipment will not be used except where specifically acceptable to the Architect.
    b. Openings in precast concrete slabs or walls for pipes, etc., shall be core drilled to exact size. Oversize the hole to allow for link seals, and to deter pipe corrosion condensation from forming.
    c. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.
    d. Openings cut through plaster or drywall shall be cut prior to plaster finish coat or texture coat on drywall. Cutting of the finish coat of plaster or texture coat of drywall will not be permitted unless written approval of the Architect is obtained.
    e. Openings shall be restored and/or repaired as required to replace the cut surface to an "as-new" and/or "as original" condition. Refer to the appropriate section of the specifications for the material involved.
3. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.
4. Provide all core drilling of holes. Where sleeves and/or blockouts are required, they shall be cut or provided at locations required. On completion of this work or as work progresses, make all repairs and do all patching required as a result of work under this Contract. All patching shall be performed in a manner that will restore the surrounding work to its original condition to the satisfaction of the Architect.
5. Assume responsibility for the proper size of all sleeves and/or blockouts in the building structure pertaining to the work and for providing the correct location of pipe sleeves and/or blockouts.
6. No cutting, boring or excavating which will weaken the structure will be permitted.

3.5 EXISTING UTILITIES AND TEMPORARY SERVICES FOR CONSTRUCTION

A. Verify the location and capacity of existing utility services pertaining to work of Division 22. Relocate existing utilities unearthed by excavation as directed by the utility service companies affected.
    1. Temporary Services for Construction
    2. Provide temporary services in strict accordance with the provisions of these specifications.

B. When any piece of plumbing equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Architect's written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.

C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

3.6 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

3.7 EXCAVATION AND BACKFILLING

A. Perform all excavation and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them in dry condition until the work has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

B. Perform excavation and backfilling in strict accordance with the provisions of these specifications including trench safety requirements.

C. All excavations shall be made to the proper depth, with allowances made for floor slabs, forms, beams, etc. Ground under piping shall be well compacted before piping is installed.
   1. Cut the bottom of the trench or excavation to uniform grade so that pipe will bear on undisturbed soil.
   2. Should rock be encountered, excavate 6" below pipe, fill with pea gravel and tamp well.
   3. Carefully lay out alignment of pipe trenches to avoid obstructions. Secure approval of proposed route of pipe before any cutting is begun.

D. After pipe lines have been inspected, tested and approved, backfill trenches or excavation with material as recommended by the manufacturer of the type of pipe used.

E. Backfilling shall be made with selected soil, free from rocks and debris and shall be pneumatically tamped with 6 inch layers to secure a field density ratio of 95 percent as defined by ASTM Designation D698-57T (Proctor Soil Compaction Test).

F. Excavated materials not suitable and not used in the backfill shall be removed from the site.

G. Field check and verify the locations of all underground utilities. Avoid disturbing these as far as possible. In the event existing utilities are damaged, they shall be repaired at no cost to Owner.

H. Compact backfill where trenching or excavation is required in improved areas such as pavements, walks, lawns, and similar areas, to a condition equal to undisturbed earth, and restore surface of the area to the condition existing prior to the trenching or excavating operation.

I. In a lime stabilized area, the lime stabilization shall be fully restored after the excavation is complete.

J. Replace concrete, curbs, paving and other surface improvements cut during excavation to their original condition.

3.8 JOBSITE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Include required work to correct conditions detrimental to the timely and proper completion of all Division 22

Work. Do not proceed until unsatisfactory conditions are corrected.

B. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

C. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.

D. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

3.9 STORAGE AND PROTECTION

A. Contractor shall provide the required protection of equipment and materials from the time of delivery until the completion of the Work. Protect from damage, rust, rain, humidity and dust.

B. Do not receive equipment or materials on the jobsite until adequate space has been provided for storage.

C. Provide adequate supports for protection from the ground and erect required shelters for items stored in the open.

D. Items stored within the building are to be adequately protected and covered with tarpaulins or other protective covering.

E. Protect the building at all times during construction from damage by workmen, their tools and/or equipment. Protect floors, steps, wall, ceilings, doors, windows and other finish surfaces.

F. Equipment and materials found in a rusty condition at completion of the work will be thoroughly cleaned of rust and refinished as required to its original condition.

3.10 PREPARATION AND COORDINATION

A. Perform coordination work in strict accordance with provisions of these specifications and the following:

1. Coordinate as necessary with other trades to assure proper and adequate interface with all work.
2. Where pipes or other fire suppression items are shown in conflict with locations of structural members and other equipment, include labor and materials required for extensions, offsets and supports to clear the encroachment.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of the fire suppression system.
4. Coordinate accepted equipment changes from those scheduled or specified with other trades affected. Additional compensation to other trades for equipment changes is the responsibility of the Contractor making the change.

B. The Mechanical, Plumbing, Electrical, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical, plumbing and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a

neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

D. The general installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".

Building lines
Structural Members
Soil and Drain Piping
Condensate Drains
Vent Piping
Supply, Return, and Outside Air Ductwork
Exhaust Ductwork
Fire Protection Piping
Gas Piping
Domestic Water (Cold and Hot)
Electrical Conduit

E. Where items such as diffusers, thermostats, switches, and control panels are not specifically located on the Drawings, locate as determined in the field by the Architect. Where such items are installed without such specific direction, relocate as directed by the Architect and at no additional cost to the Owner.

F. Verify all dimensions and distances. No additional compensation will be allowed because of differences between work shown on the Drawings and actual dimensions and distances at the jobsite.

3.11 CLEANING AND FLUSHING

A. Remove all labels, dirt, paint, grease, and stains from all piping and accessories installed under this Contract. Flush and treat piping systems.

A. A temporary flushing connection shall be arranged for each section of piping. Water required for flushing shall be furnished by the Contractor. All temporary cross connections for flushing and drainage connections shall be furnished, installed and subsequently removed by the Contractor.

B. In filling the systems, be sure to vent in such a manner that the control valves cannot backfill, thus causing foreign matter to be introduced into the valve body.

3.12 PAINTING

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be damaged in transit or during the installation, it shall be finished to match appearance of original finish. All work shall be subject to approval by Architect.

B. All equipment, piping, conduit, insulation, etc., furnished and installed in exposed areas under Divisions 22 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 22 work.

C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

END OF SECTION

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and poly-phase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location

1.4 SUBMITTALS

A. **Provide submittals as required in section 220010, "Submittal Process."**

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in plumbing equipment schedules or Sections.
B. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3600 feet above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Energy efficient, as defined in NEMA MG 1.
C. Service Factor: 1.15.
D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.
E. Rotor: Random-wound, squirrel cage.
F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
G. Temperature Rise: Match insulation rating.
H. Insulation: Class F.
I. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.
B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
C. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
D. Motors 1/20 HP and Smaller: Shaded-pole type.
E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.6 MOTOR STARTERS

A. Provide motor starters as manufactured by one of the following:
   1. General Electric Company.
   2. Siemens Energy and Automation.
   3. Square D Schneider Electric.
   4. Cutler Hammer.
B. General:
   1. Starters furnished as integral parts of factory-assembled, pre-wired equipment shall conform to the requirements of this Section.
   2. All controllers shall be provided with a heavy-duty type push-button station, rated for 10 amperes continuous load at 600 volt or less.
   3. Enclosures shall be general purpose NEMA Type 1, except that pushbutton stations installed outside the building or otherwise exposed to the weather shall be NEMA Type 3R, dust and weather tight. NEMA Type 4 enclosures shall be provided for surface mounting, except as otherwise indicated.
   4. Pushbutton stations for non-interlocking contactors shall be momentary contact type with start button, stop button, and red indicator light. Where required for delayed "seal-in" or where otherwise noted.
C. Manual Motor Starters
   1. Provide single-phase, horsepower rated manual motor starters, of sizes and ratings indicated. Equip with manually operated quick-make, quick-break toggle mechanisms; and with one-piece melting alloy type thermal units. Starter to become inoperative when thermal unit is removed. Provide starters with double break, silver alloy contacts, visible from both sides of starter, green pilot lights, and switch capable of being padlocked “OFF”.
   2. Provide surface mounted starters in NEMA Type 1 or Type 3 enclosure as required.
D. Magnetic Motor Starters
   1. Provide fused disconnect switches complete with time delay fuses.
   2. Provide contactors with three overload relays.
   3. 120 volt holding coil.
   4. Provide pilot light in cover, green type.
   5. Provide reset button, and Hand-Off-Automatic switch behind lockable cover, field convertible to Off/Auto or Start/Stop pushbutton.
   6. Provide two sets of normally open auxiliary contacts in addition to standard auxiliary holding contacts supplied with each contactor.
   7. Provide surface mounted starters in NEMA Type 1 or Type 3 enclosure as required.
E. Combinations Motor Starters
   1. Provide fused, 3-pole, load break disconnect switches with RK-1 fuses, rotary operating handle, and lock-off facility.
   2. Restrict opening of switch enclosure by the use of a defeater screw, unless switch is in the OFF position.
   3. Provide contactors with three overload relays.
   4. 120 volt holding coil.

5. Provide pilot light in cover, green.
6. Provide reset button, and Hand-Off-Automatic switch behind lockable cover, field convertible to Off/Auto or Start/Stop pushbutton.
7. Provide two sets of normally open auxiliary contacts in addition to standard auxiliary holding contacts supplied with each contactor.
8. Provide control transformer of sufficient capacity to handle operating coil and associated controls.

PART 3 - EXECUTION

3.1 MOTOR STARTERS

A. Install motor starters as indicated, in accordance with Division 16 and equipment manufacturer's written instructions, and with recognized industry practices complying with applicable requirements of NEC, UL, and NEMA standards.
B. In finished areas, mount motor protection switches flush and install suitable cover plates.
C. Install heaters correlated with full load current of motors provided.
D. Set overload devices to suit motors provided.
E. Install fuses in fusible disconnect switches.
F. In fire-rated walls, access door shall be fire rated same as wall.
G. In detention areas provide minimum 16 gauge access door with keyed lock approved by Owner.

END OF SECTION

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SECTION 22 05 16- EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Flexible, ball-joint, packed expansion joints.
2. Slip-joint packed expansion joints.
3. Expansion-compensator packless expansion joints.
4. Flexible-hose packless expansion joints.
5. Metal-bellows packless expansion joints.
6. Rubber packless expansion joints.
7. Grooved-joint expansion joints.
8. Pipe loops and swing connections.
9. Alignment guides and anchors.

1.2 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.3 SUBMITTALS

A. **Provide submittals as required in section 220010, "Submittal Process."**

B. Delegated-Design Submittal: For each anchor and alignment guide indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

PART 2 - PRODUCTS

2.1 PACKED EXPANSION JOINTS

A. Flexible, Ball-Joint, Packed Expansion Joints:

1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
   a. Hyspan Precision Products, Inc.
2. Standards: ASME Boiler and Pressure Vessel Code: Section II, "Materials"; and ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.
3. Material: Carbon-steel assembly with asbestos-free composition packing.
4. Design: For 360-degree rotation and angular deflection.
5. Minimum Pressure Rating: 250 psig at 400 deg F.
6. Angular Deflection for NPS 6 and Smaller: 30 degree minimum.
7. Angular Deflection for NPS 8 and Larger: 15 degree minimum.
8. End Connections for NPS 2 and Smaller: Threaded.
9. End Connections for NPS 2-1/2 and Larger: Flanged.

B. Slip-Joint Packed Expansion Joints:

1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
   a. Hyspan Precision Products, Inc.
2. Standard: ASTM F 1007.
3. Material: Carbon steel with asbestos-free PTFE packing.

4. Design: With internal guide and injection device for repacking under pressure. Include drip connection if used for steam piping.
5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
6. End Connections: Flanged or weld ends to match piping system.

2.2 PACKLESS EXPANSION JOINTS

A. Metal, Expansion-Compensator Packless Expansion Joints:
1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
a. Metraflex, Inc.
2. Minimum Pressure Rating: 150 psig unless otherwise indicated.
3. Configuration for Copper Tubing: Two-ply, phosphor-bronze bellows with copper pipe ends.
a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Threaded.
4. Configuration for Steel Piping: Two-ply, stainless-steel bellows; steel-pipe end connections; and carbon-steel shroud.
a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
b. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged.

B. Rubber, Expansion-Compensator Packless Expansion Joints:
1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
a. Amber/Booth Company, Inc.; a div. of Vibration Isolation Products of Texas, Inc.
b. Mason Industries, Inc.; Mercer Rubber Co.
2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 150 psig at 170 deg F unless otherwise indicated.
4. End Connections for NPS 2 and Smaller: Threaded.

C. Flexible-Hose Packless Expansion Joints:
1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
a. Metraflex, Inc.
2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.
a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged end connections.
a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 125 psig at 70 deg F and 90 psig at 600 deg F ratings.
b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

9. Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with weld end connections.
    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

D. Metal-Bellows Packless Expansion Joints:
1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
    a. Metraflex, Inc.
2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
5. Configuration: Single joint with base and double joint with base class(es) unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
    a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
    c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
7. Expansion Joints for Steel Piping: Single- or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.
    a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
    b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged.

E. Rubber Packless Expansion Joints:
1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
    a. Metraflex, Inc.
2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material: Fabric-reinforced rubber complying with FSA-NMEJ-703.
4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalies, or Chemicals: BR.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N.
11. Material for Water: BR.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 GROOVED-JOINT EXPANSION JOINTS

A. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
    a. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Five, flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water, and bolts and nuts.

2.4 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:
1. Basis-of-Design Product: Subject to compliance with requirements, based upon the following:
    a. Metraflex, Inc.
2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding spider for bolting to pipe.

B. Anchor Materials:
1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
    a. Stud: Threaded, zinc-coated carbon steel or stainless steel.
    b. Expansion Plug: Zinc-coated steel.

c. Washer and Nut: Zinc-coated steel.

5. Chemical Fasteners: Insert-type-stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
   a. Bonding Material: ASTM C 881/C 881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
   b. Stud: ASTM A 307, zinc-coated carbon steel or stainless steel with continuous thread on stud unless otherwise indicated.
   c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION-JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.
B. Install packed-type expansion joints with packing suitable for fluid service.
C. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
D. Install rubber packless expansion joints according to FSA-NMEJ-702.
E. Install grooved-joint expansion joints to grooved-end steel piping

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
C. Attach guides to pipe and secure guides to building structure.
D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
E. Anchor Attachments:
   1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
   1. Anchor Attachment to Steel Structural Members: Attach by welding.
   2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 22 05 19 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY
- A. Section Includes:
  1. Bimetallic-actuated thermometers.
  2. Liquid-in-glass thermometers.
  3. Thermowells.
  4. Dial-type pressure gages.
  5. Gage attachments.
  6. Test plugs.
  7. Test-plug kits.
  8. Sight flow indicators.

1.2 QUALITY ASSURANCE
- A. ASME B40.1: Gages, Pressure Indicating Dial Type, Elastic Element
- B. ASTM E1: Specification for ASTM Thermometers
- C. ASTM E77: Verification and Calibration of Liquid-in-Glass Thermometers

1.4 SUBMITTALS
- A. **Provide submittals as required in section 220010, "Submittal Process".**

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS
- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ashcroft Inc.
  2. Trerice, H. O. Co.
  3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
  4. Weiss Instruments, Inc.
- B. Standard: ASME B40.200.
- C. Case: Liquid-filled and sealed type(s); stainless steel with 3-inch nominal diameter.
- D. Dial: Non-reflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Shatterproof glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 LIQUID-IN-GLASS THERMOMETERS
- A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:
  1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
     a. Trerice, H. O. Co.
  2. Standard: ASME B40.200.
  3. Case: Cast aluminum; 6-inch nominal size.
  4. Case Form: Back angle unless otherwise indicated.
  5. Tube: Glass with magnifying lens and blue or red organic liquid.
  6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
  7. Window: Shatterproof glass.

8. Stem: Aluminum or brass and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Flo Fab Inc.
   b. Trerice, H. O. Co.
   c. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
   a. Design for Air-Duct Installation: With ventilated shroud.
   b. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.3 THERMOWELLS

A. General:
1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.4 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Dwyer Instruments, Inc.
   b. Trerice, H. O. Co.
   c. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   d. Weiss Instruments, Inc.
2. Standard: ASME B40.100.
3. Case: Liquid-filled type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Non-reflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.5 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
B. Siphons: Loop-shaped section of brass pipe with NPS 1/2 pipe threads.
C. Valves: Brass or stainless-steel needle, with NPS 1/2, ASME B1.20.1 pipe threads.

2.6 TEST PLUGS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Trerice, H. O. Co.
   2. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   3. Weiss Instruments, Inc.
B. Description: Test-station fitting made for insertion into piping tee fitting.
C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
D. Thread Size: NPS 1/2, ASME B1.20.1 pipe thread.
E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.7 TEST-PLUG KITS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flow Design, Inc.
   2. Trerice, H. O. Co.
   3. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
   4. Weiss Instruments, Inc.
B. Furnish one test-plug kit(s) containing one thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be at least 0 to 200 psig.
F. Carrying Case: Metal or plastic, with formed instrument padding.

2.7 SIGHT FLOW INDICATORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Archon Industries, Inc.
   2. Dwyer Instruments, Inc.
   3. Penberthy; A Brand of Tyco Valves & Controls - Prophetstown.
B. Description: Piping inline-installation device for visual verification of flow.
C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
D. Minimum Pressure Rating: 125 psig.
E. Minimum Temperature Rating: 200 deg F.
F. End Connections for NPS 2 and Smaller: Threaded.
G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.
B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
C. Install thermowells with extension on insulated piping.
D. Fill thermowells with heat-transfer medium.
E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
G. Install valve and snubber in piping for each pressure gage for fluids.
H. Install test plugs in piping tees.
I. Install flow indicators in piping systems in accessible positions for easy viewing.
J. Install permanent indicators on walls or brackets in accessible and readable positions.
K. Install connection fittings in accessible locations for attachment to portable indicators.
L. Install pressure gages in the following locations:
    1. As indicated in the Drawings.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. After installation, calibrate meters according to manufacturer's written instructions.
B. Adjust faces of meters and gages to proper angle for best visibility.

SECTION 22 05 23 - GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Work included:

a. Sanitary drain, waste, and vent piping.
b. Storm Drain and Subsoil drainage piping.
c. Domestic hot and cold water piping.
d. Equipment drains and relief valve piping.

C. Submittals: **Provide submittals as required in Section 220010 “Submittal Process”.**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer’s certifications shall be submitted to the Engineer on all such materials used.

PART 2 - PRODUCTS

2.1 VALVES, COCKS AND SPECIALTIES

A. Materials: Bronze, ductile iron, or cast iron per local codes with screwed, Vic-Press 304™, grooved, or flanged ends for steel pipe and Permalynx push-to-connect, grooved, or solder ends for copper pipe.

B. Valve locations: Unless otherwise indicated, provide a valve on each branch serving a restroom.

1. Provide a valve on inlet and outlet of each piece of equipment.
2. Provide valves to isolate individual or group of fixtures and equipment on branch runouts from piping mains. This is in addition to valves at each fixture and equipment.
3. Provide interior shut-off and drain valves on each branch to wall hydrant and hose bibb.
4. Provide valves at the base of domestic water pipe risers.
5. Provide valves as indicated and where required to adequately service parts of systems and equipment.

C. Gate Valves: Rated for 200 PSIG WOG:

1. 2-1/2" and below – Nibco T-113 for steel pipe and Nibco S-113, for copper pipe, or approved equal.

2. 3" and above – Victaulic Series 771 (cold water service), Nibco F-619 or engineer approved equal.

D. Ball Valves: Rated for 200 psig WOG.
   1. 2-1/2" and below – Nibco T-595-Y for steel pipe and NVent PL-200 or Nibco S-595-Y for copper pipe or engineer approved equal.

E. Check Valves (Domestic Water System):
   1. Swing check valve with bronze or composition disc rated for 200 psig WOG.
   2. 2-1/2" and below – Nibco T-413-B, NVent PL-510, or engineer approved equal.
   3. 3" and above – Nibco F-918-B, Victaulic Series 716, or engineer approved equal.

F. Water Balancing Cocks:
   1. Provide cocks with memory stop, Dezurik 100 or approved equal.

G. Backflow Preventer:
   1. Double check valve assembly consisting of two independently operating, spring loaded check valves, two gate valves, and four test cocks for field testing, Wilkins Model 950 or approved equal.
   2. Provide reduced pressure type if required by local codes.

H. Water Hammer Arrestors:
   1. Provide arrestors sized in accordance with PDI Standard WH-201, permanently sealed, pre-charged to 60 PSIG, suitable for temperatures up to 250 DegF and maximum 350 PSIG working pressure: Model 650 Series as manufactured by Sioux Chief Mfg. Co. or approved equal.
      a. Provide at each branch run-off to fixtures or as required by manufacturer and PDI Standard WH-201.
      b. For laundry applications, Series 660-H or approved equal.

I. Butterfly Valves:
   1. Butterfly valves may be used in lieu of gate valves on chilled water and hot water heating lines rated to 150 psig: 2" - 12", with stem shall be offset from the disc centerline to provide full 360-degree circumferential seating, Victaulic Vic-300 MasterSeal™ or " Crane 21-BRZ (21-BRB under 150 Deg. F). 14" - 24" Victaulic Series W706 or Crane 22F-BRZ (22F-BRB under 150 Deg. F) or engineer approved equal as manufactured by Jenkins, Centerline or Victaulic.

J. Gauge Cocks and Manual Air Vents:
   1. Provide brass, lever handle cock, 1/4" FPT, as shown on the drawings or as specified herein.

K. Dielectric Union s or Waterway Fittings:
   1. Provide dielectric unions or waterway fittings at all piping connections (except to valves) between dissimilar metals, Watts No. 3000 series, Victaulic Style 47, or engineer approved equal.

L. Trap Primers:
   1. Trap primer valve shall be factory assembled, pre-piped and shall include a bronze ¾" NPT, WOG rated inlet ball valve, a brass ¾" electronic solenoid valve and a type "L" copper manifold with brass compression fittings. Unit shall include a single point power connection at 120/1/60, a manual override switch, 2 amp breakers and geared 24 hour timer with relay and 5 second dwell function. A code approved atmospheric vacuum breaker shall be included for backflow protection. Complete unit shall be provided in a 16 gauge steel box with access door suitable for flush mounting or NEMA 1 rated box with cover for surface mounting. Trap primers shall be installed per manufacturer's instructions and recommendations.
      a. "Prime-Rite" PT or PTS as manufactured by Precision Plumbing Products, Inc. or approved equal.
      b. Trap primers shall be provided on all floor sinks and floor drains, Verify with authority having jurisdiction.

M. Trap Guards (If approved by local authority having jurisdiction):
   1. Trap guard shall be manufactured from smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The design shall allow for wastewater to open and adequately discharge floor drain through its interior and then close and returns to original molded shape after wastewater discharge is complete. Trap guard shall be as manufactured by ProSet Systems, Inc. or pre-approved

equal.

2. Trap guard shall meet the following standards:
   a. ASME A112.6.3.
   b. NSF/ANSI 14.
   c. CSA B 79.
3. Prior to ordering trap guard, contractor shall confirm drain manufacturer provided for project to insure proper fit for trap guard. This shall be indicated on the submittal.

2.2 FLANGES

A. Flanges shall be 150 pound; A.S.A. forged steel, raised face, weld neck or slip-on. Slip-on flanges shall be welded both inside and outside.

B. Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741 or W45 flange adapter nipple for sizes 14” through 24”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.
   2. Lift Check Valves: With stem upright and plumb.

END OF SECTION

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SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Work included:

1. Pipe hangers and supports.
2. Concrete supports for equipment.
3. Sleeving for plumbing equipment.

C. **Submittals: Provide submittals as required in Section 220010 "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.3 REFERENCE STANDARDS

A. Automatic Sprinkler Pipe Supports: NFPA 13, Standard for the Installation of Sprinkler Systems.

B. Standpipe System Supports: NFPA 14, Standard for the Installation of Standpipe and Hose Systems.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Supports, hangers, anchors, guides and supplementary steel shall be provided for horizontal and vertical piping and shall meet or exceed the ASA Code for Pressure Piping.

B. Rod sizes noted are minimum sizes. The structural integrity of the supports is the responsibility of the Contractor.

C. Hangers Supporting and Contacting Brass or Copper:

1. 3" and Smaller: Grinnell Fig. CT-109, copper plated, split-ring hanger with adjusters.
2. 4" and Larger: Grinnell Fig. CT-65, copper plated, clevis hanger with 2 nuts each rod.
3. Isolate copper or brass from ferrous metals with an approved dielectric material.

D. Hangers Supporting Insulated Lines:

1. Outside Diameter of Insulation 6" or Smaller and all Ferrous Pipe 3" Diameter and Smaller: Grinnell Fig. 108, malleable iron, split type with adjustable swivel and locknut.
2. Outside Diameter of Insulation 7" and Larger and all Ferrous Pipe Larger than 3" Diameter: Grinnell Fig. 260, malleable iron, clevis hanger with two nuts on each support.

E. Protection Shields for Hangers:

1. Galvanized metal shields shall encircle the lower half of the insulation.
2. Provide shields at hangers on domestic hot and cold water pipes on trapeze type hangers.
3. Provide rigid insulation at all shields and hangers, extending a minimum of 6" each side of hanger.
4. Shield gauges shall be as follows:

Insulation Diameter	U.S.S. Gauge (Galvanized)
Up to 3"	22
3" thru 6"	16
Above 6"	12

F. Supports for Vertical Riser Piping:
   1. Provide Grinnell Fig. 261 double bolt riser clamps at each floor. Bear on structure.
   2. At 8 feet o.c., 2-hole rigid clamps. Kindorf channels and C-105 straps. Support from vertical surfaces.
   3. Brass or copper pipe shall be isolated from support with sheet polyethylene, minimum 1/8" thick.

G. Supports for Vertical and Horizontal Piping in Chases and Partitions:
   1. Provide securely anchored supports for pipes serving plumbing fixtures and equipment near the area the pipe penetrates the wall.
   2. Supports shall be steel plate, angles or unistruts mounted vertically or horizontally with unistrut clamps P2426, P2008 or P1109.
   3. Attach supports to wall or floor construction with clip angles, brackets or other approved anchoring devices.
   4. Brass and copper pipe shall be isolated from support with sheet polyethylene, minimum 1/8" thick.

2.2 INSERTS

A. Provide inserts at each hanger as required for concrete support. Avoid interference with concrete reinforcing.

B. Inserts to be malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, and lugs for attaching to forms.

C. Provide reinforcing as required to support load.

D. Size inserts to suit threaded hanger rods.

2.3 HANGER RODS

A. Provide steel hanger rods, threaded both ends, threaded one end or continuous threaded.

B. Size hanger rods as follows:

Pipe Size	Rod Diameter
4" & Smaller	3/8"
5" thru 8"	1/2"
10" & 12"	5/8"
14" & 16"	3/4"

2.4 SLEEVES

A. Provide sleeves where pipes penetrate floors, walls, foundations, fireproofing, etc.

B. Size sleeves large enough to allow for movement due to expansion and to provide for continuous movement. Provide a bead of sealant in space between pipe and sleeve. Use link-seal to seal between pipe and sleeve for all slab on grade floor penetrations.

C. Use Schedule 40 galvanized steel pipe sleeves for all floor and foundation penetrations. Sleeves shall extend minimum of 2" above finished floor and flush with vertical wall surface.

2.5 TRAPEZES

A. Trapezes of Kindorf, Elcen or approved equal may be provided where multiple lines run horizontally at the same elevation.

2.6 CONCRETE SUPPORTS FOR EQUIPMENT

A. Provide concrete pad foundations for the support of equipment such as floor-mounted pumps, etc.

B. Unless otherwise noted, concrete pads shall be constructed of not less than 3,000 lb. concrete and not less than 4" high and shall extend on all sides a minimum of 8 inches beyond the limits of the mounted equipment. Pads shall be poured in forms built of new-dressed lumber. All corners of the foundations shall be neatly chamfered 3/4" wide by means of sheet metal of triangular wood strips nailed to the form. Reinforce with No. 4 rebar 6" on center.

C. Foundation bolts, 3/4" round-hooked, shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of size to provide 1/2" clearance around bolt. Allow 1" below the equipment bases for alignment and

grouting. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with carborundum.

D. Foundation pads for equipment located on the exterior of the building shall be provided as indicated.

E. Submit shop drawings of concrete pads for review by the Architect.

2.7 STRAP HANGERS

A. Under no circumstances will perforated strap iron or wire be acceptable for hangers on this project.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTS

A. All pipe supports shall be designed and installed to avoid interferences with other piping, hangers, ducts, electrical conduit, supports, building structure, equipment, etc. All piping shall be installed with due regard to expansion and contraction. The type of hanger, method of support, location of support, etc., shall be governed in part by this specification.

B. Pipe hangers shall be attached to the structure as follows:

1. Poured-in-Place Concrete: Each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters' Laboratories, Inc., listed universal concrete insert placed in the formwork before concrete is poured.
2. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods shall be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size. Each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently affixed thereto.
3. Steel Beams: Pipes and loads supported under steel beams shall be installed using approved beam clamps.

3.2 SPACING

A. Cast iron soil pipe shall be supported on hangers spaced no more than pipe length being installed.

B. Install hangers for steel piping with the following maximum spacing and minimum rod sizes according to MSS SP 69 Tables 3 and 4:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 1/2 inch.
9. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
10. NPS 5: Maximum span, 16 feet; minimum rod size, 5/8 inch.
11. NPS 6: Maximum span, 17 feet; minimum rod size, 3/4 inch.
12. NPS 8: Maximum span, 19 feet; minimum rod size, 3/4 inch.
13. NPS 10: Maximum span, 22 feet; minimum rod size, 7/8 inch.
14. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
15. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
16. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
17. NPS 18: Maximum span, 28 feet; minimum rod size, 1 inch.
18. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

19. NPS 1/2: Maximum span, 5 feet; minimum rod size, 3/8 inch.
20. NPS 5/8: Maximum span, 5 feet; minimum rod size, 3/8 inch.
21. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
22. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
23. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.

24. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
25. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
26. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
27. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

D. Spacing and rod sizes for other piping materials shall be as recommended by the manufacturer.

3.3 TRAPEZES

A. Trapeze members, including suspension rods, shall be properly sized for the number, size and loaded weight of the lines they are to support. Install as noted above.

3.4 MISCELLANEOUS

A. Install any other special foundations, hangers and supports indicated on the drawings, specified elsewhere, or required by installation conditions.

3.5 EQUIPMENT FOUNDATIONS

A. Provide equipment foundations associated with the work in accordance with the provisions of these specifications.

B. Provide concrete bases for all pad or floor mounted equipment.

3.6 HANGERS, SUPPORTS, ANCHORS AND GUIDES

A. All hangers and supports for fire standpipe systems and fire sprinkler systems shall be Underwriters' Laboratories, Inc. approved types.

B. Supports, hangers, anchors, and guides shall be provided for all horizontal and vertical piping as per the project specifications.

C. The Contractor shall be responsible for structural integrity of all supports. All structural hanging materials shall have a factor of safety of 5.

D. Anchor points and pipe guides as shown on drawings or as required shall be located and constructed to permit the piping system to take up its expansion and contraction freely in opposite directions away from the anchored points.

E. Guide points for expansion joints shall be located and constructed wherever required or shown on drawings and at each side of an expansion joint or loop, to permit only free axial movement in piping systems but shall not be further than 3 pipe diameters on each side of joint. Guides for pipe with expansion joints shall be of the roller type securely welded to structural steel.

F. Maximum spacing between pipe supports for steel, cast iron, plastic or copper pipe shall be per local code to prevent excessive stress: (This does not apply where there are concentrated loads between supports.)

G. Double bolt riser clamps shall be F & S, F & M, Grinnell or approved equal.

H. For copper tubing, supports shall be especially designed for copper tubing and shall be of exact O.D. diameter of tubing and shall be copper plated.

I. Roller type supports shall be used for pipes subject to axial movement. They shall be braced so that movement occurs in roller rather than support rods.

J. Provide miscellaneous steel required for support of pipes other than steel shown on the structural Drawings.

K. In general, all piping shall be supported from only structural building members or approved steel inserts embedded in concrete. Where structural members must be increased in strength and/or additional members added to provide for piping support, the mechanical contractor shall include such anticipated costs in his pricing.

3.7 SUPPORT OF VERTICAL RISERS

A. Vertical piping shall be installed in such manner that its weight plus the weight of its contents, covering and appurtenances cannot be concentrated at locations on slabs, beams and other structural elements to exceed the carrying capacity of those members as approved by the structural engineer.

B. In all cases, the Contractor shall coordinate the riser support design with the Architect. He shall submit drawings showing weights, points of support, and details of support or anchoring for approval. The Architect must approve the proposed method of support before work is started. The Contractor shall bear all responsibility for materials and workmanship described in this section and shall ensure that all hangers and supports are properly installed.

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of vibration isolation work is indicated by drawings and schedules, and by the requirements of this section.

B. The types of vibration isolation work specified in this section include the following:

1. Support isolation for motor-driven mechanical equipment.
2. Isolation including support isolation for piping risers.
3. Support isolation of piping.
4. Flexible connections for piping at equipment.

C. Refer to other sections of these specifications for equipment foundations, hangers, sealants, gaskets, flexible connections for piping, and other work related to vibration isolation work.

1.2 QUALITY ASSURANCE

A. Product Qualification: Provide each type of vibration isolation unit produced by a specialized manufacturer, with not less than 5 years' successful experience in the production of units similar to those for the project.

1. Except as otherwise indicated obtain support isolation units from a single manufacturer.
2. Engage the manufacturer to provide technical supervision of the installation of support isolation units produced by him, and of associated inertia bases (if any).

B. Manufacturer: Acceptable vibration isolation support unit manufacturers are as follows:

1. Mason Industries, Inc.
2. Vibration Mountings and Controls, Inc.
3. Amber Booth
4. Peabody Kinetics

C. Manufacturer Certification: Where vibration isolation support units are indicated for a minimum static deflection, provide manufacturer's certification that units have been tested and comply with the indicated requirements.

D. All items of equipment, whether suspended, floor mounted or otherwise supported, which are capable of producing vibration, shall be installed with vibration isolation. The isolation shall prevent the transmission of objectionable noise or vibration to the building structure.

E. Submit for approval data showing disturbing frequency, supported weight, static deflection or natural frequency, and calculations supporting same for each isolator.

1.3 SUBMITTALS

A. **Provide submittals as required in section 220010, “Submittal Process.”**

B. Manufacturer's Data, Vibration Isolation:

1. For information only, submit 2 copies of manufacturer's specifications, detailed drawings, performance characteristics data and installation instructions for each type of unit required.
2. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.
3. Where required, include independent test agencies certified report of test results for each type of unit.
4. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.
5. For spring-and-pad-type units show basis of spring-rate selection for range of loading weights.
6. Include performance certifications where required.

PART 2 - PRODUCTS

2.1 ISOLATION MATERIALS AND SUPPORT UNITS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang.

B. Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short-circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

C. Vibration hangers shall be as described above, but they shall be precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be indicated by a scale.

D. Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short-circuiting. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hole sizes shall be large enough to permit the hanger rod to spring through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have as minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eyebolt on the spring end and provision to attach the housing to the flat iron duct straps.

E. Vibration isolator shall be steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment.

F. Flexible neoprene connectors shall be used on all equipment as indicated on the drawings. They shall be manufactured of multiple plies of nylon tire cord fabric and neoprene. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Neoprene elbows shall have a single sphere forming the corner of the joint itself. Connectors up to and including 2" diameter may have threaded ends. Connectors 2-1/2" and larger shall have floating steel flanges. All connectors shall be rated a minimum of 150 psi at 200 degrees F. All sizes operating at pressures above 100 psi shall employ control cables with end fittings isolated from the anchoring plates by means of 1/2" thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

G. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Lengths shall be as tabulated:

Flanges		Male Nipples	
3 x 14	10 x 26	1/2 x 9	1-1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2-1/2 x 18
6 x 20	16 x 32	1-1/4 x 12	
8 x 22			

H. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS.

I. Where piping passes through equipment walls, floors or ceilings, the vibration isolator shall be a split seal consisting of two bolted pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240 degrees F., 10# density fiberglass may be used in lieu of the sponge.

J. Isolator pads shall be neoprene waffle rated for 60#/sq. in.

K. Pipe Riser Isolators: Provide manufacturer's standard pad-type isolator bonded to steel plate, formed for welding to pipe sleeve extension.

PART 3 - EXECUTION

3.1 PERFORMANCE OF ISOLATORS

A. General: Comply with the minimum static deflections recommended by the manufacturer, including the definitions of critical and non-critical locations, for the selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.2 APPLICATIONS

A. General: Apply the types of vibration isolation materials and units indicated at the locations shown or scheduled. Selection is Contractor's option where more than one type is indicated.

B. Provide Neoprene Pads at the following locations/items of equipment:
   1. Where shown on drawings.

C. Provide Vibration Isolation Springs for the following items of equipment:
   1. Where shown on drawings.

D. Provide Spring Isolator, housed at the following items of equipment:
   1. Where shown on drawings.

E. Provide Isolation Hangers for the following:
   1. Piping connected to machinery.

3.3 INSTALLATION

A. General:
   1. Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units.
   2. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points.
   3. Remove spacer blocks and similar devices (if any) intended for temporary protection during shipping or against overloading during installation.
   4. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.
   5. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
   6. Install inertia base frames on isolator units as indicated, so that a minimum of 2" clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.
   7. Locate isolation hangers as near the overhead support structure as possible.
   8. Weld riser isolator units in place as required preventing displacement from loading and operations.

3.4 EXAMINATION OF RELATED WORK

A. Installer of vibration isolation work shall observe the installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish a written report to the Contractor listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:
   1. Equipment installations (performed as work of other sections) on vibration isolators.
   2. Piping connections including flexible connections.
   3. Passage of piping which is to be isolated through walls and floors.

B. Do not start-up equipment until inadequacies have been corrected in a manner acceptable to the vibration isolation Installer.

3.5 DEFLECTION MEASUREMENTS

A. Upon completion of vibration isolation work, take measurements and prepare a report showing measured equipment deflections for each item of equipment.

END OF SECTION

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SECTION 22 05 53- IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Work included:

1. Valve tagging
2. Pipe marking
3. Equipment marking

C. Submittals: **Provide submittals as required in Section 220010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified. Marking system shall conform to ASME 13.1, latest edition and OSHA 29 CFR 1910.261 requirements.

PART 2 - PRODUCTS

2.1 VALVE TAGS

A. Provide a tag for each valve in main and branch piping of domestic water piping systems.

1. Tags shall be 1-1/2" diameter of solid brass with blacked filled stamped characters of 1/4" height above and 1/2" height below.
2. Provide 8" long meter seals for use with valve tags.

B. Provide a valve chart with a schedule and location plans for all identified equipment, both in a frame with an acrylic cover to be located as directed by the Architect.

2.2 PIPE MARKERS

A. Provide pipe markers for pipes that provide 360 degree visibility with ANSI approved color coded background, color of legend in relation to background color, legend letter size, and length of color field. Additionally, direction of flow arrows shall be printed on the same markers, and words shall be repeated and reversed for use with flow in either direction.

1. Each marker shall be formed with a clear acrylic covering suitable for use outdoors.
2. For diameters 3/4" to 6", marker shall be formed in order to snap on and completely surround the pipe. For diameters 6" and larger, provide radius formed markers of same material.

2.3 EQUIPMENT PLATES

A. Plate shall be black with white letters that appear when the plate is engraved.

B. Plate material shall be specifically suited for conditions surrounding the equipment. Outdoor equipment shall require special plate material for outdoor use.

C. Plate size shall be as required with lettering size appropriate for the information shown but in no case less than 1/8" high. Lettering style shall match existing facility standards.

D. Nomenclature for plates shall be based on the equipment designations shown on the equipment schedules and as approved by the Architect.

2.4 CONCEALED DEVICES

A. Operable devices and equipment located above ceilings shall be marked with color coded W. H. Brady "Tack" type markers.

2.5 MANUFACTURERS

A. Provide marking system as manufactured by W. H. Brady Company, Seton, Craftmark, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Place all markers and plates in such locations that they are easily read by a person without assuming awkward or hazardous positions.

3.2 VALVE TAGS

A. Secure one valve tag to each valve.

3.3 PIPE MARKERS

A. For diameters 3/4" to 6", markers shall snap around the pipe, completely surrounding the pipe. Markers shall not require taping or the use of any adhesive material or fasteners to permanently secure them to the pipe. For diameters 6" and larger, secure with stainless steel spring fasteners.

B. Install sufficient quantities of markers that tracing of pipe systems can be readily accomplished. Install within three feet before and/or after penetrations through walls, floors, ceilings, underground or other non-accessible enclosures; at access doors, manholes or other access points which permit view of concealed piping; and when there is a change in direction of the concealed pipe. Locations in major mechanical rooms shall be labeled at a maximum spacing of every 20 feet. Other piping shall have labels at a maximum spacing of every 30 feet and at least once in every area that the pipe passes over or through. Install additional markers where directed by the Architect.

3.4 EQUIPMENT PLATES

A. Provide engraved plates for all fire suppression equipment.

B. Secure all plates with two self-tapping metal screws with round heads. Alternately, plates may be fastened with "pop" rivets provided no cracking or injury occurs to the plate. Plates attached with adhesives shall not be permitted.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the insulation of the plumbing systems as indicated on the drawings and as specified herein.

B. Factory insulated equipment is excluded from this section of the specifications except that the insulating material characteristics shall equal or exceed those of specified materials for similar service.

C. Work Included:

1. Piping:
    a. All above ground and below ground domestic hot and cold water piping.
    b. All horizontal sanitary drains handling cooling coil condensate.
    c. All plumbing items requiring insulation due to rules and regulations for the handicapped.

D. Submittals: **Provide submittals as required in Section 220010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

D. Acceptable Manufacturers:

1. Fiberglass Insulation:
    a. Owens-Corning Fiberglas
    b. Manville
    c. Certain Teed
2. Urethane Insulation:
    a. Armstrong (Armalok)
    b. Thermacor
3. Mastics:
    a. Benjamin Foster
    b. Insul-Coustic
    c. Chicago Mastic
    d. Childers Products
4. High Temperature Bonding Cements: Ryder Thermocote
5. PVC Fittings: Zeston, Inc.

1.4 GENERAL

A. All materials shall be applied by workmen skilled in this trade. Mechanical fasteners shall be used whenever possible to assure permanent construction. Unsightly work shall be cause for rejection.

B. Materials will be applied only after all surfaces have been tested and cleaned.

C. All material, jacket, coverings, sealers, mastics and adhesives shall not exceed flame spread rating of 25 and smoke developed of 50 in accordance with ASTM Method E84, UL Standard 723 and NFPA Bulletins 255 and 90A.

D. Insulation shall be vermin resistant.

E. Non-compressible insulation material shall be installed at hangers of cold piping to eliminate through metal conductance.

F. Sizing, paint, and pipe shield or saddle shall be provided under other sections of Division 22.

G. Insulation of cold surfaces shall be vapor sealed.

H. Minimum thickness of insulation shall be as listed or energy code as adopted by authority having jurisdiction. However, sufficient insulation shall be provided to eliminate condensation on the cold

surfaces and to maintain a maximum exterior insulation surface of 125ºF. (OSHA Standard) on the hot surfaces

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Pipe Insulation:
1. Above ground-Johns Manville AP-T preformed one-piece fiberglass with reinforced craft paper and aluminum foil jacket. Include vapor barrier where required.
a. Use pre-formed PVC fitting covers with fiberglass inserts. Fiberglass shall be same density as pipe insulation.
b. Where insulation is exposed to weather, use Manville Flame-Safe ML, or approved equal, Metal-Jacketed Fiberglass pipe insulation. Attachment shall be made by 1/2" 0.020 aluminum bands with approved closure system.
2. Armstrong Armaflex or equal may be used, in thermally equivalent thicknesses for condensate piping.
3. Condensate drain lines shall be insulated from AC unit to indirect waste termination points and first 10'-0" of horizontal drain line at floor drains receiving condensate. Material shall be closed cell type with 3/4" thick molded pipe covering with a density of 7 lbs. thermal conductivity at 0.28 at 75ºF. Do not split the insulation. All joints shall be glued with manufacturer's adhesive.

2.2 ADHESIVES
A. Water based, polymeric, UL classified lagging adhesive for applying canvas and glass cloth; Foster 30-36 or Childers CP-50.
B. A fast setting, rubber based, UL classified, vapor barrier lap and attachment adhesive; Foster 85-15 or Childers CP-85.
C. Same adhesive, except non-flammable when wet; Foster 85-20 or Childers CP-82.
D. A rubber based, UL classified, fast setting contact adhesive for adhering flexible cellular insulation; Foster 82-40 or Armstrong 520.

2.3 EXPANSION AND BALL JOINT INSULATION COVERS
A. Furnish and install removable and reusable insulation covers.
B. Insulation and jacketing material shall be as required for service temperatures.
C. Covers shall have hook and loop fasteners and draw cords.

2.4 INSULATION THICKNESS
A. Piping insulation thickness based on a maximum k value of 0.23 Btu in/hr ft² °F at a mean temperature of 75°F.

Pipe Sizes (Calculate per current IECC)			
System	**Runouts To 12 ft. Max.**	**1 1/2 " and Less**	**1 1/2" Up**
Domestic hot water	1"	1"	2"
Domestic cold water.	1"	1"	1"
Horizontal drain bodies. EWC traps and tailpieces. Condensate drain piping.	1"	1"	1"

PART 3 - EXECUTION

3.1 GENERAL

A. The installation of all insulation shall be made by experienced craftsmen in a neat, workmanlike manner and shall be in accordance with the manufacturer's published recommendations for service intended, as interpreted by the Architect.

B. All adhesives used in conjunction with insulation shall be compatible with the insulation and vapor barrier used and be vermin-proof and mildew resistant.

3.2 APPLICATION

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

B. Insulation shall be the full specified thickness, continuous through walls, floors, ceilings, etc. Reducing thickness or cutting back of insulation to pass obstructions or through sleeves will not be permitted.

C. Valve and fitting insulation shall be built up to the thickness of the adjacent pipe insulation or may be factory prefabricated units at the Contractor's option.

D. No part of any system shall be insulated until all required tests have been completed.

E. All insulation shall be installed so that it does not interfere with the functions of thermometer wells, gage connections and/or cocks, unions, access panels, hand holes, manholes, sight glasses, etc., or obscure serial numbers or other nameplate data.

F. Insulation shall be extended to include stiff leg supports as required to prevent sweating.

G. Complete vapor barriers to prevent sweating shall be installed on all cold systems and equipment. If a single tape adhesive system or staples are used for closure of the longitudinal lap, a vapor barrier mastic must be used to ensure a vaporproof closure. All edges and abutments shall be sealed, waterproof and vaporproof. Supplier of jacket materials shall certify that the material proposed is approved for use in return air plenums, where applicable.

H. Where necessary, the application of insulation shall be arranged to accommodate movement of piping due to thermal expansion and/or contraction.

I. Exterior Piping: All pipe and fittings specified herein to be insulated when installed exposed to weather, shall be insulated, and wrapped with a 0.016" smooth or corrugated aluminum jacket with proper closure system positioned to shed water to make a waterproof assembly. Fittings shall be insulated with molded insulation fittings or pipe insulation carved and mitered to fit properly. Insulation shall be butted together and adhered in place with contact cement. Where possible tubing shall be slipped on without slitting. Where insulation terminates, it shall be neatly beveled and finished. No portion of this insulation shall be concealed prior to approval by the Architect.

J. Below Grade Piping: All pipe and fittings specified herein to be insulated, when installed below grade shall be insulated and spirally wrapped with open mesh glass tape embedded in asphaltic mastic and then completely covered with waterproof asphaltic mastic so as to make a waterproof assembly. Fittings shall be insulated with molded insulation fittings or pipe insulation carved and mitered to fit properly. Insulation shall be butted together and adhered in place with contact cement. Where possible tubing shall be slipped on without slitting. Where insulation terminates, it shall be neatly beveled and finished. No portion of this insulation shall be concealed before the Architect has checked and approved same.

K. Piping supports shall pass completely around the exterior of the finished insulation. Rigid blocks of insulation material shall be provided at all support points. In addition, sheet metal saddles shall be provided at support points in accordance with the following table:

Pipe Size	Gauge Metal	Saddle Length
Up to 2-1/2"	18	6"
3" - 5"	16	10"
6" - 8"	16	14"
10" and Over	16	18"

L. Saddles shall cover the bottom of the insulation, and saddle edges shall be hemmed or suitably covered to prevent damage to the insulation material.

M. The vapor barrier and finish shall be continuous at all support points.

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SECTION 220800: COMMISSIONING OF PLUMBING

PART 1 GENERAL

1.1 SUMMARY:

A. Section includes

1. Commissioning of Plumbing Systems

1.2 RELATED REQUIREMENTS

A. Section 017900 – Commissioning Demonstration and Training

B. Section 230800 – Commissioning of HVAC Systems

C. Section 260800 – Commissioning of Electrical Systems

1.3 DEFINITIONS:

A. CxA: Commissioning Agent.

B. GC: Contractor; General Contractor, not a Subcontractor.

C. O&M: Operations and Maintenance.

1.4 DESCRIPTION

A. This section describes commissioning requirements applicable to commissioned items and systems specified in Division 22 to ensure that all systems are operating in a manner consistent with the Contract Documents.

B. Conform to commissioning requirements and the commissioning plan.

1.5 RESPONSIBILITIES

A. Mechanical, Plumbing, Controls, and TAB Contractors: The commissioning responsibilities applicable to each of the mechanical, controls, and TAB contractors of Division 22 are as follows (all references apply to commissioned equipment only).

1. Construction and Acceptance Phases

a. Include the cost of participating in commissioning in the contract price. Commissioned equipment is defined in section 019113.

b. In each purchase order or subcontract written, include requirements for submittal data, completion of commissioning documentation, O&M data and training.

c. Attend and actively participate in a commissioning scope meeting and other meetings necessary to facilitate the Commissioning process.

d. Provide requested documentation to the CxA for development of the functional testing procedures.

e. Complete CxA furnished functional performance tests and procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection, and provide necessary written alarm limits to be used during the tests.

f. Complete a start-up and initial checkout plan, as required in the related section, using manufacturer's start-up procedures and the CxA furnished Prefunctional checklists for all commissioned equipment. Submit to GC for review prior to startup. CxA will verify plan for compliance. Refer to Section 019113 for further details related to start-up.

g. During the startup and initial checkout process, execute the plumbing-related portions of the prefunctional checklists for all commissioned equipment.

h. Correct system deficiencies before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air-or water-related systems.

i. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the GC.

j. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.

k. Provide all test equipment necessary to fulfill specified testing requirements.

l. Perform functional performance testing under the direction of the CxA for specified equipment. Assist the CxA in interpreting the monitored data, as necessary.

m. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and A/E, and retest the equipment.

n. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions. O&M's to be consistent with the final tested condition of all installed systems.

o. During construction, maintain as-built mark-ups for all drawings. Update as needed following functional testing. Furnish final copy to CxA for inclusion in final report.

p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Operation Manuals shall include:

a. A table of all setpoints and implications when changing them.

b. Schedules.

c. Instructions for operation of each piece of equipment for emergencies.

d. Startup and shutdown procedures.

e. First year maintenance requirements.

f. Recommended ongoing maintenance schedules

3. Warranty Period

a. Participate in deferred functional performance testing, organized by the CxA, according to the specifications.

b. Correct deficiencies and make necessary adjustments to O&M Manuals and as-built drawings for applicable issues identified in any seasonal testing.

c. Participate in the 10-month post-occupancy walk-through, as required.

B. Plumbing Contractor: The commissioning responsibilities of the plumbing contractor, during construction and acceptance phases in addition to those listed in Paragraph A, above, are:

1. Participate in the Commission the plumbing systems listed in Section 019113 and the Commission Plan.

2. Provide submittals as required by A/E and those listed on the pre-functional test sheets.

3. During the startup and initial checkout process, execute the plumbing-related portions of the pre-functional checklists for all commissioned equipment.

4. Provide all test equipment necessary to fulfill specified testing requirements (Testing per this section is a section requirement. Include all documentation and scheduling to the CxA).

5. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

6. Prepare a preliminary schedule for pipe system testing, flushing and cleaning, and equipment start-up for use by the CxA. Update the schedule as appropriate.

7. Notify the GC when pipe system testing, flushing, cleaning, and startup of each piece of equipment will occur. Be responsible to notify the GC ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

8. Refer to Section 019113 for specific details on non-conformance issues relating to pre-functional checklists and tests and for issues relating to functional performance tests.

9. The training shall consist of a review of the O&M manuals and hands-on training. Hands-on training shall include start-up, operation in all-modes possible, including manual, shut-down, and any emergency procedures and preventative maintenance for all pieces of equipment. The plumbing contractor shall fully explain and demonstrate the operation, function, and overrides of any local package controls, not controlled by the central control system. Training shall occur after functional testing is complete, unless approved otherwise by the GC. Contractor and vendor training will be as specified for the product or system. Training will be scheduled by the GC and monitored by the GC and CxA.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 STARTUP

A. The plumbing contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Division 01. Division 22 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the GC. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.2 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to section 017900 Commissioning Training and Demonstration.

B. The GC shall be responsible for reviewing the content and adequacy of the training of Owner personnel for commissioned equipment or systems. CxA will verify compliance.

C. Mechanical and Plumbing Contractor: The mechanical and plumbing contractors shall have the following training responsibilities for their commissioned systems

1. Provide the GC with a training plan 4 weeks before the planned training.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of commissioned equipment.

3. Training shall start with classroom sessions followed by hands on training on each piece of equipment.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M Manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than 1 party may be required to execute the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M Manuals for reference.

8. Training shall include

a. Use the printed installation, operation, and maintenance instruction material included in the O&M Manuals.

b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory

suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discussion of relevant health and safety issues and concerns.

d. Discussion of warranties and guarantees.

e. Common troubleshooting problems and solutions.

f. Explanation of information included in the O&M Manuals.

g. Discussion of any peculiarities of equipment installation or operation.

h. Classroom sessions shall include the use of overhead projections, slides, video/audio taped material as might be appropriate.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

10. Fully explain and demonstrate the operation, function, and overrides of any local packaged controls, not controlled by the central control system.

D. See additional training requirements in section 017900.

END OF SECTION

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SECTION 22 11 00 - FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Work included:
   a. Domestic hot and cold water piping.
   b. Valves.

C. Submittals: **Provide submittals as required in Section 220010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer's certifications shall be submitted to the Engineer on all such materials used.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Domestic Hot and Cold Water Piping:

1. Piping below grade - 2" and smaller shall be Type K copper with wrought copper fittings; piping 2-1/2" and larger shall be cast iron AWWA class 150 water main with mechanical joint fittings.
2. Piping above grade may be Type L copper with wrought copper fittings. Where pipe sizes reduce, no sharp edged orifice type reducers shall be used in grooved pipe systems.
3. Provide lead-free solder joints for all fittings.

2.2 VALVES, COCKS AND SPECIALTIES

A. Materials: Bronze, ductile iron, or cast iron per local codes with screwed, Vic-Press 304™, grooved, or flanged ends for steel pipe and Permalynx push-to-connect, grooved, or solder ends for copper pipe.

B. Valve locations: Unless otherwise indicated, provide a valve on each branch serving a restroom.

1. Provide a valve on inlet and outlet of each piece of equipment.
2. Provide valves to isolate individual or group of fixtures and equipment on branch runouts from piping mains. This is in addition to valves at each fixture and equipment.
3. Provide interior shut-off and drain valves on each branch to wall hydrant and hose bibb.
4. Provide valves at the base of domestic water pipe risers.
5. Provide valves as indicated and where required to adequately service parts of systems and equipment.

C. Gate Valves: Rated for 200 PSIG WOG:

1. 2-1/2" and below – Nibco T-113 for steel pipe and Nibco S-113, for copper pipe, or approved equal.
2. 3" and above – Victaulic Series 771 (cold water service), Nibco F-619 or engineer approved equal.

D. Ball Valves: Rated for 200 psig WOG.
1. 2-1/2" and below – Nibco T-595-Y for steel pipe and NVent PL-200 or Nibco S-595-Y for copper pipe or engineer approved equal.

E. Check Valves (Domestic Water System):
1. Swing check valve with bronze or composition disc rated for 200 psig WOG.
2. 2-1/2" and below – Nibco T-413-B, NVent PL-510, or engineer approved equal.
3. 3" and above – Nibco F-918-B, Victaulic Series 716, or engineer approved equal.

F. Water Balancing Cocks:
1. Provide cocks with memory stop, Dezurik 100 or approved equal.

G. Backflow Preventer:
1. Double check valve assembly consisting of two independently operating, spring loaded check valves, two gate valves, and four test cocks for field testing, Wilkins Model 950 or approved equal.
2. Provide reduced pressure type if required by local codes.

H. Water Hammer Arrestors:
1. Provide arrestors sized in accordance with PDI Standard WH-201, permanently sealed, pre-charged to 60 PSIG, suitable for temperatures up to 250 DegF and maximum 350 PSIG working pressure: Model 650 Series as manufactured by Sioux Chief Mfg. Co. or approved equal.
   a. Provide at each branch run-off to fixtures or as required by manufacturer and PDI Standard WH-201.
   b. For laundry applications, Series 660-H or approved equal.

I. Butterfly Valves:
1. Butterfly valves may be used in lieu of gate valves on chilled water and hot water heating lines rated to 150 psig: 2" - 12", with stem shall be offset from the disc centerline to provide full 360-degree circumferential seating, Victaulic Vic-300 MasterSeal™ or " Crane 21-BRZ (21-BRB under 150 Deg. F). 14" - 24" Victaulic Series W706 or Crane 22F-BRZ (22F-BRB under 150 Deg. F) or engineer approved equal as manufactured by Jenkins, Centerline or Victaulic.

J. Gauge Cocks and Manual Air Vents:
1. Provide brass, lever handle cock, 1/4" FPT, as shown on the drawings or as specified herein.

K. Dielectric Unions or Waterway Fittings:
1. Provide dielectric unions or waterway fittings at all piping connections (except to valves) between dissimilar metals, Watts No. 3000 series, Victaulic Style 47, or engineer approved equal.

L. Trap Primers:
1. Trap primer valve shall be factory assembled, prepiped and shall include a bronze ¾" NPT, WOG rated inlet ball valve, a brass ¾" electronic solenoid valve and a type "L" copper manifold with brass compression fittings. Unit shall include a single point power connection at 120/1/60, a manual override switch, 2 amp breakers and geared 24 hour timer with relay and 5 second dwell function. A code approved atmospheric vacuum breaker shall be included for backflow protection. Complete unit shall be provided in a 16 gauge steel box with access door suitable for flush mounting or NEMA 1 rated box with cover for surface mounting. Trap primers shall be installed per manufacturer's instructions and recommendations.
   a. "Prime-Rite" PT or PTS as manufactured by Precision Plumbing Products, Inc. or approved equal.
   b. Trap primers shall be provided on all floor sinks and floor drains.

M. Trap Guards (If approved by local authority having jurisdiction):
1. Trap guard shall be manufactured from smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The design shall allow for wastewater to open and adequately discharge floor drain through its interior and then close and returns to original molded shape after wastewater discharge is complete. Trap guard shall be as manufactured by ProSet Systems, Inc. or pre-approved equal.

2. Trap guard shall meet the following standards:
   a. ASME A112.6.3.
   b. NSF/ANSI 14.
   c. CSA B 79.
3. Prior to ordering trap guard, contractor shall confirm drain manufacturer provided for project to insure proper fit for trap guard. This shall be indicated on the submittal.

2.3 FLANGES

A. Flanges shall be 150 pound; A.S.A. forged steel, raised face, weld neck or slip-on. Slip-on flanges shall be welded both inside and outside.

B. Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741 or W45 flange adapter nipple for sizes 14" through 24".

PART 3 - EXECUTION

3.1 GENERAL

A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer and the best practices of the trade in conformance with the contract documents.

B. Refer to Section 22 0529, "Hangers and Supports for Plumbing Piping and Equipment" for general piping support requirements.

3.2 INSTALLATION

A. Refer to Section 22 0500, "Common Work Results for Plumbing" for general installation requirements.

B. Underground Pipe: The bottom of the trench shall be shaped to give substantially uniform support to the lower third of each pipe. Each pipe shall be laid true to line and grade and in such manner as to form a concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, the interior of the pipe shall be cleaned of dirt and foreign materials of any kind. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after joining has been completed. Trenches shall be kept free from water until pipe joining is complete and pipe shall not be laid when condition of trench or weather is unsuitable for such work. At all times when work is not in progress, all open ends of pipe fittings shall be securely closed to the satisfaction of the Architect so that no water, earth or other substance will enter pipe or fittings.

C. Erection of Pipe above Grade: Piping shall be properly supported and adequate provisions shall be made for flashing, expansion, contraction, slope and anchorage. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all structural elements, finished rooms, windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted.

D. All changes in direction shall be made with fittings, except that bending of pipe will be permitted providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles or other malformation will not be acceptable.

E. Copper tubing shall be joined by the following method:
   1. The tubing shall be reamed to remove all burrs from the inside diameter of the pipe.
   2. The tubing and fitting shall be sanded or brushed to a uniform bright finish.
   3. Apply a paste flux to both tubing and fitting.
   4. Fully heat the joined parts and apply solder to the joint.
   5. Completely fill the joint with solder, wiping any excess solder outside the joint while still liquid.

   6. NVent PermaLynx piping: Prepare copper tube and install in strict accordance with NVENT installation instructions. Pipe ends shall be cleaned, free from indentations, projections, burrs, and foreign matter. Use a tube preparation tool as supplied by NVent to clean and make installation mark. Push copper tube into fittings to installation depth mark, per NVent installation instructions. Keep fittings free of dirt and oil.

F. Mitering of pipe to form elbows or notching straight runs to form tees will not be permitted unless shop fabricated by a certified welder. Weldolet or Threadolet fittings may be used in lieu of welding tees.

G. Provide sleeves around all pipes passing through walls, floors, ceiling, partitions, structural members or other building parts.

END OF SECTION

SECTION 22 11 23 - DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of all pumps as indicated on the drawings and as specified.

B. Work Included

1. In-Line Circulators.

C. Submittals: Provide submittals as required in Section 22 0500, “Common Work Results for Plumbing”.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate and performance curves showing pumps meet or exceed the minimum requirements as specified.

PART 2 - PRODUCTS

2.1 IN-LINE CIRCULATORS

A. Shall be centrifugal in-line, all bronze construction, single stage, vertical split case design and shall be capable of being serviced internally without disturbing the piping. The working pressure shall be 175 psig. The impeller shall be of the enclosed type, dynamically and hydraulically balanced, keyed to the shaft and locked down. Provide with mechanical seal and oil lubricated sleeve bearings with readily accessible lubrication port. Pumps shall be coupled to the motor with a spring or resilient type coupling to ensure quiet operation. Provide pumps as manufactured by Grundfoss, Bell and Gossett, Taco, Thrush or Armstrong.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All pumps shall be located as shown or indicated on the drawings and installed as recommended by the manufacturer.

B. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitations, are non-overloading in parallel or individual operation, and operate within 15 percent of midpoint of published maximum efficiency curve.

C. Follow manufacturer's recommendations for testing and start-up.

END OF SECTION

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SECTION 22 13 00 - FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Work included:

a. Sanitary drain, waste, and vent piping.

b. Equipment drains and relief valve piping.

C. Submittals: **Provide submittals as required in Section 220010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer's certifications shall be submitted to the Engineer on all such materials used.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Sanitary Drain, Waste, and Vent Piping:

1. Piping underground shall be service weight hub and spigot cast iron pipe and shall extend to above the floor. Joints shall be positive double seal elastomeric compression joints.

2. Piping above grade, 1-1/2" or smaller and vent piping, may be threaded galvanized schedule 40 steel or DWV copper. All 2" and larger pipe shall be service weight cast iron hub and spigot or "No Hub".

3. Fittings shall be galvanized cast iron drainage fittings for threaded piping, cast iron soil fittings for hub and spigot piping and "No-Hub" piping, DWV copper for DWV copper piping.

4. Pipe Manufacturers shall be Charlotte Pipe, Tyler Pipe, or AB&I.

5. Standard Coupling Manufacturers shall be Mission, Tyler, or Anico.

6. At Owner's option, Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D 1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D 1785 and ASTM D 2665. Fittings shall conform to ASTM D 2665.

a. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. WARNING! Never test with or transport/store compressed air or gas in PVC pipe or fittings. Solvent cements shall conform to ASTM D 2564. Primer shall conform to ASTM F 656. The system is intended for non-pressure drainage applications where the temperature will not exceed 140°F.

b. Pipe Manufacturers shall be Charlotte Pipe or Spears.

7. Above grade in projects with plenum spaces, Contractor may use pipe as specified below or PVC specified above wrapped with insulation to meet flame spread rating as required by code.
   a. Piping above grade, 1-1/2" or smaller and vent piping, may be threaded galvanized schedule 40 steel or DWV copper. All 2" and larger pipe shall be service weight cast iron hub and spigot conforming to ASTM A 74 or "No Hub" conforming to CISPI 301.
   b. Fittings shall be galvanized cast iron drainage fittings for threaded piping, cast iron soil fittings for hub and spigot piping conforming to ASTM A 74 and hubless couplings per CISPI 310, DWV copper for DWV copper piping.
   c. Pipe Manufacturers shall be Charlotte Pipe, Tyler Pipe, or AB&I.
   d. Joints for hubless cast iron soil pipes and fittings shall conform to CISPI 310, latest revision and be certified by NSF for compliance to CISPI 310
   e. Extra Heavy Cast Iron Fitttings shall be manufactured from an elastomer meeting the requirements of ASTM C 564. All pipe and fittings shall be manufactured in the U.S and marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and listed by NSF International
   f. Coupling Manufacturers shall be Mission, Tyler, or Anico.

B. Equipment Drains and Relief Valve Piping:
1. All drain piping from automatic air vents, pump bases, air handling units, etc., shall be Type L hard drawn copper, not less than connection size. Condensate drains shall be trapped. Extend all equipment drain piping to a suitable drain.
2. All relief valve piping shall be Type L hard drawn copper or schedule 40 steel, not less than valve outlet size. Extend discharge piping to a hub drain or floor receptor as required by local codes.

PART 3 - EXECUTION

3.1 GENERAL
A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer and the best practices of the trade in conformance with the contract documents.
B. Refer to Section 22 0529, “Hangers and Supports for Plumbing Piping and Equipment” for general piping support requirements.

3.2 INSTALLATION
A. Refer to Section 22 0500, “Common Work Results for Plumbing” for general installation requirements.
B. Provide sleeves around all pipes passing through walls, floors, ceiling, partitions, structural members or other building parts.
C. Provide drainage lines with properly specified clean-outs. Locate clean-outs in runs at not more than 75' on center or as required by local codes. Provide clean-outs at base of each soil and waste stack and whenever necessary to make accessible all parts of drainage soil and waste systems whether or not indicated on drawings.
D. Extend clean-outs within chases to near wall and provide access cover compatible with wall construction.
E. Provide clean-outs of required size with flashing flange where installed with membrane water proofing. Lubricate threaded clean-out plugs. Provide clearance at clean-out for rodding of drainage system.
F. Lubricate threaded clean-out plugs. Provide clearance at clean-out for rodding of drainage system.
G. Encase exterior clean-outs in concrete flush with grade.
H. Minimum slope of piping shall be in accordance with the following unless otherwise specifically shown on the drawings or specified.

Type of Piping or Fluid Conveyed	System Component	Length for 1" Fall	Direction of Fall
Sewer, Sanitary through 3”	Main or Branch	4 feet	Direction of Flow
Sewer, Sanitary through 4” and above	Main or Branch	8 feet	Direction of Flow

END OF SECTION

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SECTION 22 14 00 - FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Work included:

a. Storm Drain and Subsoil drainage piping.

C. Submittals**: Provide submittals as required in Section 220010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer's certifications shall be submitted to the Engineer on all such materials used.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Storm Drain and Subsoil Drainage Piping:

1. Piping below grade - Service weight hub and spigot cast iron soil pipe and fittings with elastomeric joints as specified above.
2. Piping above grade - Service weight hub and spigot or "No Hub" cast iron pipe and fittings.
3. Subsoil piping shall be corrugated polyethylene perforated tubing with solvent weld fittings as manufactured by Advanced Drainage Systems, Inc. or approved equal.
4. Fittings shall be galvanized cast iron drainage fittings for threaded piping, cast iron soil fittings for hub and spigot piping conforming to ASTM A 74 and hubless couplings shall conform to CISPI Standard 310 and shall be listed with NSF International, DWV copper for DWV copper piping.
5. Pipe Manufacturers shall be Charlotte Pipe, Tyler Pipe, or AB&I.
6. Standard Coupling Manufacturers shall be Mission, Tyler, or Anico.

PART 3 - EXECUTION

3.1 GENERAL

A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the

manufacturer and the best practices of the trade in conformance with the contract documents.

B. Refer to Section 22 0529, “Hangers and Supports for Plumbing Piping and Equipment” for general piping support requirements.

3.2 INSTALLATION

A. Refer to Section 22 0500, “Common Work Results for Plumbing” for general installation requirements.

B. Provide sleeves around all pipes passing through walls, floors, ceiling, partitions, structural members or other building parts.

END OF SECTION

SECTION 22 1423 - REINFORCED CONCRETE STORM SEWERS AND APPURTENANCES

PART 1 - GENERAL

1.01 SCOPE

A. The work includes the construction of reinforced concrete pipe storm sewers and other miscellaneous drainage structures and appurtenances.

1.02 SUBMITTALS

A. Submit to the Architect/Engineer in conformance with the requirements of the CONDITIONS OF THE CONTRACT.
B. Sustainable Submittals:
   1. Recycled material data. Provide for every material unless other noted:
      a. Product information from manufacturer documenting percentages by weight of post-consumer and pre-consumer recycled content.
      b. Material costs for each product having recycled content.
   2. Regional material data. Provide for each product unless other noted:
      a. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
      b. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
      c. Include statement indicating cost for each regional material and fraction by weight that is considered regional.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Section 312333 -Trenching and Backfilling
B. Match material requirements under 033000 Reinforced Cast in Place Concrete for Sidewalks and 032000 Concrete Reinforcement

PART 2 - PRODUCTS

2.01 MATERIALS

A. Reinforced Concrete Pipe: Reinforced concrete pipe shall conform to the current specifications for reinforced concrete pipe, ASTM Designation C76 of the class shown on the plans. If not otherwise shown on the plans, all reinforced concrete pipes shall be Class lll. All pipe shall be machine made by a process that will provide for uniform placement of zero slump concrete in the form and compaction by mechanical devices which will assure a dense concrete in the finished product.
B. Concrete for Inlets and Appurtenances: Reinforced concrete for inlets shall have a minimum compressive strength at twenty-eight (28) days of 4,000 pounds per square inch and a minimum cement content of five (5) sacks of cement per cubic yard of concrete.
C. Mortar: Mortar for pipe joints and connections to other drainage structures shall be composed of one (1) part by volume of Portland cement and two (2) parts of sand.

PART 3 - EXECUTION

3.01 BEDDING

A. All pipe shall receive embedment per the detail on the plans.

3.02 EXCAVATION

A. Excavation for storm sewer pipes shall consist of performing all excavation of every description and of whatever substance is encountered to the depth required. All excavated material which is not required for backfill or fill shall be removed and disposed of by the Contractor. All excavation shall be made by open cut; banks of trenches shall be kept as nearly vertical as possible and, if required,

shall be properly sheeted and braced. For pipes having an inside diameter of thirty-three (33") inches or less, the trench shall be excavated a minimum of sixteen (16") inches wider than the outside diameter of the pipe. The trench shall be excavated a minimum of sixteen (16") inches wider than the outside diameter of the pipe so that a clear space of not less than eight (8") inches is provided on each side of the pipe.

B. Cold Applied, Preformed Plastic Gaskets. These preformed gaskets may be used for sealing tongue and groove concrete pipe sewers. The gasket shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler and shall contain no solvents, irritating fumes, or obnoxious odors. The gasket joint sealer shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength and shall be supplied in extruded rope form of suitable cross section. The gasket joint sealer shall be protected by a removable two piece wrapper designed so that one-half may be removed longitudinally without disturbing the other half to facilitate application. Preformed gaskets shall be Ram-Nek, as manufactured by K T. Snyder Co., Inc. of Houston, Texas, or approved equal.

3.05 BACKFILL

A. After the bedding has been prepared and the pipes installed as required, backfill shall be placed in accordance with Section 32 13 13. If the material, when tested, fails to meet the density requirements, the backfill shall be required to be removed and replaced to meet the proper density.

B. Backfill shall not be placed until the Architect/Engineer or his representative has observed the trench and authorized the placing of backfill. All debris shall be removed from the trench prior to beginning the backfilling operations. Sheet, shoring and bracing shall be pulled and removed during the progress of the backfilling in such a manner to protect the trench and the pipe.

C. Backfilling shall then be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface of slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the Architect/Engineer. The top one (1') foot of backfill material shall be of as good quality as the original topsoil which was removed.

3.06 DRAINAGE STRUCTURES

A. Inlets: Inlets shall be constructed as shown on the drawings. Excavation shall be made with appropriate equipment with a minimum of interference with adjacent improvements and existing utilities. After installation of inlets, all excavated areas which are not occupied by the inlet shall be backfilled with selected materials from the excavation. The backfill material shall be compacted to not less than ninety-five (95%) percent to one hundred (100%) percent of standard density, in accordance with AASHTO T-99.

END OF SECTION 221423

SECTION 22 34 36 - COMMERCIAL GAS DOMESTIC WATER HEATER

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of the heating system as indicated on the drawings and as specified. Provide factory trained start-up service for all equipment.

B. Work Included:

1. Condensing Gas Fired Storage Water Heater

1.2 QUALITY ASSURANCE

A. Listing: The water heater will be listed ETL listed to UL 795 or ANSI Z21.10.3/CSA 4.3 “Gas Water Heaters”

B. ASME Compliance: Water heater shall bear the ASME HLW stamp and be National Board listed.

C. Water heaters with full rated input between 199,000 and 300,000 BTU will operate at a minimum 95.3% thermal efficiency at full firing rate when tested to the ANSI Z21.10.3 thermal efficiency test protocol (DOE 10 CFR 431).

D. The water heater will comply with current ASHRAE 90.1 requirements.

E. Water heater manufacturer certified to the ISO 9001 International Quality System.

1.3 SUBMITTALS

A. **Provide submittals in accordance with section 220010, “Submittal Process”**

B. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties and accessories for each model indicated.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, components, and size of each field connection

D. Wiring Diagrams: Detail for wiring power signal, differentiate between manufacture- installed and field-installed wiring

E. Maintenance Data: Include in the maintenance manuals specified in Division 1. Include maintenance guide and wiring diagrams.

1.4 WARRANTY

A. Storage tank, heating surfaces, and combustion chamber will have a manufacturer’s 15-year warranty (8 years non-prorated, 7 years prorated) covering manufacturing or material defects, waterside or fire side corrosion, leaks, and/or the production of rusty water. Warranties must be directly provided from the water heater manufacturer. Warranties provided by distributors, contractors, sales representatives or third party insurers will not be accepted.

B. Burner and all heater parts: 1 year

PART 2 – PRODUCTS

2.1 CONDENSING GAS FIRED STORAGE WATER HEATER

A. Water heaters will be of the BTU input(s) and storage capacity indicated on the equipment schedule.

B. The water heater will be a vertical fire tube, design that is constructed and stamped in accordance with Section IV, Part HLW of the ASME code. Water heater will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure.

C. Water heater will be a single-pass, down-fired, fire tube design contained within an integral storage tank.

D. Tank, combustion chamber and fire tubes will be unlined. Lined or plated water heaters will not be acceptable.

E. Tank, combustion chamber and fire tubes will be constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2and ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”

F. Tank will be welded utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.

G. All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.

H. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable.

I. All water contacting tank surfaces will be non-porous and exhibit 0% water absorption.

J. All tank connections/fittings will be non-ferrous or stainless steel.

K. To preserve thermal efficiency, the water heater will not use or require a circulator piped from the hot water outlet to the cold water inlet of the heater for the purpose of temperature control during normal operation. Connection for a building return circulation line will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping. Connection to a sidearm tank, if used, will be made to a dedicated hot return fitting at the center of the storage vessel and not the cold inlet piping.

L. Finished vessel will not require sacrificial or impressed current anodes and none will be used. Water heaters or sidearm storage tanks that employ anode rods of any type will not be acceptable.

M. Combustion will be provided by a premix, fan-assisted surface burner with a gas train meeting UL, ANSI and FM standards for the input specified.

N. MASS code requirements for the input specified.

O. Burner will be stainless steel.

P. Gas train components will capable of self-proportionating gas and air to maintain optimum combustion in response to varying vent pressures.

Q. At 199,000 to 399,000 BTU input, the burner will be fixed input.

R. Burner NOx emissions will be less than 20 ppm when corrected to 3% oxygen.

S. Water heater will be a category IV, condensing appliance and vent through PVC or Polypropylene. Water heater will satisfy requirements for sealed combustion. Vents for inlet air and exhaust can terminate in different pressure zones.

T. WATER HEATER TRIM

a. <u>As a minimum</u>, the heater will be equipped with the following:

1. electronic flame monitoring
2. electronic low water cutoff
3. an *immersion* operating control
4. an *immersion* UL listed temperature limiting device
5. an ASME- rated temperature and pressure relief valve
6. and options as selected on form PV 8293

U. Operating and safety controls shall meet the requirements of UL 795 and FM

V. The water heater shall employ an electronic operating control with digital temperature readout. Operator shall be capable of connecting to a building automation system through serial connection using Modbus RTU protocol.

W. Provide heaters as manufactured by PVI, A.O. Smith, or Lochinvar.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install water heaters level and plumb in accordance with manufacturers written instructions and referenced standards

B. Start up on the unit shall be performed by factory trained and authorized personnel. A copy of the startup report shall be provided to the owner and submitted in the O&M Manuals.

3.2 EQUIPMENT START-UP

A. Prior to operation, the factory start-up representative shall, in the presence of the Architect's representative perform all system and equipment checks as prescribed by the manufacturer in his written start-up procedures.

B. The factory start-up representative shall place the equipment in operation and record all start-up data. Three copies of all data shall be given to the Architect.

END OF SECTION

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SECTION 22 42 00- COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of a complete and operating plumbing system inside the building and to points outside the building as indicated on the drawings and as specified.

B. Work Included

1. Plumbing fixtures.
2. Plumbing accessories.
3. Plumbing equipment.

C. Submittals: **Provide submittals as required in Section 220010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified. All work shall conform to the requirements of applicable codes.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Furnish and install all plumbing fixtures and equipment as scheduled and shown on drawings. All plumbing fixture brass trim shall be so designed that all wearing parts are to be in a standardized renewable operating unit which can be removed without detaching the supply fixture or faucet proper. The standardized renewable operating units are to be interchangeable with all supply fixtures and faucets. All exposed metal parts of all fixtures, including faucets, waste fittings, waste plugs, strainers, flush valves, traps, supplies, nipples and escutcheons shall be chromium plated brass, unless other materials or finish is specified. Angle stops with S.P.S. brass nipples from wall to stops shall be provided on all water supplies to fixtures. Fixture trim must be that of the fixture manufacturer wherever possible and must bear a permanent impression of the manufacturer.

B. Furnish and install all plumbing fixtures specified herein and shown on plans. American Standard are specified, however, Crane, Elkay or Kohler may be used if a substitution request is submitted to the architect and consultant for review and they are equal in all respects to those specified. Contractor shall submit on trim as well as fixtures.

C. Wall hung fixtures where scheduled on drawings are to be supported by Josam, Wade, Smith or approved equal chair carriers with integral adjustable fittings.

D. Floor drains shall be as scheduled and in accordance with ANSI A112.21.1. Provide caulking flange for connection to cast iron pipe, screwed outlets for connection to steel pipe, and side outlet when shown. Provide suitable clamping device and extensions if required, where installed in connection with waterproofing membrane. (Submit detailed shop drawings for these drains). Double drainage pattern floor drains shall have integral seepage pan for embedding in floor construction, and weep holes to provide adequate drainage from pan to drain pipe

2.2 PLUMBING SPECIALTIES

A. Clean-outs

1. Provide drainage lines with properly specified clean-outs. Locate clean-outs in runs at not more than 75' on center or as required by local codes. Provide clean-outs at base of each soil and waste stack and whenever necessary to make accessible all parts of drainage soil and waste systems whether or not indicated on drawings. Extend clean-outs within chases

to near wall and provide access cover compatible with wall construction. Provide clean-outs of required size with flashing flange where installed with membrane water proofing.

2. Exterior Surfaced Areas: Round cast nickel bronze access frame and vandal proof non-skid cover; Model 4245 as manufactured by JR Smith or approved equal.
3. Exterior Unsurfaced Areas: Ferrule type with coated cast iron body and round tapered thread bronze cover; Model 4280 as manufactured by JR Smith or approved equal.
4. Interior Finished Floor Areas: Coated cast iron body, round with scoriated cover Model 4025C in service areas, square with bronze foot traffic cover Model 4045C compatible with floor finish in finished floor areas or carpet clean-out cover where required; clean-outs shall be as manufactured by JR Smith or approved equal.
5. Interior Finished Wall Areas: Cast iron body, cast iron plug, and round flat stainless steel access cover secured with machine screw; Model 4402 as manufactured by JR Smith or approved equal.
6. Interior Unfinished Accessible Areas: Cast iron tee with threaded plug. Provide bolted stack clean-outs on vertical rainwater leaders.

B. Access Boxes (Coordinate all locations with Architect prior to installation): Provide 18 gauge steel frame and door with heavy duty piano hinge and keyed cam-lock.
   1. Walls:
      a. Provide square frame and secured cover with brushed chrome plate finish in tile walls.
      b. Provide square frame and cover with bonderized prime-coated steel face and lock in walls of other finished rooms.
   2. Ceilings:
      a. Provide square frame and cover with bonderized prime-coated steel face and lock.
   3. Floors:
      a. Provide plain steel frame with plain nickel-bronze scoriated cover.

C. Provide cast brass "P" traps on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed traps shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be wrought cast brass. Slip joints not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture, or as scheduled.

PART 3 - EXECUTION

3.1 INSPECTION

A. Review millwork and other related shop drawings for coordination and ADA requirements. Confirm location and size of fixture and/or opening before rough-in and installation.
B. Verify adjacent construction is ready to receive rough in and finish work of this Section

3.2 INSTALLATION OF PLUMBING PIPING

A. The plumbing piping system shall be installed as specified in Section 22 1300, “Facility Sanitary Sewerage”.
B. Lubricate threaded clean-out plugs. Provide clearance at clean-out for rodding of drainage system.
C. Encase exterior clean-outs in concrete flush with grade.

3.3 INSTALLATION OF PLUMBING FIXTURES

A. Install each fixture with trap, easily removable for servicing and cleaning.
B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons to make a watertight finished connection.
C. Fixture heights will be defined on the Architectural Drawings. Where the mounting heights vary, the defined heights as shown on the Architectural Drawings shall prevail. Install components level and plumb.
D. All fixtures must be securely fastened to the floor or walls by means of inserts or expansion bolts in concrete work, and by means of expansion bolts, toggle bolts or through bolts in masonry work, and by means of framing and screws in frame construction, to the satisfaction of the Architect.
E. Drains
   1. Contractor shall install all floor and roof drains according to manufacturer's recommendations. Provide and install all flashing and weatherproofing as required. Adjust

extension sections on all drains as required for proper height adjustment.

2. All floor drains to be trapped. Connect floor drains to sanitary waste piping as indicated on plans.
3. Each AC equipment drain opening which normally discharges water (such as air conditioning unit drains, overflows, and similar drips and drains) shall be connected to the drain openings by means of an indirect drain or piped down directly over the floor drains which are provided for this purpose.
4. Each water relief valve discharge shall be piped down to 6 inches above floor, but not necessarily over a floor drain or connected to a drain opening, unless otherwise indicated. No drain piping is required from the discharges or drain valves, unless otherwise indicated.
5. All drains, overflow, condensate and relief, to be routed to nearest trapped hub or floor drain if not shown on drawings.

3.4 ADJUSTING AND CLEANING

A. Adjust stops and regulating valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. At completion, clean plumbing fixtures and equipment.

END OF SECTION

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SECTION 23 00 10 - SUBMITTAL PROCESS

PART 1 – GENERAL

1.1 SUBMITTALS

A. Comply with all submittal provisions of Division 1.

B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 23 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to **"mdengca@md-eng.com".** Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications.

C. Contractor is responsible to separate submittals per specification section. Unseparated submittals are subject to rejection without review.

D. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.

E. Submittals that have been reviewed and marked as REJECTED (REJ) or REVISE & RESUBMIT (RES) should be resubmitted within 10 days to be reviewed again by engineer.

F. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.

G. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).

1.2 REQUIRED SPECIFICATIONS (Project specific)

A. The chart below are the submittals required for the project.

1. Submittals marked with an "**X**" are required for this project.
2. Submittals without an "**X**" are not required for this project.

See required specifications on next page

Required X	Submittal Name	Spec Reference
X	Common Work Results for HVAC *-O&M manual, Shop Drawings*	23 05 00
	Common Work Results for Steam Generation *-Polyphase Motors, Single Phase Motors,* *-Motor Starters*	23 05 13
X	Hangers & Supports for HVAC Piping & Equip. *-Hangers and supports, Inserts, Hanger rods* *-Sleeves, Trapezes*	23 05 29
X	Vibration & Seismic Controls for HVAC Pipe, etc. *-Isolation material, Support units,*	23 05 48
X	Identification for HVAC Piping & Equipment *-Valve tags, Pipe markers, Equipment plates,*	23 05 53
X	Testing, Adjusting & Balancing for HVAC *-Certifications*	23 05 93
X	HAVC Insulation *-Piping Insulation, Duct insulation, Adhesives* *-Sealants, Covers, Aluminum UV covers.*	23 07 00
	Instrumentation & Control for HVAC *-Shop drawings, Software, Equipment*	23 09 00
X	Sequence of Operations for HVAC Controls *-Control system, Shop drawings. Testing*	23 09 93
X	Facility Natural Gas Piping *-Piping, Valves, Cocks, Regulators, Flanges*	23 11 23
X	Refrigeration Piping *-Pipe, Fittings, Valves, Cocks, Hangers, Sleeves* *-Trapezes, Brazing Rod*	23 23 00
	Variable Frequency Motor Controllers (VFD) *-Manufacturer, Product info*	23 29 23
	DX Split Systems *-Equipment type*	23 76 00
	OSA Units *-Equipment*	
	Vehicle Exhaust System *-Equipment submittal*	23 25 16
	Packaged Outdoor HVAC Equipment *-Packaged Equipment, Controls, Hail Guards*	23 74 00

Required X	Submittal Name	Spec Reference
X	Air Distribution *-Duct Work, Flexible duct, Access doors* *-Fire & Smoke dampers*	23 31 00
X	Hangers & Supports for Duct Work *-duct hangers*	23 31 50
X	HVAC Power Ventilators *-Up blast, Belt driven, Utility fans, V-belt*	23 34 23
X	Diffusers, Registers, Grills *-Air supplies, Returns, Louvers, Roof hoods* *-Louvered penthouse, Goosenecks*	23 37 13
X	Heat Generation Equipment *-Tubular Infrared Heaters, Heater flues*	23 50 00
X	VRF Air Conditioning Systems (General) *-VRF Equipment, Condenser, FCU,* *- Refrigeration selector boxes, Controls*	23 81 49
	VRF Air Conditioning Systems (LG) *-VRF Equipment, Condenser, FCU,* *- Refrigeration selector boxes, Controls*	23 81 46
	VRF Air Conditioning Systems (Mitsubishi) *-VRF Equipment, Condenser, FCU,* *- Refrigeration selector boxes, Controls*	23 81 49
	VRF Air Conditioning Systems (Daikin) *-VRF Equipment, Condenser, FCU,* *- Refrigeration selector boxes, Controls*	23 81 49
	VRF Air Conditioning Systems (Toshiba) *-VRF Equipment, Condenser, FCU,* *- Refrigeration selector boxes, Controls*	23 81 49
X	Unit Heaters *-Electric UH, Gas UH, Flue piping*	23 82 39

SECTION 23 05 00 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The General Requirements for Mechanical Work are intended to be complementary to the General Requirements of the Construction Contract.

B. Work Included: Provide complete mechanical systems where shown on the drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to the following summary of work:

1. Furnish and install a complete gas system as shown on drawings and described herein.
2. Furnish and install a complete heating and air conditioning system as shown on drawings and described herein.
3. Furnish and install a complete ventilation system as shown on drawings and described herein.
4. Other items and services required to complete the systems.

1.2 GENERAL REQUIREMENTS

A. Unless otherwise specified, materials are to be new and of current U.S. manufacture, free from defects and of the best quality of their respective kinds.

B. Equipment and/or materials damaged in shipment or handling, or otherwise damaged before installation, shall be replaced with new equipment and/or materials. Damaged equipment and/or materials shall not be repaired at the jobsite.

C. Furnishing of the proper equipment and/or materials and to see that it is installed as recommended by the manufacturer is entirely the responsibility of the Contractor. If required for proper installation, the Contractor shall obtain advice and supervisory assistance from a representative of the specific manufacturer of the equipment being installed.

D. Materials and adhesives to conform to Federal Standard Flame-Spread Properties, Inc., with composite fire and smoke hazard ratings, maximum 25 for flame spread and 50 for smoke developed. Adhesives to be waterproof.

E. The Contractor shall promptly notify the Architect in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect instructions before proceeding with the work. Should the Contractor perform any such work that does not comply with the manufacturer's directions or such instructions from the Architect, he shall bear all costs arising in connection with the deficiencies.

F. Belts, pulleys, chains, gears, couplings, projecting screws, keys or other rotating parts which are located so that a person can come in close proximity thereto shall be fully enclosed properly provided with a guard.

1.3 QUALITY ASSURANCE AND APPLICABLE STANDARDS

A. Use adequate numbers of skilled workers that are thoroughly trained and experienced in the necessary crafts and are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. The Contractor shall be responsible for fitting his material and apparatus into the building and shall carefully lay out his work at the site to conform to the structural conditions, to avoid all obstructions, to conform to the details of the installation and thereby to provide an integrated satisfactory operating installation. **The contractor must support all duct, pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support duct, pipe, equipment, and all other items furnished under this scope from the metal deck.**

C. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

D. Codes: Perform all work in accordance with the latest edition of the following codes:

1. State and city building, fire, plumbing and mechanical codes.
2. International Fire Code

3. International Mechanical Code
4. International Plumbing Code
5. National Electrical Code
6. International Energy Conservation Code
7. National Fire Protection Association (NFPA)
8. American with Disabilities Act (ADA)
9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities.
10. All authorities having jurisdiction.
11. Architectural code review drawing.
12. Dallas Green Building Program

E. The Contractor shall comply in every respect with all requirements of National Fire Protection Association, local Fire Department regulations and utility company requirements. In no case does this relieve the Contractor of the responsibility of complying with these Specifications and Drawings where specified conditions are of higher quality than the requirements of the above-specified authorities. Where requirements of the Specifications and Drawings are more lenient than the requirements of the above authorities having jurisdiction, the Contractor shall make installations in compliance with the requirements of the above authorities with no extra compensation.

F. Where conflicts occur between drawings, specifications or code requirements, the most stringent requirement shall take precedence.

G. Standards: The specifications and standards of the following organizations are by reference made a part of these specifications. All work, unless otherwise indicated, shall comply with the requirements and recommendations wherever applicable:
1. American National Standards Institute (ANSI).
2. Air Conditioning and Refrigeration Institute (ARI).
3. American Gas Association (AGA).
4. American Society for Testing and Materials (ASTM).
5. American Society of Mechanical Engineers (ASME).
6. American Society of Refrigeration, Heating and Air Conditioning Engineers (ASHRAE).
7. Electrical Testing Laboratories (ETL).
8. National Bureau of Standards (NBS).
9. National Electrical Manufacturer's Association (NEMA).
10. National Fire Protection Association (NFPA).
11. Sheet Metal and Air Conditioning National Association (SMACNA).
12. Underwriters Laboratories, Inc. (UL).

H. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. ASME Boiler and Pressure Vessel Code: Section IX.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. The requirements and recommendations of the latest edition of the Occupational Safety and Health Administration (OSHA) Act are by reference made a part of these specifications. All work shall comply with the requirements and recommendations wherever applicable.

1.5 SUBMITTALS

A. Comply with all submittal provisions of Division 1.

B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 23 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to **"mdengca@md-eng.com".** Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications

C. Product Data: Submit the following:
1. Materials list of items proposed to be provided under Division 23.
2. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in the following paragraph.

3. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in a clear and concise format. All substitutions shall be approved in writing by Architect. The Architect's decision shall be final.
4. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.
5. Submittals that have been reviewed and marked as REJECTED (REJ) or MAKE CORRECTIONS NOTED (MCN) should be resubmitted within 10 days to be reviewed again by engineer.
6. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.
7. Manufacturer's recommended installation procedures which, when reviewed by the Architect, shall become the basis for accepting or rejecting actual installation procedures used on the work.
8. Sign the submittal as an indication of compliance with the contract documents. Any deviations from the contract documents shall be indicated on the submittal prior to signing. Any deviations not indicated shall be cause for rejection and removal of the non-complying equipment at the Contractor's expense.

D. Submittals required of materials and equipment under this section include the following:
1. Piping and Accessories Materials:
   a. **Clearly marked up** manufacturer's data showing compliance with the specifications for: **(Include model numbers and highlight products)**
      1) Piping material proposed for each system.
      2) Valves, cocks, and specialties.
      3) Flexible connectors for piping.
      4) Flanges.
   b. l/8" scale (minimum) gas, and refrigerant piping shop drawings showing coordinated piping routing and arrangements with all equipment, accessories and system expansion and contraction compensation methods.
2. Vibration Isolation and Sound Control Materials:
   a. **Submit shop drawings** showing the structural design and details of inertia bases, steel beam bases, and other custom-fabricated work not covered by manufacturer's submitted data.
   b. Furnish layouts of templates to be furnished to fabricators of equipment bases, foundations, and other support systems, as needed for coordination of vibration isolation units with other work.
   c. Submit shop drawings indicating the scope of vibration isolation work, locations of units and flexible connections. Include support isolation points for piping, air handling units, inertia bases, etc.
   d. Include schedule of isolation units, showing size or manufacturer's part number, the weight supported and resulting deflection of each unit.
   e. For spring isolation units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.
   f. For spring-and-pad type isolation units, show the basis of spring rate selection for the range of loading weights.
3. Mechanical Identification Materials:
   a. **Clearly marked-up** product literature or samples showing compliance with specified materials for: **(Include model numbers and highlight products)**
      1) Valve tagging.
      2) Pipe marking.
      3) Equipment marking.
4. Insulation:
   a. Manufacturer's certified data on thermal performance.

b. Details, when required, of methods to be used in providing for unusual piping expansion and contraction.
c. Manufacturer's data on any alternate insulation material of reduced thickness, including pre-insulated pipe.
d. Manufacturer's data on all jacketing materials, sealants and fasteners.

5. Heating:
   a. Provide clearly marked-up manufacturer's data showing compliance with scheduled values and specifications for: **(Include model numbers and highlight products)**
      1) Flue pipe and accessories.
      2) Unit heaters.
   b. Provide all electrical characteristics.
6. Refrigeration:
   a. **Provide clearly marked-up** manufacturer's data showing compliance with scheduled values and specifications for: **(Include model numbers and highlight products)**
      1) Condensing Units
   b. Provide all electrical characteristics.
7. Dedicated Outdoor Air System:
   a. **Provide clearly marked-up** manufacturer's data showing compliance with scheduled values and specifications for: **(Include model numbers and highlight products)**
      1) DOAS, factory assembled.
      2) Fan coil units.
      3) Filters.
   b. Provide all electrical characteristics.
8. Ventilation Fans and equipment:
   a. **Shop Drawings:** Indicate assembly of centrifugal fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.
   b. Product Data: Submittal data for approval for all fans of every description furnished. Shall include the following:
      1) Fan curves with specified operating point clearly plotted. The recommended range of operation shall be stable.
      2) Fans shall be capable of operating stably at reduced loads imposed by means of variable speed drives.
      3) Data on sound power levels for both fan inlet and outlet at rated capacity.
      4) Electrical characteristics and connection requirements.
      5) All data on fan accessories.
      6) Manufacturer's Installation Instructions.
9. Air Distribution Materials:
   a. **Provide clearly marked-up** manufacturer's data showing compliance with scheduled values and specifications for: **(Include model numbers and highlight products)**
      1) Air devices.
      2) 1/4" scale ductwork shop drawings for all systems showing equipment locations, detailed data such as bottom of duct elevations, airstream sizes, all duct accessories, and duct construction details showing compliance with SMACNA requirements for the specified duct pressure of each system.
      3) Fire dampers, fire and smoke dampers.
10. Testing and Balancing:
    a. Brief description of test and balance contractor experience.
    b. Certificate of Qualification from AABC.
    c. Biographical information of the Registered Professional Engineer and certified Test and Balance Supervisor proposed to manage the project.
    d. List of instruments to be used with latest date of calibration test for each.
    e. Test and balance reports.

f. VRF experience Certifications.

11. Record Documents: Reference the requirements detailed in this section.
12. Operation and Maintenance Data: Reference the requirements detailed in this section.

E. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost plus ten percent (10%).

1.6 SUBSTITUTIONS

A. Comply with all provisions of Division 1.

B. The use of manufacturers' names and catalog numbers followed by the phrase "or equal" is generally used to establish a standard of quality and utility for the specified items and to provide a dimensional reference for construction documents that are drawn to scale.

C. Submittals for "equal" items shall, where applicable, include the following data that are not necessarily required for specified items:

1. Performance characteristics.
2. Materials.
3. Finish.
4. Certification of conformance with specified codes and standards.
5. Manufacturer's specifications and other data needed to prove compliance with the specified requirements. The term "Compliance" is understood to mean that the Contractor certifies that the submitted equipment will meet or exceed the contract document requirements. Items that do not clearly meet this definition should be identified and explained as required in Paragraph 6 below.
6. Identify the difference between the specified item or function and the proposed. Explain with enough detail so that the Architect/ Engineer/Owner can easily determine that the item complies with the functional intent. List any disadvantages or advantages of the proposed item versus the specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Include shop drawings for all piping and ductwork equipment per Paragraph 1.5 Submittals. Organize in a clear and concise format.

D. Submittals of "equal" components or systems may be rejected if:

1. The material or equipment would necessitate the alteration of any portion of the mechanical, electrical, architectural or structural design.
2. Dimensions vary from the specified material or equipment in such a manner that accessibility or clearances are impaired or the work of other trades is adversely affected.

E. Proposed substitutions for materials or equipment must be submitted ten (10) days prior to final bid date for consideration as approved equals. Otherwise, such substitutions will not be permitted. Proposals for substitutions shall be made only by the prime bidders. Manufacturers, distributors, and sub-contractors shall not make proposals to the Architect for substitutions.

F. All equipment installed on this project shall have local representation, local factory authorized service, and a local stock of repair parts

G. No substitution shall be made unless authorized in writing by the Architect. Should a substitution be accepted, and should the substitute material prove defective or otherwise unsatisfactory for the service intended, and within the guarantee period, the Contractor shall replace this material or equipment with material or equipment specified, at his own expense, and to the satisfaction of the Architect.

H. Contractors submitting bids on substitute materials and equipment must also provide a written performance guarantee certifying that the substitute materials and equipment will produce the specified effects and meet the approval of the Architect.

1.7 ORDINANCES, PERMITS, METERS, UTILITIES AND ROYALTIES

A. Procure all permits and licenses necessary for completion of this project and pay all lawful fees required and necessary pursuant in obtaining said permits and licenses. All required certificates of approvals and inspections by local governing and regulating authorities shall be obtained and paid for by the Contractor.

B. Pay all fees required for the connection of gas to utility mains, and any meter fees if required.

C. Pay any royalty payments required or fees for the use of patented equipment or systems. Defend

all law suits or claims for infringement of any patent rights and shall hold the Owner and/or Architect/Engineer harmless from loss as a result of said suits or claims.

1.8 COMPATIBILITY OF EQUIPMENT

A. Assume full responsibility for satisfactory operation of all component parts of the mechanical systems to assure compatibility of all equipment and performance of the integrated systems in accordance with the requirements of the specifications. Should the Contractor consider any part of the specifications or drawings as rendering his acceptance of such responsibility impossible, prohibitive, or restrictive, he shall notify the Engineer before submitting his bid, and the bid shall be accompanied by a written statement of any objections or exceptions to the specifications and drawings.

B. The size of mechanical and electrical equipment indicated on the Drawings is based on the dimensions of a particular manufacturer. While other manufacturers may be acceptable, it is the responsibility of the Contractor to determine if the equipment he proposes to furnish will fit in the space. Fabrication Drawings shall be prepared when required by the Architect/Engineer or Owner to indicate a suitable arrangement.

C. All equipment shall be installed in a manner to permit access to all surfaces. All valves, motors, drives, filters, and other accessory items shall be installed in a position to allow removal for service without disassembly of another part.

1.9 CONSTRUCTION REQUIREMENTS

A. The drawings show the arrangements of work. Should project conditions necessitate rearrangement, or if the materials or equipment can be installed to a better advantage in a different manner, the Contractor shall, before proceeding with the work, prepare and submit five copies of Drawings of the proposed arrangement for the Architect's review. Allow a minimum of ten (10) working days for review.

B. Should the Contractor propose to install equipment requiring space conditions other than those shown, or rearrange the equipment, he shall assume responsibility for the rearrangement of the space and shall have the Architect review the change before proceeding with the work. The request for such changes shall be accompanied by shop drawings of the space in question. Identify monetary credits proposed or other benefits of the change. Allow a minimum of ten (10) working days for review.

C. The Contractor shall be responsible for the proper location and size of all slots, holes or openings in the building structure pertaining to his work and for the correct location of pipe sleeves.

1.10 CONNECTIONS FOR OTHERS

A. The Mechanical Contractor shall rough in for and make all gas connections to all equipment, machinery, etc., provided by others in accordance with detailed roughing-in Drawings provided by the equipment suppliers, by actual measurements of the equipment connections, or as detailed.

B. After the equipment is set in place, this Contractor shall make all final connections and shall provide all required pipe, fittings, valves, traps, etc.

C. Provide all air gap fittings required, using materials hereinbefore specified. In each service line connected to an item of equipment or piece of machinery, provide a shutoff valve. On each drain not provided with a trap, provide a suitable trap.

D. All pipe fittings, valves, traps, etc., exposed in finished areas and connected to chrome plated lines provided by others shall be chrome plated to match.

E. Provide all galvanized sheet metal ductwork, transition pieces, etc., required for a complete installation. Exposed sheet metal shall be paint-grip type.

1.11 LOCATION OF OUTLETS

A. Supply and return air outlets in suspended acoustical tile ceilings shall occur symmetrically in tile joints or in the centers of whole tiles. The final determination of the exact location of each outlet and the arrangement to be followed shall be acceptable to the Architect.

B. The drawings show the locations of the various outlets and equipment. Exact locations of these outlets and equipment shall be determined by reference to the general construction plans and to all detail drawings, equipment drawings, roughing-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Architect reserves the right to make any reasonable change in location of any outlet or equipment before installation, without additional

cost.

C. The Contractor shall install his work complete and in good working order. If any of the requirements of the drawings and specifications are impossible to perform, or if the installation when made in accordance with such requirements will not perform satisfactorily, he shall report same to the Architect for correction.

D. No extra compensation will be allowed for extra work or change caused by failure to comply with the above requirements.

1.12 PROJECT RECORD DOCUMENTS

A. Provide the record documents associated with the work of Division 23 in strict accordance with the provisions of these specifications.

B. Throughout progress of the Division 23 Work, maintain an accurate record of changes in the Contract Documents that apply to work of Division 23. Changes shall include all addendums issued during bidding. Maintain an accurate record of the location of mechanical service lines and outlets and all outside utilities.

C. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff as approved by the Architect.

D. Accuracy of Records

1. Thoroughly coordinate changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of drawings and other documents where such entry is required to show the change properly. Match the symbology and format of the base documents.
2. Accuracy of records shall be such that a future verification of items shown in the Contract Documents may rely reasonably on information obtained from the approved Project Record Documents.

E. Maintain the job set of Record Documents completely protected from deterioration and from loss and damage until completion of the work and transfer of all recorded data to the final Project Record Documents.

F. Making Entries on Drawings

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe the change by graphic line and note as required.
2. Date all entries.
3. Call attention to the entry by a "cloud" drawn around the area or areas affected.
4. In the event of overlapping changes, use different colors for the overlapping changes.
5. Make entries within 24 hours after receipt of information that the change has occurred.
6. Maintain the base drawing format and use the same symbology.
7. Convert field mark-ups to finished CADD record drawings when required in this section.

G. Conversion of Schematic Layouts

1. In some cases on the drawings, arrangements of ductwork and piping and similar items are shown schematically and are not intended to portray precise physical layout. Determine final physical arrangement subject to the Architect's approval. However, design of future modifications of the facility may require accurate information as to the final physical layout of items which are shown only schematically on the drawings.
2. Show on the job set of record drawings, by dimension accurate to within one inch, the centerline of each run of items such as all sleeves and piping, etc., below grade, in walls, or in the concrete slab. A surface mounted device indicates the exact location:
   a. Clearly identify the item by accurate note such as "Sanitary Sewer" and the like.
   b. Show, by symbol or note, the vertical location of the item "under slab," "in ceiling plenum," "exposed," and the like.
   c. Make all identification sufficiently descriptive that it may be related reliably to the specifications.

H. Final Project Record Documents

1. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.
2. Provide CAD electronic files in .dwg format using AutoCAD software. Upon written request, completion of a release form, and payment of the Engineer’s standard fee of $200 plus applicable sales tax for a set-up charge and $50 per drawing plus applicable sales tax for

copies of such files, Engineer will provide AutoCAD electronic files of base Contract Drawings in dwg format on compact discs. Engineer will also provide a list of drawing layers and names that shall be maintained.

3. Provide completed record drawings on CD-R and one full size hard copy of each drawing.
4. Refer to Division 1 for additional requirements.

1.13 OPERATION AND MAINTENANCE DATA

A. Submit two copies of a preliminary draft of the proposed manual or manuals to the Architect for review and comments. Allow a minimum of ten (10) working days for review.

B. Submit specified number copies of the approved manual to the Architect prior to indoctrination of operation and maintenance personnel.

C. Prepare in accordance with the following standards:

Format:

Size: 8½" x 11"

Paper: White bond, at least 20 lb. weight

Text: Neatly written or printed

Drawings: 11" in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within the Manual and provide a drawing pocket inside rear cover or bind in with text.

Flysheets: Separate each section of the Manual with neatly prepared flysheets briefly describing contents of the ensuing section; flysheets may be in color.

Binding: Use heavy-duty plastic or fiber-board covers with binding mechanism concealed inside the manual; 3-ring binders will be acceptable; all binding is subject to the Architect's approval.

Measurements: Provide all measurements in U.S. standard units such as feet-and-inches, lbs, and cfm. Where items may be expected to be measured within ten years in accordance with metric formulae, provide additional measurements in the "International System of Units" (SI).

D. Provide front and back covers for each manual, using durable material approved by the Architect, and clearly identified on or through the cover with at least the following information:

OPERATING AND MAINTENANCE MANUAL (Required Layout Below)

- Title Page
    - Job Name
    - Site Address
    - Include Contact information of prime contractor.
- Table of contents
- Warranty Information.
    - Include all contractor warranties
        - Signed and dated documents
- Permits-Inspections
- Subcontractor list
    - Include all subcontractors.
        - Company name, Contact info.
        - Trade Responsibility.
- Vendor list
    - Include name and addresses of vendors
        - Warranty information
        - Replaceable parts
- Approved submittals
    - Include all approved product submittals
- Reports/Certificates/Redlines
    - Engineers Observation Reports
    - Engineer/Manufacturer Start-up Report (VRF only)
    - Contractor Start-up Report
    - Manufacturer Start-up Report
    - Test & Balance Report
    - As-builts for Duct, & refrigeration piping
    - Updated VRF Selection Report (Refrigeration line measurements and refrigeration calculations)
    - Owners Training Report (All Trades)
- O&M Manuals
- Equipment Information.
    - Include Model, Serial and location.
- Signed Approval
    - Page for approval signature of the engineer and approval date.

E. Contents: Include at least the following:
   1. Neatly typewritten index near the front of the manual, giving immediate information as to location within the manual of all emergency information regarding the installation.
   2. Complete instructions regarding operation and maintenance of all equipment provided including lubrication, disassembly, and reassembly.
   3. Complete nomenclature of all parts of all equipment.
   4. Complete nomenclature and part number of all replaceable parts, name and address of nearest vendor, and all other data pertinent to procurement procedures.
   5. Copy of all guarantees and warranties issued.
   6. Manufacturer's bulletins, drawings, and descriptive data, clearly indicating the precise items included in this installation and deleting, or otherwise clearly indicating, all manufacturers' data with which this installation is not concerned.
   7. Such other data as required in other sections of these specifications.

1.14 WARRANTY

A. Contractor shall warranty all equipment and workmanship for a period of one year after date of substantial completion and replace or repair any faulty equipment or installation at no cost to the Owner for such service during this period, all in accordance with requirements of Division 1.

B. This warranty shall not void specific warranties issued by manufacturers for greater periods of time. Nor shall it void any rights guaranteed to the Owner by law.

C. Warranties shall be in writing in a form satisfactory to the Owner, and shall be delivered to the Owner before final payment is made.

D. Upon completion of the work of Division 23, thoroughly clean all exposed portions of the mechanical installation, removing all traces of soil, labels, grease, oil and other foreign material and using only the type cleaner recommended by the manufacturer of the item being cleaned.

PART 2 - PRODUCTS

2.1 ACCESS DOORS

A. Access doors mounted in painted surfaces shall be of Milcor (Inland-Ryerson Construction Products Company) manufacturer, Style K for plastered surfaces and Style M or DW for non-plastered surfaces. The Style K doors shall be set so that the finished surface of the door is even with the finished surfaces of the adjacent finishes. Access doors mounted on tile surfaces shall be stainless steel materials. Access doors shall be a minimum of 18" x 18" in size.

PART 3 - EXECUTION

3.1 ACCCESS DOORS

A. In fire-rated walls, access door shall be fire rated same as wall.

B. In detention areas provide minimum 16 gauge access door with keyed lock approved by Owner.

3.2 TESTING AND INSPECTION

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. Make written notice to the Architect adequately in advance of each of the following stages of construction:
   1. When all rough-in is complete, but not covered.
   2. As specified in all Division 23 sections.
   3. At the completion of the work of Division 23.

C. When material or workmanship is found to not comply with the specified requirements, remove the noncomplying items from the job site and replace them with items complying with the specified requirements at no additional cost to the Owner. This shall be performed within 3 days after receipt of written notice of noncompliance.

3.3 INSTALLATION METHODS

A. Unless noted otherwise, piping and ductwork may be run exposed in mechanical rooms and janitor's closets. Piping and ductwork exposed in mechanical rooms and janitor's closets shall be run tight against the structure, as required by the Architect, allowing for expansion.

B. Conceal piping and ductwork to be installed as hereinbefore specified.

C. Piping suspended from the structure shall be adequately and properly supported on hanger rods or clamps as specified in Section 23 0529 “Hangers and Supports for HVAC Piping and Equipment”. Perforated strap hangers will not be permitted. **The contractor must support all duct, pipe, equipment, and all other items furnished and installed under this scope from steel joists or structural steel frames. It is prohibited to support duct, pipe, equipment, and all other items furnished under this scope from the metal deck.**

D. Where space is limited above ceilings, below concrete beams or other concrete projections, piping shall be sleeved through the beam or projection, rather than hung below. Provide sleeves where required and locate where approved by the Architect.

E. Cut pipe accurately to measurements established at the building and install into position without springing or forcing. All open ends of pipes shall be capped or otherwise closed until the systems are closed with final connections.

F. No pipe joints nearer than 12" to a wall, ceiling or floor penetration will be permitted, unless joint is of the welded type.

G. Piping systems shall be made up straight and true and run at proper grades to permit proper flow of the contained material. Piping shall be graded for proper drainage.

H. Piping shall follow as closely as possible the routes shown on plans, which take into consideration conditions to be met at the site and in the building. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after approval from the Architect.

I. All piping shall be installed with due regard to expansion and contraction and so as to prevent excessive strain and stress in the piping and in connections to equipment.

J. All piping shall be clean when it is installed; rust and/or dirt shall be removed.

K. Screw joints shall be made with taper threads, properly cut. Threads shall be cut using graphite and oil applied to the pipe only. When threads are cut on pipes, the ends shall be carefully reamed to remove any burrs. Pipe shall be up-ended and hammered to remove all shavings and foreign material, before installing.

L. Requirements for assembling joints in cast iron and copper lines are set forth elsewhere in these specifications. For any special materials, consult the manufacturers for the recommended procedures in assembling the joints.

M. This Contractor shall provide wall or ceiling access doors for unrestricted access to all concealed items of the fire suppression system.

N. Install roof pipe penetrations through sleeves, and flash with membrane flashing and roofing mastic compatible with roofing system. Roofing Supplier/Contractor shall approve roof penetration and flashing.

O. For additional installation requirements, refer to individual sections in Division 23.

3.4 CUTTING AND PATCHING

A. Perform cutting and patching associated with the work in strict accordance with the provisions of Division 1 of these Specifications and the following:

1. Coordinate work to minimize cutting and patching work. Cut and patch walls, floors, etc., resulting from work in existing construction or by failure to provide proper openings or recesses in new construction. If cutting and patching is required, it shall be performed by trades specializing in that type work.

2. Perform Architect-approved cutting and demolition by methods which will prevent damage to other portions of the work and provide proper surfaces to receive installation of new work and/or repair.

a. Openings cut through concrete and masonry shall be made with masonry saws and/or core drills and at such locations acceptable to the Architect. Impact-type equipment will not be used except where specifically acceptable to the Architect.

b. Openings in precast concrete slabs or walls for pipes, etc., shall be core drilled to exact size. Oversize the hole to allow for link seals, and to deter pipe corrosion condensation from forming.

c. Where openings are cut through masonry walls, provide and install lintels or other structural supports to protect the remaining masonry. Adequate supports shall be provided during the cutting operation to prevent any damage to the masonry occasioned by the operation. All structural members, supports, etc., shall be of the proper size and shape, and shall be installed in a manner acceptable to the Architect.

d. Openings cut through plaster or drywall shall be cut prior to plaster finish coat or texture coat on drywall. Cutting of the finish coat of plaster or texture coat of drywall will not be permitted unless written approval of the Architect is obtained.

e. Openings shall be restored and/or repaired as required to replace the cut surface to an "as-new" and/or "as original" condition. Refer to the appropriate section of the specifications for the material involved.

3. Perform fitting and adjusting of products to provide finished installation complying with the specified tolerances and finishes.

4. Provide all core drilling of holes. Where sleeves and/or blockouts are required, they shall be cut or provided at locations required. On completion of this work or as work progresses, make all repairs and do all patching required as a result of work under this Contract. All patching shall be performed in a manner that will restore the surrounding work to its original condition to the satisfaction of the Architect.

5. Assume responsibility for the proper size of all sleeves and/or blockouts in the building structure pertaining to the work and for providing the correct location of pipe sleeves and/or blockouts.

6. No cutting, boring or excavating which will weaken the structure will be permitted.

3.5 EXISTING UTILITIES AND TEMPORARY SERVICES FOR CONSTRUCTION

A. Verify the location and capacity of existing utility services pertaining to work of Division 26. Relocate existing utilities unearthed by excavation as directed by the utility service companies affected.

1. Temporary Services for Construction

2. Provide temporary services in strict accordance with the provisions of these specifications.

B. When any piece of fire suppression equipment is operable and it is to the advantage of the Contractor to operate the equipment, he may do so, providing that he properly supervises the operation, and has the Architect’s written permission to do so. The warranty period shall, however, not commence until such time as the equipment is operated for the beneficial use of the Owner, or date of substantial completion, whichever occurs first.

C. Regardless of whether or not the equipment has or has not been operated, the Contractor shall properly clean the equipment, install clean filter media, properly adjust, and complete all deficiency list items before final acceptance by the Owner. The date of acceptance and performance certification will be the same date.

3.6 DEMOLITION AND RELOCATION

A. The Contractor shall modify, remove, and/or relocate all materials and items so indicated on the Drawings or required by the installation of new facilities. All removals and/or dismantling shall be conducted in a manner as to produce maximum salvage. Salvage materials shall remain the property of the Owner, and shall be delivered to such destination or otherwise disposed of as directed by the Owner. Materials and/or items scheduled for relocation and which are damaged during dismantling or reassembly operations shall be repaired and restored to good operative condition. The Contractor may, at his discretion, and upon the approval of the Owner, substitute new materials and/or items of like design and quality in lieu of materials and/or items to be relocated.

B. All items which are to be relocated shall be carefully removed in reverse to original assembly or placement and protected until relocated. The Contractor shall clean and repair and provide all new

materials, fittings, and appurtenances required to complete the relocations and to restore to good operative order. All relocations shall be performed by workmen skilled in the work and in accordance with standard practice of the trades involved.

C. When items scheduled for relocation and/or reuse are found to be in damaged condition before work has been started on dismantling, the Contractor shall call the attention of the Owner to such items and receive further instructions before removal. Items damaged in repositioning operations are the Contractor's responsibility and shall be repaired or replaced by the Contractor as approved by the Owner, at no additional cost to the Owner.

D. Service lines and wiring to items to be removed, salvaged, or relocated shall be removed to points indicated on the Drawings, specified, or acceptable to the Owner. Service lines and wiring not scheduled for reuse shall be removed to the points at which reuse is to be continued or service is to remain. Such services shall be sealed, capped, or otherwise tied-off or disconnected in a safe manner acceptable to the Owner. All disconnections or connections into the existing facilities shall be done in such a manner as to result in minimum interruption of services to adjacent occupied areas. Services to existing areas or facilities which must remain in operation during the construction period shall not be interrupted without prior specific approval of the Owner as hereinbefore specified.

3.7 EXCAVATION AND BACKFILLING

A. Perform all excavation and backfilling necessary for the installation of the work. This shall include shoring and pumping in ditches to keep them in dry condition until the work has been installed. All shoring required to protect the excavation and safeguard employees shall be properly performed.

B. Perform excavation and backfilling in strict accordance with the provisions of these specifications including trench safety requirements.

C. All excavations shall be made to the proper depth, with allowances made for floor slabs, forms, beams, etc. Ground under piping shall be well compacted before piping is installed.

D. Backfilling shall be made with selected soil, free from rocks and debris and shall be pneumatically tamped with 6 inch layers to secure a field density ratio of 95 percent as defined by ASTM Designation D698-57T (Proctor Soil Compaction Test).

E. Excavated materials not suitable and not used in the backfill shall be removed from the site.

F. Field check and verify the locations of all underground utilities. Avoid disturbing these as far as possible. In the event existing utilities are damaged, they shall be repaired at no cost to Owner.

G. In a lime stabilized area, the lime stabilization shall be fully restored after the excavation is complete.

H. Replace concrete, curbs, paving and other surface improvements cut during excavation to their original condition.

3.8 JOBSITE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Include required work to correct conditions detrimental to the timely and proper completion of all Division 23 Work. Do not proceed until unsatisfactory conditions are corrected.

B. The Contractor shall at all times take such precautions as may be necessary to properly protect all materials and equipment from damage from the time of delivery until the completion of the work. This shall include the erection of all required temporary shelters and supports to adequately protect any items stored in the open on the site from the weather, the ground and surrounding work; the cribbing of any items above the floor of the construction; and the covering of items in the incomplete building with tarpaulins or other protective covering; the installation of electric heaters in electrical switchgear and similar equipment to prevent moisture damage. Failure on the part of the Contractor to comply with the above will be sufficient cause for the rejection of the items in question.

C. Take particular care not to damage the building structure in performing work. All finished floors, step treads, and finished surfaces shall be covered to prevent any damage by workmen or their tools and equipment during the construction of the building.

D. Equipment and materials shall be protected from rust both before and after installation. Any equipment or materials found in a rusty condition at the time of final inspection must be cleaned of rust and repainted as specified elsewhere in these Specifications.

3.9 STORAGE AND PROTECTION

A. Contractor shall provide the required protection of equipment and materials from the time of delivery until the completion of the Work. Protect from damage, rust, rain, humidity and dust.

B. Do not receive equipment or materials on the jobsite until adequate space has been provided for storage.
C. Provide adequate supports for protection from the ground and erect required shelters for items stored in the open.
D. Items stored within the building are to be adequately protected and covered with tarpaulins or other protective covering.
E. Protect the building at all times during construction from damage by workmen, their tools and/or equipment. Protect floors, steps, wall, ceilings, doors, windows and other finish surfaces.
F. Equipment and materials found in a rusty condition at completion of the work will be thoroughly cleaned of rust and refinished as required to its original condition.

3.10 PREPARATION AND COORDINATION

A. Perform coordination work in strict accordance with provisions of these specifications and the following:

1. Coordinate as necessary with other trades to assure proper and adequate interface with all work.
2. Where pipes or other fire suppression items are shown in conflict with locations of structural members and other equipment, include labor and materials required for extensions, offsets and supports to clear the encroachment.
3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete installation of the fire suppression system.
4. Coordinate accepted equipment changes from those scheduled or specified with other trades affected. Additional compensation to other trades for equipment changes is the responsibility of the Contractor making the change.

B. The Mechanical, Electrical, and associated Drawings are necessarily diagrammatic by their nature, and are not intended to show every connection in detail or every pipe or conduit in its exact location. These details are subject to the requirements of standards referenced elsewhere in these specifications, and structural and architectural conditions. The Contractor shall carefully investigate structural and finish conditions and shall coordinate the separate trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and suspended ceilings, etc., in finished portions of the building, unless specifically noted to be exposed. All exposed work shall be installed parallel or perpendicular to the lines of the building unless otherwise noted.

C. When the mechanical and electrical Drawings do not give exact details as to the elevation of pipe, conduit and ducts, the Contractor shall physically arrange the systems to fit in the space available at the elevations intended with proper grades for the functioning of the system involved. Piping, exposed conduit and the duct systems are generally intended to be installed true and square to the building construction, and located as high as possible against the structure in a neat and workmanlike manner. The Drawings do not show all required offsets, control lines, pilot lines and other location details. Work shall be concealed in all finished areas.

D. The general installation precedence of materials shall be as follows. Note that if an interference is encountered, this shall guide the contractor in the determination of which trade shall be given the "Right-of-Way".

Building lines
Structural Members
Soil and Drain Piping
Condensate Drains
Vent Piping
Supply, Return, and Outside Air Ductwork
Exhaust Ductwork
Fire Protection Piping
Gas Piping
Domestic Water (Cold and Hot)
Electrical Conduit

E. Where items such as diffusers, thermostats, switches, and control panels are not specifically located on the Drawings, locate as determined in the field by the Architect. Where such items are installed without such specific direction, relocate as directed by the Architect and at no additional cost to the Owner.

F. Verify all dimensions and distances. No additional compensation will be allowed because of differences between work shown on the Drawings and actual dimensions and distances at the jobsite.

3.11 PAINTING

A. All equipment shall be delivered to the job with suitable factory finish. Should the finish be damaged in transit or during the installation, it shall be finished to match appearance of original finish. All work shall be subject to approval by Architect.

B. All equipment, piping, conduit, insulation, etc., furnished and installed in exposed areas under Divisions 23 of these Specifications and as hereinafter specified shall be cleaned, prepared, and painted according to the following specification. In the event of a conflict between the specifications referenced, the provisions of this specification shall prevail only for Division 23 work.

C. Before painting, materials and equipment surfaces shall be thoroughly cleaned of cement, plaster, and other foreign materials, and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all cracks and corners scraped out. Exposed metal work shall be carefully brushed down with the steel brushes to remove rust and other spots and left smooth and clean.

3.12 TRAINING

A. Contractors are responsible to provide owner with an adequate amount of training to be able to operate any system installed.
    1. This includes training for any HVAC, or Fire.
    2. Provide a sign in sheet that is to be added to the O&M manual
        1. Owners & all building maintenance personal are required to have training.

END OF SECTION

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SECTION 23 05 29 - PIPE HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Work included:

1. Pipe hangers and supports.
2. Concrete supports for equipment.
3. Sleeving for mechanical equipment.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

1.3 SUBMITTALS:

A**. Provide submittals as required in Section 230010, "Submittal Process".**

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Supports, hangers, anchors, guides and supplementary steel shall be provided for horizontal and vertical piping and shall meet or exceed the ASA Code for Pressure Piping.

B. Rod sizes noted are minimum sizes. The structural integrity of the supports is the responsibility of the Contractor.

C. Hangers Supporting and Contacting Brass or Copper:

1. 3" and Smaller: Grinnell Fig. CT-109, copper plated, split-ring hanger with adjusters.
2. 4" and Larger: Grinnell Fig. CT-65, copper plated, clevis hanger with 2 nuts each rod.
3. Isolate copper or brass from ferrous metals with an approved dielectric material.

D. Hangers Supporting Insulated Lines:

1. Outside Diameter of Insulation 6" or Smaller and all Ferrous Pipe 3" Diameter and Smaller: Grinnell Fig. 108, malleable iron, split type with adjustable swivel and locknut.
2. Outside Diameter of Insulation 7" and Larger and all Ferrous Pipe Larger than 3" Diameter: Grinnell Fig. 260, malleable iron, clevis hanger with two nuts on each support.

E. Protection Shields for Hangers:

1. Galvanized metal shields shall encircle the lower half of the insulation.
2. Provide shields at hangers on dual and low temperature pipes on trapeze type hangers.
3. Provide rigid insulation at all shields and hangers, extending a minimum of 6" each side of hanger.
4. Shield gauges shall be as follows:

Insulation Diameter	U.S.S. Gauge (Galvanized)
Up to 3"	22
3" thru 6"	16
Above 6"	12

F. Supports for Vertical Riser Piping:

1. Provide Grinnell Fig. 261 double bolt riser clamps at each floor. Bear on structure.

2. At 8 feet o.c., 2-hole rigid clamps. Kindorf channels and C-105 straps. Support from vertical surfaces.
3. Brass or copper pipe shall be isolated from support with sheet polyethylene, minimum 1/8" thick.

G. Supports for Vertical and Horizontal Piping in Chases and Partitions:
1. Provide securely anchored supports for pipes serving plumbing fixtures and equipment near the area the pipe penetrates the wall.
2. Supports shall be steel plate, angles or unistruts mounted vertically or horizontally with unistrut clamps P2426, P2008 or P1109.
3. Attach supports to wall or floor construction with clip angles, brackets or other approved anchoring devices.
4. Brass and copper pipe shall be isolated from support with sheet polyethylene, minimum 1/8" thick.

2.2 INSERTS

A. Provide inserts at each hanger as required for concrete support. Avoid interference with concrete reinforcing.
B. Inserts to be malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, and lugs for attaching to forms.
C. Provide reinforcing as required to support load.
D. Size inserts to suit threaded hanger rods.

2.3 HANGER RODS

A. Provide steel hanger rods, threaded both ends, threaded one end or continuous threaded.
B. Size hanger rods as follows:

Pipe Size	Rod Diameter
4" & Smaller	3/8"
5" thru 8"	1/2"
10" & 12"	5/8"
14" & 16"	3/4"

2.4 SLEEVES

A. Provide sleeves where pipes penetrate floors, walls, foundations, fireproofing, etc.
B. Size sleeves large enough to allow for movement due to expansion and to provide for continuous movement. Provide a bead of sealant in space between pipe and sleeve. Use link-seal to seal between pipe and sleeve for all slab on grade floor penetrations.
C. Use Schedule 40 galvanized steel pipe sleeves for all floor and foundation penetrations. Sleeves shall extend minimum of 2" above finished floor and flush with vertical wall surface.

2.5 TRAPEZES

A. Trapezes of Kindorf, Elcen or approved equal may be provided where multiple lines run horizontally at the same elevation.

2.6 CONCRETE SUPPORTS FOR EQUIPMENT

A. Provide concrete pad foundations for the support of equipment such as floor-mounted pumps, air handling units, fans, etc.
B. Unless otherwise noted, concrete pads shall be constructed of not less than 3,000 lb. concrete and not less than 4" high and shall extend on all sides a minimum of 8 inches beyond the limits of the mounted equipment. Pads shall be poured in forms built of new-dressed lumber. All corners of the foundations shall be neatly chamfered 3/4" wide by means of sheet metal of triangular wood strips nailed to the form. Reinforce with No. 4 rebar 6" on center.

C. Foundation bolts, 3/4" round-hooked, shall be placed in the forms when the concrete is poured, the bolts being correctly located by means of templates. Each bolt shall be set in a sleeve of size to provide 1/2" clearance around bolt. Allow 1" below the equipment bases for alignment and grouting. After grouting, the forms shall be removed and the surface of the foundations shall be hand rubbed with carborundum.

D. Foundation pads for equipment located on the exterior of the building shall be provided as indicated.

E. Submit shop drawings of concrete pads for review by the Architect.

2.7 STRAP HANGERS

A. Under no circumstances will perforated strap iron or wire be acceptable for hangers on this project.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTS

A. All pipe supports shall be designed and installed to avoid interferences with other piping, hangers, ducts, electrical conduit, supports, building structure, equipment, etc. All piping shall be installed with due regard to expansion and contraction. The type of hanger, method of support, location of support, etc., shall be governed in part by this specification.

B. Pipe hangers shall be attached to the structure as follows:

1. Poured-in-Place Concrete: Each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters' Laboratories, Inc., listed universal concrete insert placed in the formwork before concrete is poured.
2. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods shall be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size. Each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently affixed thereto.
3. Steel Beams: Pipes and loads supported under steel beams shall be installed using approved beam clamps.

3.2 SPACING

A. Install hangers for steel piping with the following maximum spacing and minimum rod sizes according to MSS SP 69 Tables 3 and 4:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
6. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
7. NPS 3: Maximum span, 12 feet; minimum rod size, 1/2 inch.
8. NPS 3-1/2: Maximum span, 13 feet; minimum rod size, 1/2 inch.
9. NPS 4: Maximum span, 14 feet; minimum rod size, 5/8 inch.
10. NPS 5: Maximum span, 16 feet; minimum rod size, 5/8 inch.
11. NPS 6: Maximum span, 17 feet; minimum rod size, 3/4 inch.
12. NPS 8: Maximum span, 19 feet; minimum rod size, 3/4 inch.
13. NPS 10: Maximum span, 22 feet; minimum rod size, 7/8 inch.
14. NPS 12: Maximum span, 23 feet; minimum rod size, 7/8 inch.
15. NPS 14: Maximum span, 25 feet; minimum rod size, 1 inch.
16. NPS 16: Maximum span, 27 feet; minimum rod size, 1 inch.
17. NPS 18: Maximum span, 28 feet; minimum rod size, 1 inch.
18. NPS 20: Maximum span, 30 feet; minimum rod size, 1-1/4 inches.

B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 5 feet; minimum rod size, 3/8 inch.

2. NPS 5/8: Maximum span, 5 feet; minimum rod size, 3/8 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
6. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

C. Spacing and rod sizes for other piping materials shall be as recommended by the manufacturer.

3.3 TRAPEZES

A. Trapeze members, including suspension rods, shall be properly sized for the number, size and loaded weight of the lines they are to support. Install as noted above.

3.4 EQUIPMENT FOUNDATIONS

A. Provide equipment foundations associated with the work in accordance with the provisions of these specifications.

B. Provide concrete bases for all pad or floor mounted equipment.

3.5 MISCELLANEOUS

A. Install any other special foundations, hangers and supports indicated on the drawings, specified elsewhere, or required by installation conditions.

END OF SECTION

SECTION 23 05 48- VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of vibration isolation work is indicated by drawings and schedules, and by the requirements of this section.

B. The types of vibration isolation work specified in this section include the following:

1. Support isolation for motor-driven mechanical equipment.
2. Isolation including support isolation for piping risers.
3. Support isolation of piping.
4. Flexible connections for piping at equipment.

C. Refer to other sections of these specifications for equipment foundations, hangers, sealants, gaskets, flexible connections for piping, and other work related to vibration isolation work.

1.2 QUALITY ASSURANCE

A. Product Qualification: Provide each type of vibration isolation unit produced by a specialized manufacturer, with not less than 5 years' successful experience in the production of units similar to those for the project.

1. Except as otherwise indicated obtain support isolation units from a single manufacturer.
2. Engage the manufacturer to provide technical supervision of the installation of support isolation units produced by him, and of associated inertia bases (if any).

B. Manufacturer: Acceptable vibration isolation support unit manufacturers are as follows:

1. Mason Industries, Inc.
2. Vibration Mountings and Controls, Inc.
3. Amber Booth
4. Peabody Kinetics

C. Manufacturer Certification: Where vibration isolation support units are indicated for a minimum static deflection, provide manufacturer's certification that units have been tested and comply with the indicated requirements.

D. All items of equipment, whether suspended, floor mounted or otherwise supported, which are capable of producing vibration, shall be installed with vibration isolation. The isolation shall prevent the transmission of objectionable noise or vibration to the building structure.

E. Submit for approval data showing disturbing frequency, supported weight, static deflection or natural frequency, and calculations supporting same for each isolator.

1.3 SUBMITTALS

A. Manufacturer's Data, Vibration Isolation:

1. **Provide submittals as required in Section 230010, “Submittal Process”.**
2. For information, submit manufacturer's specifications, detailed drawings, performance characteristics data and installation instructions for each type of unit required.
3. Include data for each type and size of unit, showing isolation efficiency, stiffness, natural frequency and transmissibility at lowest operating speed of equipment.
4. Where required, include independent test agencies certified report of test results for each type of unit.
5. For spring units, show wire size, spring diameter, free height, solid-compression height, operating height, fatigue characteristics and ratio of horizontal to vertical stiffness.
6. For spring-and-pad-type units show basis of spring-rate selection for range of loading weights.
7. Include performance certifications where required.

PART 2 - PRODUCTS

2.1 ISOLATION MATERIALS AND SUPPORT UNITS

A. Double deflection neoprene mountings shall have a minimum static deflection of 0.35". All metal surfaces shall be neoprene covered to avoid corrosion and have friction pads both top and bottom so they need not be bolted to the floor. Bolt holes shall be provided where bolting is required. On equipment such as small vent sets and close coupled pumps, steel rails shall be used above the mountings to compensate for the overhang.

B. Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short-circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

C. Vibration hangers shall be as described above, but they shall be precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be indicated by a scale.

D. Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short-circuiting. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hole sizes shall be large enough to permit the hanger rod to spring through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have as minimum additional travel to solid equal to 50% of the rated deflection. Hangers shall be provided with an eyebolt on the spring end and provision to attach the housing to the flat iron duct straps.

E. Vibration isolator shall be steel members welded to height saving brackets to cradle machines having legs or bases that do not require a complete supplementary base. Members shall be sufficiently rigid to prevent strains in the equipment.

F. Flexible neoprene connectors shall be used on all equipment as indicated on the drawings. They shall be manufactured of multiple plies of nylon tire cord fabric and neoprene. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Neoprene elbows shall have a single sphere forming the corner of the joint itself. Connectors up to and including 2" diameter may have threaded ends. Connectors 2-1/2" and larger shall have floating steel flanges. All connectors shall be rated a minimum of 150 psi at 200 degrees F. All sizes operating at pressures above 100 psi shall employ control cables with end fittings isolated from the anchoring plates by means of 1/2" thick bridge bearing neoprene washer bushings designed for a maximum of 1000 psi.

G. Flexible stainless steel hose shall have stainless steel braid and carbon steel fittings. Sizes 3" and larger shall be flanged. Smaller sizes shall have male nipples. Lengths shall be as tabulated:

Flanges		Male Nipples	
3 x 14	10 x 26	1/2 x 9	1-1/2 x 13
4 x 15	12 x 28	3/4 x 10	2 x 14
5 x 19	14 x 30	1 x 11	2-1/2 x 18
6 x 20	16 x 32	1-1/4 x 12	
8 x 22			

H. Hoses shall be installed on the equipment side of the shut-off valves horizontally and parallel to the equipment shafts wherever possible. Hoses shall be type BSS.

I. Where piping passes through equipment walls, floors or ceilings, the vibration isolator shall be a split seal consisting of two bolted pipe halves with 3/4" or thicker neoprene sponge bonded to the inner faces. The seal shall be tightened around the pipe to eliminate clearance between the inner sponge face and the piping. Concrete may be packed around the seal to make it integral with the floor, wall or ceiling if the seal is not already in place around the pipe prior to the construction of the building member. Seals shall project a minimum of 1" past either face of the wall. Where temperatures exceed 240 degrees F., 10# density fiberglass may be used in lieu of the sponge.

J. Isolator pads shall be neoprene waffle rated for 60#/sq. in.

K. Pipe Riser Isolators: Provide manufacturer's standard pad-type isolator bonded to steel plate, formed for welding to pipe sleeve extension.

PART 3 - EXECUTION

3.1 PERFORMANCE OF ISOLATORS

A. General: Comply with the minimum static deflections recommended by ASHRAE, including the definitions of critical and non-critical locations, for the selection and application of vibration isolation materials and units as indicated.

B. Manufacturer's Recommendations: Except as otherwise indicated, comply with manufacturer's recommendations for selection and application of vibration isolation materials and units.

3.2 APPLICATIONS

A. General: Apply the types of vibration isolation materials and units indicated at the locations shown or scheduled. Selection is Contractor's option where more than one type is indicated.

B. Provide Neoprene Pads at the following locations/items of equipment:
   1. Where shown on drawings.

C. Provide Vibration Isolation Springs for the following items of equipment:
   1. Where shown on drawings.

D. Provide Spring Isolator, housed at the following items of equipment:
   1. Where shown on drawings.

E. Provide Isolation Hangers for the following:
   1. Piping connected to machinery.

3.3 INSTALLATION

A. General:
   1. Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units.
   2. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points.
   3. Remove spacer blocks and similar devices (if any) intended for temporary protection during shipping or against overloading during installation.
   4. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.
   5. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
   6. Install inertia base frames on isolator units as indicated, so that a minimum of 2" clearance below base will result when frame is filled with concrete and supported equipment has been installed and loaded for operation.
   7. Locate isolation hangers as near the overhead support structure as possible.
   8. Weld riser isolator units in place as required preventing displacement from loading and operations.

3.4 EXAMINATION OF RELATED WORK

A. Installer of vibration isolation work shall observe the installation of other work related to vibration isolation work, including work connected to vibration isolation work; and, after completion of other related work (but before equipment startup), shall furnish a written report to the Contractor listing observed inadequacies for proper operation and performance of vibration isolation work. Report shall cover, but not necessarily be limited to the following:
   1. Equipment installations (performed as work of other sections) on vibration isolators.
   2. Piping connections including flexible connections.
   3. Passage of piping which is to be isolated through walls and floors.

B. Do not start-up equipment until inadequacies have been corrected in a manner acceptable to the vibration isolation Installer.

3.5 DEFLECTION MEASUREMENTS

A. Upon completion of vibration isolation work, take measurements and prepare a report showing measured equipment deflections for each item of equipment.

END OF SECTION

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Work included:

1. Valve tagging
2. Pipe marking
3. Equipment marking

C. Submittals: **Provide submittals as required in Section 230010. "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified. Marking system shall conform to ASME 13.1, latest edition and OSHA 29 CFR 1910.261 requirements.

PART 2 - PRODUCTS

2.1 VALVE TAGS

A. Provide a tag for each valve in main and branch piping of natural gas and refrigerant piping systems.

1. Tags shall be 1-1/2" diameter of solid brass with blacked filled stamped characters of 1/4" height above and 1/2" height below.
2. Provide 8" long meter seals for use with valve tags.

B. Provide a valve chart with a schedule and location plans for all identified equipment, both in a frame with an acrylic cover to be located as directed by the Architect.

2.2 PIPE MARKERS

A. Provide pipe markers for pipes that provide 360 degree visibility with ANSI approved color coded background, color of legend in relation to background color, legend letter size, and length of color field. Additionally, direction of flow arrows shall be printed on the same markers, and words shall be repeated and reversed for use with flow in either direction.

1. Each marker shall be formed with a clear acrylic covering suitable for use outdoors.
2. For diameters 3/4" to 6", marker shall be formed in order to snap on and completely surround the pipe. For diameters 6" and larger, provide radius formed markers of same material.

2.3 EQUIPMENT PLATES

A. Plate shall be black with white letters that appear when the plate is engraved.

B. Plate material shall be specifically suited for conditions surrounding the equipment. Outdoor equipment shall require special plate material for outdoor use.

C. Plate size shall be as required with lettering size appropriate for the information shown but in no case less than 1/8" high. Lettering style shall match existing facility standards.

D. Nomenclature for plates shall be based on the equipment designations shown on the equipment schedules and as approved by the Architect.

2.4 CONCEALED DEVICES

A. Operable devices and equipment located above ceilings shall be marked with color coded W. H. Brady "Tack" type markers.

2.5 MANUFACTURERS

A. Provide marking system as manufactured by W. H. Brady Company, Seton, Craftmark, or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Place all markers and plates in such locations that they are easily read by a person without assuming awkward or hazardous positions.

3.2 VALVE TAGS

A. Secure one valve tag to each valve.

3.3 PIPE MARKERS

A. For diameters 3/4" to 6", markers shall snap around the pipe, completely surrounding the pipe. Markers shall not require taping or the use of any adhesive material or fasteners to permanently secure them to the pipe. For diameters 6" and larger, secure with stainless steel spring fasteners.

B. Install sufficient quantities of markers that tracing of pipe systems can be readily accomplished. Install within three feet before and/or after penetrations through walls, floors, ceilings, underground or other non-accessible enclosures; at access doors, manholes or other access points which permit view of concealed piping; and when there is a change in direction of the concealed pipe. Locations in major mechanical rooms shall be labeled at a maximum spacing of every 20 feet. Other piping shall have labels at a maximum spacing of every 30 feet and at least once in every area that the pipe passes over or through. Install additional markers where directed by the Architect.

3.4 EQUIPMENT PLATES

A. Provide engraved plates for all HVAC equipment and all remote mounted starter/disconnects.

B. Secure all plates with two self-tapping metal screws with round heads. Alternately, plates may be fastened with "pop" rivets provided no cracking or injury occurs to the plate. Plates attached with adhesives shall not be permitted.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SUMMARY

A. Testing and Balancing Agency Qualifications

1. The testing, adjusting, and balancing of the heating, ventilating and air conditioning systems shall be performed by a technical firm or balancing agency certified in Air and Hydronic TAB and system commissioning by the Associated Air Balance Council (AABC). The TAB agency shall also employ a permanent full time Registered Professional Engineer on staff with a minimum of five years specialized experience in testing and balancing. The testing and balancing agency shall possess calibrated instruments, qualified engineers, and skilled technicians to perform required tests in accordance with the AABC National Standards.
2. The testing and balancing agency shall be an independent firm separate and distinct from; not to be associated with, or be subsidiary of a firm performing work under other Sections of Division 22 & 23 and shall be under contract directly to the Owner.

B. Testing and Balancing Agency Responsibilities

1. Submittals
   a. Engineer and Technicians Data: Submit proof that the agency, the Test and Balance Engineer assigned to supervise the procedures, and the technicians proposed to perform the procedures meet the qualifications specified.
   b. Sample Form: Submit sample forms, proposed for use on this project, for approval.
   c. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Certified Agency.
   d. **Certification from VRF manufacturer for test and balance of VRF products. Without this certification, the T&B company will not be considered an approved T&B company for VRF products**
2. Review the construction documents, submittal, and shop drawings for balance ability. Submit a list of suggestions or recommendations to the Architect/Engineer for consideration.
3. Perform a job site observation prior to the ceiling installation to verify that ductwork, piping, dampers, valves, and air terminal devices have been installed per the contract documents. Submit in writing to the Architect/Engineer a list of any discrepancies noted.
4. Test, adjust and balance the heating, ventilating, and air conditioning systems in accordance with AABC National Standards for field measurement.
5. Verify the operation, calibration, and set points of all heating, ventilating, and air conditioning systems controls.
6. Functional performance tests of the control and smoke purge system and its components.
7. Submit in writing to the Architect/Engineer a list of deficiencies for correction by the installing contractor. In the event a deficiency remains after being reported as corrected, the balancing agency may submit an itemized request for its lost time for payment by the installing contractor. All deficiencies that prevent proper T&B work from being completed shall be corrected prior to submittal of the Final T&B Report.
8. Measure and record space temperature readings after occupancy for a period of two consecutive eight hour periods. Make adjustments if necessary to achieve an even temperature distribution.
9. Submit certified, bound, typewritten report for approval by the Owner and Architect/Engineer including all test report data, instrument calibration, and schematic drawings of the HVAC layout.
10. Make a total of three inspections within 90 days after occupancy of the building to insure that satisfactory conditions are being maintained. Submit a report of the findings to the Owner and Architect/Engineer.

11. Make an inspection in the building during the opposite season from which the initial adjustments were made. At that time, make any necessary modifications to the initial adjustments required to produce optimum operation of the system for all seasons. Submit a report of the findings to the Owner and Engineer.

C. Contractor Responsibilities

1. The Contractor shall provide the T&B firm with copies of all Drawings, Specifications, Shop Drawings, Submittal Data, Up-to-Date Revisions, Change Orders, and other data required for planning, preparation and execution of the T&B work.
2. Coordinate the HVAC installation and start up schedule with the T&B Agency and General Contractor to allow sufficient time prior to the completion date for testing and balancing to be conducted and deficiency items corrected and retested. Provide sufficient personnel and utilities to operate the HVAC systems during normal and overtime hours to meet the completion date and testing and balancing schedule.
3. The Mechanical Contractor shall install all systems complete and provide balancing valves, test plugs, thermometer wells, flow measurement orifices, volume dampers, splitter dampers, etc. necessary for T&B work. All equipment shall be operated at the Contractor's expense for a minimum of three consecutive days prior to balancing in order to make certain the equipment is free from mechanical defects, runs smoothly and quietly, and performs satisfactorily to meet the requirements set forth in the contract documents.
4. Provide written notification to the T&B agency and General Contractor the systems are ready for balancing. Should the systems not be ready for balancing, it shall be the Contractor's responsibility to compensate the T&B Agency for time lost.
5. Correct any deficiency items noted during testing and balancing including controls calibration, installation of balancing devices, sheave replacements, and motor replacements at no additional cost to the Owner. Provide written notification to the Testing and Balancing Agency and General Contractor when systems are ready for retesting. Should the systems not be ready for retesting it shall be the Contractors responsibility to compensate the T&B Agency for time lost.
6. It shall be the responsibility of the Contractor to install all valves, dampers, and other adjustment devices in a manner that will leave them accessible and readily adjustable.
7. The Control, or Mechanical Contractor shall provide and install the control system, complete with all temperature, pressure and humidity sensors installed and calibrated for accurate control.
8. Perform all tests of plumbing and piping systems and equipment as specified herein and as required to obtain approvals from all authorities having jurisdiction.
9. Provide all instruments, materials and labor to perform the testing and to obtain and record all measurements.
10. The Contractor is to perform duct leakage testing in accordance with the latest edition of the SMACNA - HVAC Air Duct Leakage Test Manual and maintain a log book on site indicating the area tested, date tested, leakage amount, and personnel performing the test. At the end of the project submit a final type written report with the results. The test and balance agency is to be notified one week prior to duct leakage testing and at their option witness the testing to confirm the testing is being performed in accordance with these specifications.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The balancing agency shall have a complete set of instruments as required by AABC or NEBB standards.

B. Calibration histories for each instrument used for measurement shall be available for examination. Calibration, accuracy, and maintenance of all instruments shall be in accordance with AABC standards.

PART 3 – EXECUTION

3.1 CLEANING AND ADJUSTING

A. Equipment, piping, valves, fittings and fixtures shall be cleaned of grease, metal cuttings and foreign matter that may have accumulated from operation of the system during the test. Any stoppage, discoloration or other damage to the finish, furnishings or parts of the building, due to the Contractor's failure to properly protect such items shall be repaired by the Contractor without additional cost to the Owner.

B. When the work is complete, the water systems shall be adjusted for all required flows. Flush valves and automatic control devices shall be adjusted for proper operation. Hot water heaters shall be tested for proper operation of all safety and operating controls as recommended by the manufacturer. Demonstrate that supply and recirculation systems are balanced for specified flows and temperatures and as shown on the drawings.

C. Sterilization: After pressure tests have been made, the entire domestic water distribution system shall be thoroughly flushed with water until all entrained dirt and mud have been removed, and shall be sterilized by chlorinating material. The chlorinating material shall be either liquid chlorine conforming to Federal Specification BB-C-120 or hypochlorite conforming to Federal Specification 0-C-114, Type II, Grade B, or Federal Specification 0-S-602, Grade A or B. The chlorinating material shall provide a dosage of not less than 50 parts per million and shall be introduced into the system in an approved manner. The treatment water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 10 ppm of residual chlorine at the extreme end of the system at the end of the retention period.

D. All valves and faucets in the system being sterilized shall be opened and closed several times during the contact period. The system shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. Samples of water shall be taken from several points in the system in properly sterilized containers for bacterial examination. The sterilizing shall be repeated until tests indicate the absence of pollution for at least two full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.2 EQUIPMENT AND SYSTEM TESTS

A. General: The Test and Balance firm shall test all HVAC equipment and systems and make final adjustments and corrections necessary to place the systems in proper operating condition.

1. After testing and balancing, patch insulation, ductwork, and housings, using materials identical to those removed. Air test drilled openings shall be sealed with plastic plugs to allow future access. Seal insulation to re-establish integrity of the vapor barrier.
2. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices to show final settings.

B. Air Distribution Devices:

1. Proportion each air handling unit, damper, register, diffuser and grille so that air distribution will be as scheduled, with tests showing air quantities indicated for each inlet and outlet that do not vary by more than plus 10% or minus 5 percent from those indicated on the drawings.

C. Ductwork:

1. The contractor shall perform duct leakage testing on 25% of the supply, return and exhaust ductwork in accordance with SMACNA - HVAC Air Duct Leakage Test Manual. Seal any ductwork not meeting the following acceptable leakage rates and retest until test is successful.

Duct System	Allowable % Leakage
Low Pressure Supply	2% @ construction pressure class
Low Pres. Return/Exhaust	2% @ construction pressure class
Smoke Exhaust	2% @ construction pressure class

D. Gas System:

1. The complete gas piping system shall be tested with air at a pressure of fifteen (15) PSI and proved tight at such pressure for twenty-four (24) hours. Test may be done in segments as dictated by construction requirements.
   Peppermint fumes or soap bubbles shall be used to locate leaks. All tests shall be approved by the local authorities and reviewed by a representative of the Architect before the tests are removed.

E. Fan Balancing:

1. Provide proper fan design and balance fans and drives to limit vibration (displacement in mils) at operating speed to the values in the following table unless specified elsewhere. Measure vibration at each fan bearing, in all three planes.

FAN VIBRATION CRITERIA

Fan RPM (peak-to peak)	Mils (in each plane)
500	4.2
800	3.0
1200	2.0
1700	1.5
2000 and greater	1.3

3.3 SYSTEM OPERATING TESTS

A. After the successful completion of all equipment start-up and test requirements, the following formal testing and balancing shall be performed on the complete mechanical system:

1. Temperature Controls - The balancing agency shall be assisted by the temperature controls contractor in the commissioning of the operation and calibration of all temperature control systems. The following tests are required:
   a. Verify all controlling devices are calibrated and set for design operating conditions.
   b. Verify all components are installed and functional.
   c. Verify the accuracy of each temperature sensor by temperature measurement.
   d. Check the sequence of operation for all control modes to ensure that they are in accordance with the contract documents.
   e. Verify that default setpoints are correct if different from the normal operating set points.
   f. Verify all interlock systems function.
   g. Perform all system verifications to assure the safety of the system and its components.
   h. Verify changeover from heating to cooling occurs as specified.
   i. Calibrate and adjust all thermostats and other controlling devices.
   j. Replace defective controllers at no cost to the Owner.
2. Mechanical Contractor Responsibility
   a. Final Operating Test: An operating test shall be performed by the Contractor to the satisfaction of the Architect and the Owner for a period of not less than 8 hours. Should any element of the system not perform properly, the Contractor shall make all required corrections, and the test shall be repeated until successfully performed

3.4 AIR SYSTEM PROCEDURES

A. The balancing agency shall perform the following testing and balancing functions in accordance with the AABC National Standards for TAB.

1. Diffusers and Grilles - Determine air velocity at outlets with a velometer or anemometer and using air device manufacturer's data, calculate the delivery cfm, or determine cubic feet per minute flow with a test hood.
2. Fans - Test supply, return, exhaust fans and adjust fan blower speeds to achieve specified CFM.
3. Current and Voltage - Measure and record motor full load amperage and voltage. Actual

amperages higher than nameplate full load amps are not acceptable. Verify heater sizes.

4. Pitot-tube Traverse - Perform a Pitot-tube traverse (minimum of 16 points) on main supply and return ducts to obtain design CFM. If a Pitot-tube traverse is not practical, the summation of the outlets or inlets may be used with an explanation why a traverse was not conducted.
5. Outside Air - Test and adjust system outside air by Pitot-tube traverse. If a Pitot-tube traverse is not practical, the percentage of outside air may be determined by calculations from the return air, outside air, and mixed air temperatures when the temperature differential between the return and outside air is greater than 20^{o}F.
6. Static Pressure - Test and record system static pressures, including entering and leaving static pressures of each fan, coil section, and filter section.
7. Air Temperature - Take wet bulb and dry bulb air temperatures on the entering and leaving side of each cooling coil. Dry bulb temperature shall be taken on the entering and leaving side of each heating coil.
8. Main Ducts - Adjust main ducts to within design CFM requirements and traverse for total CFM quantities.
9. Branch Ducts - Adjust branch ducts to within design CFM requirements. Multi-diffuser branch ducts shall have at least one volume damper completely open.
10. Tolerances
    a. Test and balance each diffuser, grille and register to within plus 7% and minus 5% of design requirements.
    b. Test and balance each fan and air-handling unit to within plus 10% and minus 5% of design requirements. Test and balance units having filters with clean filters in place.
11. Minimizing Drafts - Adjust all diffusers, grilles, and registers to minimize drafts in all areas.
12. If inspections or tests reveal defects, such defective work or material shall be replaced or repaired as necessary and inspections and tests shall be repeated. Repairs to piping shall be made with new materials. Patching of screwed joints or holes shall not be acceptable.

3.5 TEST AND BALANCE REPORT

A.. The Final TAB Report shall be typewritten on 8.5 x 11 inch white bond paper, in bound form with an index and tabs to segregate the data into logical sections. The summary shall include information on special testing conditions and results. A listing of the TAB Agency, Contractor, Owner, Architect, and Engineer shall be included.

B. The report shall present data entered on AABC standard forms (modified as necessary to include additional data hereinafter required) or pre-approved acceptable equivalent thereof.

C. The report shall contain copies of pump curves, fan curves, field test reports and as-built plans (size 11 x 17 inches) of the HVAC systems.

D. Include a certification sheet containing the seal and name, corporate address, telephone number, and signature of the Certified Test and Balance Engineer.

E. Include a listing of the instrumentation's used for the procedures along with the proof of calibration.

F. System Identification - Each supply, return, and exhaust opening shall be identified and numbered on reduced plans no larger than 11 x 17 inches to correspond to the numbers used on the report data sheets.

G. Air Outlet Test Report Forms - Each grille, diffuser, and register shall be identified as to location (room number) and area served. Record the size, type, and manufacturer of each diffuser, grille, and register.

H. Air Handling Unit Test Report Forms - Record the manufacturer, model number and motor nameplate data and all design and manufacturer-rated data including supply, return, and outside airflows, fan rpm, sp, and bhp. Report the following.

1. Total actual CFM by traverse. Include duct traverse form. If not practical, the sum of the outlets may be used, or a combination of each of these procedures.
2. Inlet and outlet static pressures at the fan, coil and filter sections.
3. Actual outside air and return air total CFM.
4. Actual operating current, voltage, and brake horsepower of each fan motor.
5. Final RPM of the fan and motor.

6. Fan and motor sheave sizes and center distance. Belt size and quantity.
8. Coil EAT and LAT (db/wb), EWT, LWT, and air pressure drops.
9. Outside air temperature (DB/WB).

I. Fan Test Report Forms - Record the manufacturer, model number, motor nameplate data and all design and manufacturer-rated data. Report the following.
1. Total actual CFM by traverse. Include duct traverse form. If not practical, the sum of the outlets may be used, or a combination of each of these procedures.
2. Suction and discharge static pressure of each fan.
3. Actual operating current, voltage, and brake horsepower of each fan motor.
4. Final RPM of the fan and motor.
5. Fan and motor sheave sizes and center distance. Belt size and quantity.

J. Pumps Test Forms - Submit pump curve showing design, operating, and no-flow points of operation. Also, record the following items on each pump test form:
1. Manufacturer, size, and serial number.
2. All design and manufacturer's rated data.
3. Pump operating suction and discharge pressure and final total dynamic head and apparent GPM.
4. No flow (pump discharge valve closed) suction and discharge pressure and corresponding total dynamic head.
5. Rated and actual operating current, voltage, RPM, and brake horsepower of each pump motor.

3.6 FINAL JOB MEETING

A. At job completion, all Division 21, 22, 23, 26, and 28 representatives shall meet at the job site and shall demonstrate the operation of all equipment and systems. The Architect and Owner shall be advised in writing 10 days prior to the time and date of this inspection.

3.7 SYSTEM PERFORMANCE VERIFICATION:

A. Testing and Balancing Agency
1. At the time of final inspection, the Test and Balance Agency may be required to recheck, in the presence of the Owner's representative, specific and random selections of data, air quantities, and air motion recorded in the Certified Report.
2. Points and areas for recheck shall be selected by the Owner's representative.
3. Measurement and test procedures shall be the same as approved for work forming basis of Certified Report.
4. If tests elicit a measured flow deviation of 10% or more from that recorded in the Certified Report the report will be rejected, all systems shall be retested, new data recorded, new Certified Report submitted, and new inspection tests made, at no additional cost to Owner.

END OF SECTION

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the insulation of the mechanical systems as indicated on the drawings and as specified herein.

B. Factory insulated equipment is excluded from this section of the specifications except that the insulating material characteristics shall equal or exceed those of specified materials for similar service.

C. Work Included:

1. Piping:
   a. Cooling coil condensate drain lines.
   b. All refrigerant lines.
2. Ductwork:
   a. Supply air:
      1) Insulate externally with thermal duct wrap.
   b. Return air:
      1) Insulate externally with thermal duct wrap.
   c. Make-up air duct:
      1) Insulated externally.
   c. All round ductwork exposed to view shall be double wall factory internally insulated with 1" thick glass fiber duct and fittings.

D. **Submittals: Provide submittals as required in Section 230010, "Submittal Process".**

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

D. Acceptable Manufacturers:

1. Fiberglass Insulation:
   a. Owens-Corning Fiberglas
   b. Manville
   c. Certain Teed
2. Urethane Insulation:
   a. Armstrong (Armalok)
   b. Thermacor
3. Mastics:
   a. Benjamin Foster
   b. Insul-Coustic
   c. Chicago Mastic
   d. Childers Products
4. High Temperature Bonding Cements: Ryder Thermocote
5. PVC Fittings: Zeston, Inc.

1.3 GENERAL

A. All materials shall be applied by workmen skilled in this trade. Mechanical fasteners shall be used whenever possible to assure permanent construction. Unsightly work shall be cause for rejection.

B. Materials will be applied only after all surfaces have been tested and cleaned.

C. All material, jacket, coverings, sealers, mastics and adhesives shall not exceed flame spread rating of 25 and smoke developed of 50 in accordance with ASTM Method E84, UL Standard 723 and NFPA Bulletins 255 and 90A.

D. Insulation shall be vermin resistant.
E. Non-compressible insulation material shall be installed at hangers of cold piping to eliminate through metal conductance.
F. Sizing, pipe shield or saddle, and internal duct insulation shall be provided under Division 23.
G. Insulation of cold surfaces shall be vapor sealed.
H. Minimum thickness of insulation shall be as listed or energy code as adopted by authority having jurisdiction. However, sufficient insulation shall be provided to eliminate condensation on the cold surfaces and to maintain a maximum exterior insulation surface of 125ºF. (OSHA Standard) on the hot surfaces.

PART 2 - PRODUCTS

2.1 PIPING SYSTEMS

A. Pipe Insulation:

1. Above ground-Johns Manville AP-T preformed one-piece fiberglass with reinforced craft paper and aluminum foil jacket. Include vapor barrier where required.
   a. Use pre-formed PVC fitting covers with fiberglass inserts. Fiberglass shall be same density as pipe insulation.
   b. Where insulation is exposed to weather, use Manville Flame-Safe ML, or approved equal, Metal-Jacketed Fiberglass pipe insulation. Attachment shall be made by 1/2" 0.020 aluminum bands with approved closure system.
2. **1" Armstrong SOLID CORE** Armaflex or equal **for all refrigerant lines**. Split Armaflex is not approved in refrigeration applications. **Both the liquid and gas refrigerant lines must be insulated**
3. Condensate drain lines shall be insulated from AC unit to indirect waste termination points and first 10'-0" of horizontal drain line at floor drains receiving condensate. Material shall be closed cell type with 3/4" thick molded pipe covering with a density of 7 lbs. thermal conductivity at 0.28 at 75ºF. Do not split the insulation. All joints shall be glued with manufacturer's adhesive.

2.2 DUCTWORK SYSTEMS

A. External insulation for metal ductwork (flexible blanket): Johns Manville Microlite fiberglass duct wrap with FSK reinforced craft paper and aluminum foil facing, conforming to the requirements of NFPA 90A and 90B.
B. High velocity ductwork with external insulation shall be insulated with blanket wrap fiberglass insulation, 1-1/2 inches thick, one (1) pound density or minimum thermal resistance of 6.0, complete with scrim kraft jacket. Facing overlapping joints shall be at least two (2) inches and held in place with outward clinching staples on approximately four (4) inch centers. Underside of ducts exceeding 24 inches in diameter shall be spot cemented and finally secured with sheet metal screws and washers.
C. High velocity flexible ductwork shall be UL 181, Class I, with rating to meet or exceed NFPA 90A-90B and reinforced with a perforated sheet metal inner jacket.
D. High velocity ductwork located in non-conditioned spaces shall be insulated with 2" thick fiberglass board insulation with vapor barrier jacket.
E. Other manufacturers are Certainteed, Knauf, and Owens Corning or approved equal.

2.3 ADHESIVES

A. Water based, polymeric, UL classified lagging adhesive for applying canvas and glass cloth; Foster 30-36 or Childers CP-50.
B. A fast setting, rubber based, UL classified, vapor barrier lap and attachment adhesive; Foster 85-15 or Childers CP-85.
C. Same adhesive, except non-flammable when wet; Foster 85-20 or Childers CP-82.
D. A rubber based, UL classified, fast setting contact adhesive for adhering flexible cellular insulation; Foster 82-40 or Armstrong 520.

2.4 INSULATION THICKNESS

A. Piping insulation thickness based on a maximum k value of 0.23 Btu in/hr ft² °F at a mean temperature of 75°F.

Pipe Sizes			
System	**Runouts To 12 ft. Max.**	**1 1/2 " and Less**	**1 1/2" Up**
Refrigerant piping	1"	1"	2"
Condensate drain piping	1"	1"	1"

B. Exterior Duct Insulation: All supply, return and outside air ductwork, shall be insulation 2" thick, with a minimum installed R value of 8.0.

2.5 DUCT SEALANTS

A. A fast setting, rubber based, UL classified, high velocity duct sealer; Foster 32-14 or 3M EC-800.
B. Same sealer, except non-flammable when wet; Foster 30-02.

2.6 EXPANSION AND BALL JOINT INSULATION COVERS

A. Furnish and install removable and reusable insulation covers.
B. Insulation and jacketing material shall be as required for service temperatures.
C. Covers shall have hook and loop fasteners and draw cords

PART 3 - EXECUTION

3.1 GENERAL

A. The installation of all insulation shall be made by experienced craftsmen in a neat, workmanlike manner and shall be in accordance with the manufacturer's published recommendations for service intended, as interpreted by the Architect.
B. All adhesives used in conjunction with insulation shall be compatible with the insulation and vapor barrier used and be vermin-proof and mildew resistant.

3.2 APPLICATION

A. Install materials in accordance with manufacturer's instructions.
B. Ductwork:
   1. External Duct Insulation: All external duct shall be installed without sagging or loose fitting sections. Outer jacket shall be sealed with mastic to form a continuous vapor barrier. Install as recommended by the insulation manufacturer.
   2. Flexible fiberglass insulation shall be wrapped around ducts and secured with outward clinching staples. Ducts 24" wide and larger shall have the insulation additionally secured with stick clips on 18" centers or with 4" wide bands of adhesive applied on 18" centers. Insulation shall be lapped a minimum of 4" and all seams and penetrations shall be sealed with an approved mastic reinforced with 3" glass mesh reinforcement. Where insulation terminates, all raw glass shall be sealed to duct.
C. Insulation shall be the full specified thickness, continuous through walls, floors, ceilings, etc. Reducing thickness or cutting back of insulation to pass obstructions or through sleeves will not be permitted.
D. Valve and fitting insulation shall be built up to the thickness of the adjacent pipe insulation or may be factory prefabricated units at the Contractor's option.
E. No part of any system shall be insulated until all required tests have been completed.
F. All insulation shall be installed so that it does not interfere with the functions of thermometer wells, gage connections and/or cocks, unions, access panels, hand holes, manholes, sight glasses, etc., or obscure serial numbers or other nameplate data.
G. Insulation shall be extended to include stiff leg supports as required to prevent sweating.

H. Complete vapor barriers to prevent sweating shall be installed on all cold systems and equipment. If a single tape adhesive system or staples are used for closure of the longitudinal lap, a vapor barrier mastic must be used to ensure a vaporproof closure. All edges and abutments shall be sealed, waterproof and vaporproof. Supplier of jacket materials shall certify that the material proposed is approved for use in return air plenums, where applicable.

I. Where necessary, the application of insulation shall be arranged to accommodate movement of piping due to thermal expansion and/or contraction.

J. **Exterior Refrigeration Piping: All pipe and fittings specified herein to be insulated when installed exposed to weather, and wrapped with an 0.016" smooth or corrugated aluminum jacket with proper closure system positioned to shed water to make a waterproof assembly**. Fittings shall be insulated with molded insulation fittings or pipe insulation carved and mitered to fit properly. Insulation shall be butted together and adhered in place with contact cement. Where possible tubing shall be slipped on without slitting. Where insulation terminates, it shall be neatly beveled and finished. No portion of this insulation shall be concealed prior to approval by the Architect.

K. Below Grade Piping: All pipe and fittings specified herein to be insulated, when installed below grade shall be insulated and spirally wrapped with open mesh glass tape embedded in asphaltic mastic and then completely covered with waterproof asphaltic mastic so as to make a waterproof assembly. Fittings shall be insulated with molded insulation fittings or pipe insulation carved and mitered to fit properly. Insulation shall be butted together and adhered in place with contact cement. Where possible tubing shall be slipped on without slitting. Where insulation terminates, it shall be neatly beveled and finished. No portion of this insulation shall be concealed before the Architect has checked and approved same.

L. Piping supports shall pass completely around the exterior of the finished insulation. Rigid blocks of insulation material shall be provided at all support points. In addition, sheet metal saddles shall be provided at support points in accordance with the following table:

Pipe Size	Gauge Metal	Saddle Length
Up to 2-1/2"	18	6"
3" - 5"	16	10"
6" - 8"	16	14"
10" and Over	16	18"

M. Saddles shall cover the bottom of the insulation, and saddle edges shall be hemmed or suitably covered to prevent damage to the insulation material.

N. The vapor barrier and finish shall be continuous at all support points.

O. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

a. Fan discharges.
b. Intervals of lined duct preceding unlined duct.
c. Upstream edges of transverse joints in ducts where air velocities are higher than 2000 fpm or where indicated.

9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
   a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.

P. Lined exterior ductwork shall be treated with an acid etch bath and two coats of UV resistant paint. Color shall be approved by Architect.

Q. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

END OF SECTION

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SECTION 230800: COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 SUMMARY:

A. Section includes

1. Commissioning HVAC Systems

2. Commissioning Building HVAC Systems Automation Controls

3. Commissioning Testing, Adjusting and Balancing (TAB)

1.2 RELATED REQUIREMENTS

A. Section 017900 – Commissioning Demonstration and Training

B. Section 019113 – General Commissioning Requirements

C. Section 220800 – Commissioning of Plumbing Systems

D. Section 260800 – Commissioning of Electrical Systems

E. Other

1.3 DEFINITIONS:

A. CxA: Commissioning Agent.

B. GC: Contractor; General Contractor, not a Subcontractor.

C. O&M: operations and Maintenance.

1.4 DESCRIPTION

A. Conform to commissioning requirements and the commissioning plan.

1.5 RESPONSIBILITIES

A. Mechanical, Electrical, Plumbing, Controls, and TAB Contractors: The commissioning responsibilities applicable to each of the mechanical, controls, and TAB contractors of CSI Masterformat Division 23 (all references apply to commissioned equipment only):

1. Construction and Acceptance Phases

a. Include the cost of participating in commissioning in the contract price. Commissioned equipment is defined in section 019113.

b. In each purchase order or subcontract written, include requirements for submittal data, completion of commissioning documentation, O&M data and training.

c. Attend and actively participate in a commissioning scope meeting and other meetings necessary to facilitate the Commissioning process.

d. Provide requested documentation to the CxA for development of the functional testing

procedures.

e. Complete CxA furnished functional performance tests and procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection, and provide necessary written alarm limits to be used during the tests.

f. Complete a start-up and initial checkout plan using manufacturer's start-up procedures and the CxA furnished Prefunctional checklists for all commissioned equipment. Submit to GC for review prior to startup. CxA will verify plan for compliance. Refer to Section 019113 for further details related to start-up.

g. During the startup and initial checkout process, execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment.

h. Correct system deficiencies before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air-or water-related systems.

i. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the GC.

j. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments, and problem-solving.

k. Provide all test equipment necessary to fulfill specified testing requirements.

l. Perform functional performance testing under the direction of the CxA for specified equipment. Assist the CxA in interpreting the monitored data, as necessary

m. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and A/E, and retest the equipment.

n. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions. O&M's to be consistent with the final tested condition of all installed systems.

o. During construction, maintain as-built red-line mark-ups for all drawings. Update as needed following functional testing.

p. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

2. Operation Manuals shall include:

a. A table of all setpoints and implications when changing them.

b. Schedules.

c. Instructions for operation of each piece of equipment for emergencies.

d. Startup and shutdown procedures.

e. Recommendations for re-commissioning frequency by equipment type.

f. Recommended maintenance schedules.

3. Warranty Period

a. Participate in deferred functional performance testing, organized by the CxA, according to the specifications.

b. Correct deficiencies and make necessary adjustments to O&M Manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor: The commissioning responsibilities of the HVAC mechanical contractor, during construction and acceptance phases, in addition to those listed in Paragraph A, above, are:

1. Participate in the Commissioning of the mechanical systems listed in Section 019113 and the Commissioning Plan.

2. Provide submittals as required by A/E and those listed on the Prefunctional checklist.

3. Provide startup for all HVAC equipment, except for the building automation control system. Clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

4. Provide all test equipment necessary to fulfill specified testing requirements. Data Loggers and test equipment not specified in equipment or system sections excluded.

5. Assist and cooperate with the TAB contractor and CxA by:

a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

b. Including cost of sheaves and belts that may be required by TAB.

c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Providing an approved plug.

d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

6. Install a P/T plug at water sensors which is an input point to the control system.

7. List and clearly identify on the as-built drawings the location of all air-flow stations (if applicable).

8. Prepare a preliminary schedule for CSI Masterformat Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up, and TAB start and completion for use by the CxA. Update the schedule as appropriate.

9. Notify the GC when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment, and TAB will occur. Be responsible to notify the GC ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently execute the commissioning process.

10. Refer to Section 019113 for specific details on non-conformance issues relating to prefunctional checklists and tests and for issues relating to functional performance tests.

11. The training shall consist of a review of the O&M manuals and hands-on training. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packages controls, not controlled by the central control system. Training shall occur after functional testing is complete, unless approved otherwise by the GC. Contractor and vendor training will be as specified for the product of system. Training will be scheduled by the GC and monitored by the GC and CxA.

C. Controls Contractor: The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in Paragraph A, above, are:

1. Sequences of Operation Submittals: The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment based on the approved project equipment, regardless of the completeness and clarity of the sequences in the construction documents specifications. They shall include

   a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components, and function.

   b. All interactions and interlocks with other systems.

   c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.

   d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).

   e. Start-up sequences.

   f. Warm-up mode sequences.

   g. Normal operating mode sequences.

   h. Unoccupied mode sequences.

   i. Shutdown sequences.

   j. Capacity control sequences and equipment staging.

   k. Temperature and pressure control: setbacks, setups, resets, etc.

   l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.

   m. Effects of power or equipment failure with all standby component functions.

   n. Sequences for all alarms and emergency shut downs.

   o. Seasonal operational differences and recommendations.

   p. Initial and recommended values for all adjustable settings, setpoints, and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.

   q. Schedules, if known.

   r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers shall not repeat for different sequence sections, unless the sections are numbered.

2. Control Drawings Submittal

   a. The control drawings shall have a key to all abbreviations.

   b. The control drawings shall contain graphic schematic depictions of the systems and each

component.

c. The schematics shall include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment if primarily controlled by packaged or integral controls.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M Manual submittal.

4. CxA shall utilize a DDC functional testing tool that is a Native BACnet-based system hosted on the EMCS server. This system will collect EMCS data on all building controllers, application controllers, and all input/output devices and shall communicate using the protocols and network standards as defined by ANSI/ASHRAE Standard 135–2004, BACnet. Gateways provided by the CxA shall be used for communication to systems and controllers installed under this section. Gateways may be used for communication to existing systems or to systems installed under other sections.

   The Energy Management and Control System (EMCS) application program provided by the controls contractor in DDC specification 230900 shall be written to communicate specifically utilizing BACnet protocols. The use of the DDC functional testing tool and the building energy management control system (EMCS) communication protocol requires that the system devices and communication networks be uniquely identified. This is to ensure that messages are correctly sent and received within the network, and between devices.
   To achieve a unique BACnet system identification regime, three sets of numbers are required to be allocated within a system. These numbers are respectively allocated to; a device connected to a particular LAN, a device located in a particular building, and a network within the building on which the device is installed. The numbers are described as follows:

   a. MAC Address
   b. Device Instance
   c. Network Number

5. Assist and cooperate with TAB contractor in the following manner

   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB contractor any unique instruments needed for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).

   b. For a given area, have all required prefunctional checklists, calibration, startup, and selected functional tests of the system completed prior to TAB.

   c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

6. Assist and cooperate with the CxA in the following manner.

   a. Using a skilled technician who is familiar with the installed systems in this building, execute the functional testing of the controls system during both initial functional testing and seasonal functional testing. Assist in the functional testing of all equipment. Provide 2-way radios during the testing.

   b. Execute all control system trend logs.

7. Provide a signed and dated certification to the GC upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.

8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control, and virtual points.

9. List and clearly identify on the as-built duct and piping drawings the locations of all monitoring and control sensors.

10. Provide all test equipment necessary to fulfill specified testing requirements.

D. TAB Contractor: The duties of the TAB contractor, in addition to those listed in Paragraph A, above, are

1. Submit the outline of the TAB plan and approach for each system and component to the CxA, QC, and the controls contractor 6 weeks prior to starting the TAB. This plan shall be developed after the TAB has met with the GC and become familiar with the control system.

2. The submitted plan shall include:

a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.

b. An explanation of the intended use of the building control system. The controls contractor shall comment on feasibility of the plan.

c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted, and balanced with the data cells to be gathered for each.

d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

e. Final test report forms to be used.

f. Submit NEBB or AABC procedural standards or provide detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch/sub-main proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors shall be discussed. Provide the analogous explanations for the waterside.

g. List of all airflow, water flow, system capacity, and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

h. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.). (Describe in Narrative and submit in final reports).

i. The identification and types of measurement instruments to be used and their most recent calibration date.

j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.

k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.

l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).

m. Details of how building static and exhaust fan/relief damper capacity will be checked.

n. Details of methods for making any specified coil or other system plant capacity measurements.

o. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.

p. Details regarding specified deferred or seasonal TAB work.

q. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.

r. Details of any required interstitial cavity differential pressure measurements and calculations.

s. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

t. Plan for formal progress reports (scope and frequency).

u. Plan for formal deficiency reports (scope, frequency, and distribution).

3. The TAB field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CA and GC at least twice a week.

4. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

5. Provide a draft copy of the TAB report to the CxA within 2 weeks of completion. The report shall contain a full explanation of the methodology, assumptions, and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB, or ASHRAE Standard 111.

6. Provide the CxA with any updates as a result of A/E review.

7. Provide all test equipment necessary to fulfill specified testing requirements.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 STARTUP

A. The mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 01 91 13. CSI Masterformat Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the GC. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.2 OPERATIONS AND MAINTENACE (O&M) MANUALS

A. The following O&M Manual requirements do not replace O&M Manual documentation requirements elsewhere in these specifications.

B. Special Control System O&M Manual Requirements: In addition to documentation that may be specified elsewhere, the controls contractor shall compile and organize at a minimum the following data on the control system in a labeled 3-ring binders with indexed tabs.

1. 3 copies of the controls training manuals in a separate manual from the O&M Manuals.

2. Operation and Maintenance Manuals containing

a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.

b. Full as-built set of control drawings.

c. Full as-built sequence of operations for each piece of equipment.

d. Full print out of all schedules and set points after testing and acceptance of the system.

e. Full as-built print out of any custom software programs.

f. Electronic copy on disk of the entire program for this facility.

g. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

h. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.

i. Control equipment component submittals, parts lists, etc.

j. Warranty requirements.

k. Copies of all checkout tests, other than commissioning tests, and calibrations performed by the Contractor.

3. Field checkout sheets and trend logs should be provided to the GC for inclusion in the on-site Commissioning filing system.

C. Special TAB Documentation requirements: The TAB contractor shall compile and submit the following with other documentation that may be specified elsewhere in the Specifications.

1. The TAB contractor shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

3.3 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The GC shall be responsible for reviewing the content and adequacy of the training of Owner personnel for commissioned equipment or systems. CxA will verify compliance.

C. Mechanical and Plumbing Contractor: The mechanical and plumbing contractors shall have the

following training responsibilities for their commissioned systems

1. Provide the GC with a training plan 4 weeks before the planned training.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of commissioned equipment.

3. Training shall start with classroom sessions followed by hands on training on each piece of equipment.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M Manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than 1 party may be required to execute the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M Manuals for reference.

8. Training shall include

    a. Use the printed installation, operation, and maintenance instruction material included in the O&M Manuals.

    b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

    c. Discussion of relevant health and safety issues and concerns.

    d. Discussion of warranties and guarantees.

    e. Common troubleshooting problems and solutions.

    f. Explanation of information included in the O&M Manuals.

    g. Discussion of any peculiarities of equipment installation or operation.

    h. Classroom sessions shall include the use of overhead projections, slides, video/audio taped material as might be appropriate.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

10. Fully explain and demonstrate the operation, function, and overrides of any local packaged controls, not controlled by the central control system.

11. Training shall occur after functional testing is complete, unless approved otherwise by the

GC.

D. Controls Contractor: The controls contractor shall have the following training responsibilities for their commissioned systems

1. Provide the GC with a training plan 4 weeks before the planned training.

2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.

3. Training manuals: The standard operating manual for the system and any special training manuals shall be provided for each trainee. In addition, copies of the system technical manual shall be demonstrated during training. Manuals shall include detailed description of the subject matter for each session. The manuals shall cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Copies of audiovisuals shall be delivered to the Owner.

4. The training sessions shall be tailored to the needs and skill-level of the trainees.

5. The trainers shall be knowledgeable on the system and its use in buildings.

6. Provide 2 training sessions structured as follows:

a. Building Systems: The first session shall be held on-site and consist of two (2) 4-hour sessions of actual hands-on training after the completion of system commissioning. The session shall include instruction on

1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.

2) Security levels, alarms, system start-up, shut-down, power outage, and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.

3) All trending and monitoring features (values, change of state, totalization, etc.) including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees shall actually set-up trends in the presence of the trainer.

4) Every screen shall be completely discussed, allowing time for questions.

5) Use of keypad or plug-in laptop computer via phone lines or networks.

6) Use of remote access to the system via phone lines or networks.

7) Setting up and changing an air terminal unit controller.

8) Graphics generation.

9) Point database entry and modifications.

10) Understanding DDC field panel operating programming (when applicable).

b. The second training will be conducted on-site 6 months after occupancy and will consist

of 4 hours of training. The session shall be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.

E. The TAB contractor shall have the following training responsibilities

1. TAB shall meet for 2 hours with facility staff after completion of TAB and instruct them on the following

a. Go over the final TAB report, explaining the layout and meanings of each data type.

b. Discuss any outstanding deficient items in control, ducting, or design that may affect the proper delivery of air or water.

c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans, and pumps that are close to or are not meeting their design capacity.

d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.

e. Other salient information that may be useful for facility operations, relative to TAB.

F. See additional training information in section 017900.

END OF SECTION

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SECTION 23 09 93 - SEQUENCE OF OPERATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. All other Sections of Division 15

B. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings for all requirements.

1.3 SCOPE

A. Control sequence is hereby defined to mean the manner in which, and methods by which, the controls function. The requirements for each type of operation are specified in this section.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for **elsewhere in these Contract Documents.**

PART 2 - SEQUENCE OF OPERATION FOR THE MECHANICAL SYSTEM

2.1 AIR HANDLING UNITS

A. Each indoor air handling unit shall be controlled by a wall controller as specified and as indicated on the plans.

B. Smoke detectors furnished and wired by Division 16 in the supply and return air of the unit shall, upon detection of smoke shall de-energize the supply fan.

2.2 UNIT HEATERS

A. A space thermostat shall control the unit heaters.

2.3 EXHAUST FANS

A. Exhaust fans serving one room shall start and stop with a motion sensor interlocked with the light fixtures The fans shall run for 5 minutes (adjustable) after the lights turn off.

2.4 BUNKER GEAR VENTILATION FAN

A. The fan shall have an HOA switch mounted 48" A.F.F. at a location as directed by the architect and owner.

B. In the auto position, the fan shall operate in the following manner. On sensing a RH level above setpoint, the fan shall be energized. The fan shall be de-energized upon sensing an RH level below setpoint.

2.5 ELECTRICAL INTERLOCKS

A. Provide electrical interlocks as listed herein, in other sections of these specifications and as noted in the equipment schedules.

B. Electrical interlocks shall be made by means of auxiliary contacts on motor starters or shall be accomplished with separate relays unless indicated otherwise. No motor power lead shall be utilized in an interlock circuit, unless indicated otherwise. Each separate control power lead serving a starter shall be provided with a disconnecting switch suitably identified and housed, which may be a toggle switch or other suitable disconnecting device, or proper capacity and number of poles.

2.6 APPARATUS BAY EXHAUST FAN.

A. The Apparatus bay fan shall have a timer switch adjustable from 1-60 minutes mounted 48” AFF at a location directed by the architect and the owner to allow for manual operation. The switch shall open an outside air in-take damper. An end switch on the damper shall start the Apparatus Bay Exhaust Fan. The outside air in-take damper shall be closed, and the exhaust fan shall stop when the time is complete.

B. CO sensor and NO2 sensor shall be located at a height as recommended by the manufacturer in location indicated on the plans or by the architect.

C. In the auto position, the fan shall operate in the following manner. On sensing a CO or NO2 level above set point (adjustable), the relay shall open an outside air in-take damper. An end switch on the damper shall start the Apparatus Bay Exhaust Fan. On the sensing an acceptable CO or NO2 level, the outside air-intake damper shall be closed, and the exhaust fan shall stop. The fans shall also be interlocked to the garage door motors. When the garage door motors are powered down to a closed position the fans shall be energized and run for 15 minutes (adjustable).

END OF SECTION

SECTION 231123 - FACILITY NATURAL GAS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Gas piping.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer’s certifications shall be submitted to the Engineer on all such materials used.

1.3 SUBMITTALS

A. **Provide submittals as required in section 230010, “Submittal Process”**

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Gas Piping:

1. Piping below grade - Schedule 40 black steel pipe conforming to ASTM A-120 with factory fabricated steel fittings, threaded or welded. All buried piping shall be protected against corrosion by a factory applied wrapping, following the recommendations of the local gas company. All field-fabricated joints shall be similarly protected. Non-ferrous pipe with tracer wire may be used if approved by local governing authorities.2.

2. Underground gas distribution piping may be polyethylene plastic gas pipe SDR 11 conforming to ASTM D 2513 only when approved for use with 5 psi medium pressure distribution by both the Gas Utility Company and local building officials, and shall be listed by IAPMO.

a. Plastic pipe shall be buried in its entirety and shall not run under or within any structure and shall be furnished with a copper trace wire.

b. Any connection of such plastic pipe to metallic pipe shall be by means of an approved compression coupling with insert.

c. Joints in such plastic pipe of 1-1/2" and smaller shall be made by an approved Dresser coupling socket weld fitting or compression fitting if approved by local code. Pipe 2" and larger may be joined as described above or by heat fusion method, but all such work shall be in accordance with the manufacturer's recommendations.

d. Meter and regulator risers shall be made with pre-bent factory coated steel piping joined as described in (b) above. Such steel piping shall be at least three (3) feet long on that end joining to the plastic.

e. Where plastic pipe joins to building, all exposed pipe shall be steel. All exposed metal on Dresser couplings shall be wrapped and sealed to prevent corrosion.

f. Pipe shall be permanently marked at maximum 2 foot intervals with the following minimum information:
   1.) Manufacturer's name and the word "Natural Gas"
   2.) Material designation
   3.) SDR 11
   4.) IAPMO listing

3. Piping above grade - Schedule 40 black steel pipe conforming to ASTM A-120 with threaded black malleable iron fittings. All piping 2-1/2" and larger shall be welded. Welded fittings shall be factory fabricated schedule 40 black steel as manufactured by Tube-Turns or approved equal.

2.2 VALVES, COCKS AND SPECIALTIES

A. Materials: Bronze, ductile iron, or cast iron per local codes with screwed, Vic-Press 304™, grooved, or flanged ends for steel pipe and Permalynx push-to-connect, grooved, or solder ends for copper pipe.

B. Valve locations:
   1. Provide a valve on inlet and outlet of each piece of equipment.
   2. Provide valves to isolate individual or a group of equipment on branch runouts from piping mains. This is in addition to valves at each fixture and equipment.
   3. Provide valves as indicated and where required to adequately service parts of systems and equipment.

C. Gas Cocks:
   1. Cocks on 2" lines and smaller shall be Jenkins 30A or Crane No. 324 or approved equal.
   2. Cocks on 2-1/2" line and larger shall be Emco-Nordstrom No. 143 flanged pattern or approved equal.
   3. All gas cocks at boilers shall be lubricated plug type.
   4. Provide removable handles for all plug cocks.
   5. Other special type valves or patterns shall be used where required.

D. Gauge Cocks and Manual Air Vents:
   1. Provide brass, lever handle cock, 1/4" FPT, as shown on the drawings or as specified herein.

E. Dielectric Unions or Waterway Fittings:
   1. Provide dielectric unions or waterway fittings at all piping connections (except to valves) between dissimilar metals, Watts No. 3000 series, Victaulic Style 47, or engineer approved equal.

2.3 PRESSURE REGULATORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Actaris Metering Systems
   2. Elster American Meter Company.
   3. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   4. Maxitrol Company.
   5. Richards Industries; Jordan Valve Div.

B. General Requirements:
   1. Single stage and suitable for natural gas.
   2. Steel jacket and corrosion-resistant components.
   3. Elevation compensator.
   4. End Connections: Threaded for regulators NPS 2 and smaller.
   5. Venting:
      a. Regulators with included approved vent-limiting device (REG 3 and REG 5A) do not require venting to atmosphere provided they are mounted in a ventilated location (e.g. near a gas appliance which also requires placement in a ventilated area).
      b. Ventilated locations include (but not limited to) mechanical rooms, and attics.
      c. Vent limiting device: Limit the fuel gas leakage to 2.5 cc per hour in the event of a diaphragm failure.

C. Service Regulators
    1. Diaphragm Case: Die-cast aluminum with polyurethane top coat.
    2. Valve Body: Cast iron.
    3. Closing Spring: Steel, zinc plated.
    4. Diaphragm Plate: Steel.
    5. Seat Disc: Nitrile rubber.
    6. Orifice: Aluminum.
    7. Lever: Steel, zinc plated.
    8. Vent Screen: Stainless steel.
    9. Seal Plug: Die-cast aluminum.
    10. Maximum Inlet Pressure: 60 psig.

D. Low Pressure Regulators
    1. Diaphragm Case: Die-cast aluminum with polyurethane top coat.
    2. Valve Body: Cast iron.
    3. Closing Spring: Steel, zinc plated.
    4. Diaphragm Plate: Steel.
    5. Seat Disc: Nitrile rubber.
    6. Orifice: Aluminum.
    7. Lever: Steel, zinc plated.
    8. Vent Screen: Stainless steel.
    9. Seal Plug: Die-cast aluminum.
    10. Maximum Inlet Pressure: 5 psig.

E. Appliance Pressure Regulators: Provided by manufacturer of appliance. Appliance pressure regulator will comply with ANSI Z21.18.
    1. Body and Diaphragm Case: Die-cast aluminum.
    2. Closing Spring: Steel, zinc plated, interchangeable.
    3. Diaphragm Plate: Steel, zinc plated.
    4. Seat Disc: Nitrile rubber.
    5. Orifice: Aluminum.
    6. Lever: Steel, zinc plated.
    7. Vent Screen: Stainless steel.
    8. Seal Plug: Die-cast aluminum.
    9. Maximum Inlet Pressure: 1 psig.

2.4 FLANGES

A. Flanges shall be 150 pound; A.S.A. forged steel, raised face, weld neck or slip-on. Slip-on flanges shall be welded both inside and outside.

B. Flange Adapters: Flat face, for direct connection to ANSI Class 125 or 150 flanged components. Victaulic Style 741 or W45 flange adapter nipple for sizes 14” through 24”.

PART 3 - EXECUTION

3.1 GENERAL

A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer and the best practices of the trade in conformance with the contract documents.

B. Refer to Section 23 0529, “Hangers and Supports for HVAC Piping and Equipment” for general piping support requirements.

3.2 INSTALLATION

A. Refer to Section 23 0500, “Common Work Results for HVAC” for general installation requirements

B. Underground Pipe: The bottom of the trench shall be shaped to give substantially uniform support to the lower third of each pipe. Each pipe shall be laid true to line and grade and in such manner as to form a concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, the interior of the pipe shall be cleaned of dirt and foreign materials of any kind. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after joining has been completed. Trenches shall be kept free from water until pipe joining is complete and pipe shall not be laid when condition of trench or weather is unsuitable for such work. At all times when work is not in progress, all open ends of pipe fittings shall be securely closed to the satisfaction of the Architect so that no water, earth or

other substance will enter pipe or fittings.

C. Erection of Pipe above Grade: Piping shall be properly supported and adequate provisions shall be made for flashing, expansion, contraction, slope and anchorage. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all structural elements, finished rooms, windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted.

D. All changes in direction shall be made with fittings, except that bending of pipe will be permitted providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles or other malformation will not be acceptable.

E. Copper tubing shall be joined by the following method:
   1. The tubing shall be reamed to remove all burrs from the inside diameter of the pipe.
   2. The tubing and fitting shall be sanded or brushed to a uniform bright finish.
   3. Apply a paste flux to both tubing and fitting.
   4. Fully heat the joined parts and apply solder to the joint.
   5. Completely fill the joint with solder, wiping any excess solder outside the joint while still liquid.

F. Mitering of pipe to form elbows or notching straight runs to form tees will not be permitted unless shop fabricated by a certified welder. Weldolet or Threadolet fittings may be used in lieu of welding tees.

G. Provide sleeves around all pipes passing through walls, floors, ceiling, partitions, structural members or other building parts.

H. Gas Piping:
   1. All gas piping within the building shall be run exposed or enclosed in a sleeve vented to the outdoors, if required by local codes.
   2. All piping shall be run straight without sags or traps and shall be so pitched as to drain back to the riser and from the riser to the system low points. A dirt pocket consisting of a nipple and a cap shall be provided at the bottom of each riser and at all low points of the gas distribution system. Provide access for cleaning of same dirt pocket.
   3. Provide connections throughout the system to allow for adequate horizontal and vertical expansion and contraction of piping.
   4. Provide a pressure regulator, with relief piping routed to the outdoors, at each gas consuming device or group of devices, where such devices operate at a pressure less than that of the gas supply line. Refer to the drawings for additional regulators and other information. Coordinate required regulators with others furnishing gas burning equipment.

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. The Contractor shall furnish and install items as shown on the drawings or as necessary to provide a complete working system in accordance with the intent of the drawings and specifications, including all valves as indicated or as necessary to completely control the entire piping system. The piping drawings are diagrammatic and indicate the general routing, locations, and connections. The piping may require be offsetting, lowering or rising as needed to avoid interferences or as directed at the site. This does not relieve the Contractor from responsibility for the proper installation of piping systems.

B. Work Included:

1. Refrigerant piping and accessories.

C. Submittals: Provide submittals as required in Section 230010, "Submittal Process".

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements to comply with ANSI, ASTM, ASME, CISPI, IAPMO, PDI, and AWWA and all other applicable standards.

D. Copies of each welder's certification documents shall be furnished to the Architect prior to them performing work.

E. All pipes, valves, and fittings shall be manufactured in the United States. Mill Test reports and manufacturer's certifications shall be submitted to the Engineer on all such materials used.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refrigerant Piping:

1. Seamless ACR copper tubing, Type L, hard drawn with wrought or bronze solder joint fittings.
2. Soft copper is not an accepted product. Soft copper shall only be used for a maximum of 4' to flare a connection to a FCU. (VRF Indoor Unit)
3. Coiled/pre-insulated line-sets are not an accepted product.

2.2 VALVES, COCKS AND SPECIALTIES

A. Materials: Bronze, or copper only

B. Isolation Valve locations:

1. Provide a valve on inlet and outlet of each piece of equipment**. (all refrigeration lines)**
   - **a. Locate at condenser (VRF Out Door Unit)**
   - **b. Locate at fan coil unit. (VRF Indoor Unit)**
   - **c. Locate at inlet and outlet of all refrigeration selector boxes**
2. Provide valves to isolate individual or a group of equipment on branch runouts from piping mains. This is in addition to valves at each fixture and equipment.
3. Provide valves as indicated and where required to adequately service parts of systems and equipment.

C. Refrigerant Valves:

1. KeepRite 410A Refrigeration ball valves with relief port attached to brass valve.
2. Globe and Angle Valves: Forged brass or bronze alloy with packed stem and seal cap.
3. Check Valves: Spring-loaded, forged brass or bronze alloy body with solder connections.
4. Relief Valves: Forged brass bodies with nonferrous corrosion resistant internal working

parts. Valves shall be in accordance with ANSI B9.1.

5. Solenoid Valves: Two-position, direct acting or pilot operated type, UL listed, with manual opening stem and constructed for servicing without removal from lines. Valves shall have coil housing, stainless steel enclosing tube, replaceable seat, and proper inlet and outlet connections for the type of pipe containing the valve.

2.3 PIPE HANGERS AND SUPPORTS

A. Supports, hangers, anchors, guides and supplementary steel shall be provided for horizontal and vertical piping and shall meet or exceed the ASA Code for Pressure Piping.

B. Rod sizes noted are minimum sizes. The structural integrity of the supports is the responsibility of the Contractor.

C. Hangers Supporting and Contacting Copper:

1. 3" and Smaller: Grinnell Fig. CT-109, copper plated, split-ring hanger with adjusters.

D. Hangers Supporting Insulated Lines:

1. **All hangers must support outside of insulation and not on pipe directly.**

E. Supports for Vertical Riser Piping:

1. Brass or copper pipe shall be isolated from support with sheet polyethylene, minimum 1/8" thick.

F. Supports for Vertical and Horizontal Piping in Chases and Partitions:

1. Provide securely anchored supports for pipes serving plumbing fixtures and equipment near the area the pipe penetrates the wall.
2. Supports shall be steel plate, angles or unistruts mounted vertically or horizontally with unistrut clamps P2426, P2008 or P1109.
3. Attach supports to wall or floor construction with clip angles, brackets or other approved anchoring devices.
4. Brass and copper pipe shall be isolated from support with sheet polyethylene, minimum 1/8" thick.

2.4 SLEEVES

A. Provide sleeves where pipes penetrate floors, walls, foundations, fireproofing, etc.

B. Size sleeves large enough to allow for movement due to expansion and to provide for continuous movement. Provide a bead of sealant in space between pipe and sleeve.

2.5 TRAPEZES

A. Trapezes of Kindorf, Elcen or approved equal may be provided where multiple lines run horizontally at the same elevation.

2.6 STRAP HANGERS

A. **Under no circumstances will perforated strap iron, zip ties, tape, fabric strap or wire be acceptable for hangers or supports on this project.**

2.7 BRAZING ROD

A. **Refrigerant piping shall be brazed with no less than silver solder "Sil-Fos"#15.**

PART 3 - EXECUTION

3.1 GENERAL

A. All work shall be performed by workmen skilled in the trade required for the work. All materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer and the best practices of the trade in conformance with the contract documents.

B. **Contractor shall consider all refrigeration piping materials are subject to change in temperature and will expand and contract with this change. Installation techniques must allow for expansion and contraction changes, this will prevent stress that will buckle and rupture the copper tubing or joint. Consider components, pipe type, length, hanger type, and rapid temperature differences within the piping system when calculating expansion. It is the contractor's responsibility to ensure that the pipe has adequate room for expansion and contraction without putting undue stress on the VRF components such as "Y" branches, changeover boxes, headers, and indoor units. Contractor shall follow the**

recommendations found in the most recent issue of *The Piping Handbook*, for expansion loops, expansion joints, pipe offsets and other methods to allow the refrigerant pipe to expand and contract based on the temperature ranges within each refrigerant pipe in the system. Failure to follow this procedure can cause a tendency for lines to bow, and possibly buckle or rupture, particularly on smaller pipe sizes.

3.2 INSTALLATION

A. Refer to Section 23 0500, “Common Work Results for HVAC” for general installation requirements.

B. Erection of Pipe above Grade: Piping shall be properly supported and adequate provisions shall be made for flashing, expansion, contraction, slope and anchorage. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all structural elements, finished rooms, windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate installation will not be permitted.

C. All changes in direction shall be made with fittings, except that bending of pipe will be permitted providing a hydraulic pipe bender is used. Bent pipe showing kinks, wrinkles or other malformation will not be acceptable.

D. Copper tubing shall be joined by the following method:

1. The tubing shall be reamed to remove all burrs from the inside diameter of the pipe.
2. The tubing and fitting shall be sanded or brushed to a uniform bright finish.
3. The tubing shall be brazed with silver solder no less than #15 sil-fos.

E. **Provide sleeves around all pipes passing through walls, floors, ceiling, partitions, structural members or other building parts.**

F. Refrigerant Piping:

1. Refrigerant piping shall not be run concealed in walls or partitions nor underground or under the floor except as indicated on the drawings. Where pipe passes through building structure, pipe joints shall not be concealed, but shall be located where they may be readily inspected.
2. **Refrigerant piping shall be brazed with silver solder "Sil-Fos"#15.** The inside of tubing and fittings shall be free of flux. The parts to be joined shall be cleaned bright with emery cloth and shall be heated to a temperature slightly greater than the solder flow point, and shall be kept hot until the solder has penetrated the full depth of the fitting. Joints shall be cooled in the air after which flame marks and traces of flux shall be removed. **During the brazing operation, the tubing shall be protected from forming an oxide film on the inside by slowly flowing dry nitrogen to expel the air**. Installation of the piping shall comply with ANSI B31.5.
3. Refrigerant lines shall be installed so that the gas velocity in the evaporator suction line is sufficient to move the oil along with the gas to the compressor. Where equipment location requires a vertical riser, the line size shall be as shown and installed to provide sufficient gas velocity or a double riser shall be installed as shown on the drawings. The larger riser shall have a trap, of minimum volume, formed by the use of 90 degree and 45 degree ells. The small riser shall be located with its inlet just upstream of the trap and shall connect to the top of the horizontal line. Valves shall not be installed in risers except as shown on the drawings.
4. Refrigerant driers, sight glass liquid and moisture indicators, and strainers shall be provided in refrigerant piping for remote installations when not furnished by the manufacturer as part of the equipment. Driers shall be installed in liquid line with service valves and a valved bypass line which are the same size as liquid line in which the drier is installed. Driers of 50 cubic inches and larger shall be installed with the cover and the full cartridge being easily removable.
5. Sight glass liquid and moisture indicators shall be installed in the liquid line downstream of the drier. Connections shall be the same size as the liquid line in which it is installed, up to 7/8"; 1-1/8" and larger shall have a 1/4" indicator installed in the "By-pass" position.
6. **Refrigeration lines shall not be installed over and IT equipment or electrical equipment. Route lines accordingly. IF routing refrigeration lines over IT equipment or other electrical equipment is unavoidable, refrigeration lines shall be installed wrapped with an 0.016" smooth or corrugated aluminum jacket with proper closure system positioned to shed water to make a waterproof assembly.**
7. Refrigerant Charging Valve: A valved refrigerant charging connection shall be provided

for each field piped refrigeration system when not provided as part of the condensing unit. The valve shall be located on the reducing outlet of a full size tee in the liquid line, upstream from the refrigerant drier and sight glass moisture indicator. Valves shall be of the seal cap type, 1/2" min. port size.

3.3 INSTALLATION OF SUPPORTS

A. All pipe supports shall be designed and installed to avoid interferences with other piping, hangers, ducts, electrical conduit, supports, building structure, equipment, etc. All piping shall be installed with due regard to expansion and contraction. The type of hanger, method of support, location of support, etc., shall be governed in part by this specification.

B. Pipe hangers shall be attached to the structure as follows:

1. Poured-in-Place Concrete: Each hanger rod shall be fitted with a nut at its upper end, which nut shall be set into an Underwriters' Laboratories, Inc., listed universal concrete insert placed in the formwork before concrete is poured.
2. Steel Bar Joists: Where pipes and loads are supported under bar joists, hanger rods shall be run through the space between the bottom angles and secured with a washer and two nuts. Where larger lines are supported beneath bar joists, hanger rods shall be secured to angle irons of adequate size. Each angle shall span across two or more joists as required to distribute the weight properly and shall be welded to the joists or otherwise permanently affixed thereto.
3. Steel Beams: Pipes and loads supported under steel beams shall be installed using approved beam clamps.

3.4 SPACING

A. Install hangers for steel piping with the following maximum spacing and minimum rod sizes according to MSS SP 69 Tables 3 and 4:

1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
5. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.

B. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 5 feet; minimum rod size, 3/8 inch.
2. NPS 5/8: Maximum span, 5 feet; minimum rod size, 3/8 inch.
3. NPS 1: Maximum span, 6 feet; minimum rod size, 3/8 inch.
4. NPS 1-1/4: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.

C. Spacing and rod sizes for other piping materials shall be as recommended by the manufacturer.

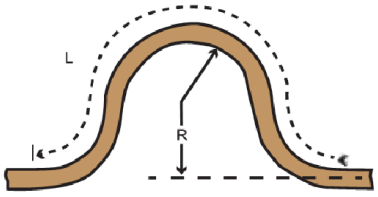
3.5 TRAPEZES

A. Trapeze members, including suspension rods, shall be properly sized for the number, size and loaded weight of the lines they are to support. Install as noted above.

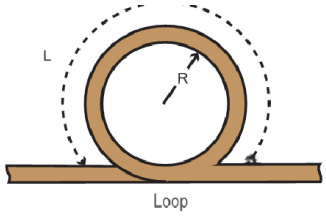
3.6 EXPANSION & CONTRACTION JOINTS

1. Under normal conditions, the vapor pipe temperature of a refrigeration system can vary as much as 180deg F. with this large variance in pipe temperature, the contractor must install pipe expansion and contraction to avoid pipe and fitting failures.
2. The refrigerant pipe support system must be built to allow free expansion to occur. When a segment of pipe is mounted between two fixed points, provisions must be provided to allow pipe expansion to naturally occur. The only way to protect the system from failures is to install expansion loops, U-bends or expansion hoses mounted in the horizontal position.
3. When expansion loops are installed in a vertical riser, the loop is to be formed in a horizontal position resulting in a torsional movement during expansion and contraction. Pipe that runs through a shaft shall have an expansion joint before entering shaft, and before exiting the shaft.

4. Expansion Calculations:
   A. LE=CxLx(Tr-Ta)x12
      LE = Linear Pipe Expansion
      C = Constant (Copper 0.0000104 in/in degree F)
      L = Length of pipe (ft)
      Tr = Refrigerant pipe Temp
      Ta = Ambient air Temp
      12 = Inches to feet conversion.
5. Types of expansion joints.
   a. U-Bends- One solid piece of bent copper.
   b. Expansion loops.
   c. Stainless steel vibration absorbers - Braded refrigeration hose.



Large Tubing U-bend (>3/4 in.)



Loop

Tube OD	Radius - R - inch For travel of ... 1/2 "	1 "	1 1/2 "	2 "	2 1/2 "	3 "	4 "
7/8	10	15	19	22	25	27	30
1 1/8	11	16	20	24	27	29	33
1 3/8	11	17	21	26	29	32	36
1 5/8	12	18	23	28	31	35	-----
2 1/8	14	20	25	31	34	-----	-----
2 5/8	16	22	27	32	-----	-----	-----
3 1/8	18	24	30	34	-----	-----	-----
4 1/8	20	28	34	-----	-----	-----	-----

6. Pipe Length Calculations for Fittings:
   a. When measuring liquid line to calculate refrigerant charge it is important to calculate for fitting losses. Count all fittings and add the equivalent feet of pipe for each fitting. See chart below.

Nominal Pipe Size	90 Degree Standard	90 Degree Long Radius	90 Degree Street	45 Degree Standard	45 Degree Street
3/8	1.4’	0.9’	2.3’	0.7’	1.1’
1/2	1.6’	1.0’	2.5’	.08’	1.3’
3/4	2.0’	1.4’	3.2’	.09’	1.6’
1	2.6’	1.7’	4.1’	1.3’	2.1’
1-1/4	3.3’	2.3’	5.6’	1.7’	3.0’
1-1/2	4.0’	2.6’	6.3’	2.1’	3.4’
2	5.0’	3.3’	8.2’	2.6’	4.5’

END OF SECTION

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SECTION 23 31 13.01 - VENTILATION DUCTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pre-insulated HVAC ductwork system.

1.2 RELATED SECTIONS

A. Section 23 05 00 - Common Work Results for HVAC.

1.3 REFERENCES

A. ASTM International (ASTM):
   1. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

B. American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE):
   1. ASHRAE Design Fundamentals Handbook.
   2. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

C. National Fire Protection Association (NFPA):
   1. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.
   2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
   1. SMACNA HVAC Air Duct Leakage Test Manual
   2. SMACNA Phenolic Duct Construction Standards
   3. SMACNA HVAC Duct System Design Manual.

E. Underwriters Laboratories (UL):
   1. UL 181 - Standards for Factory Made Air Ducts and Air Connectors.
   2. UL 723 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Submit under provisions of Section 23 00 10, “Submittal Process”

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Physical properties, performance criteria, and product limitations.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Shop Drawings:
   1. Provide project specific, scaled, shop drawings and calculations including layout, capacities, ventilation and warranty requirements.
   2. Show details including material layers and thicknesses, terminations, joints, and relationship to adjacent construction for each system to be installed.

D. Qualifications: Submit manufacturer and installer qualifications

E. LEED Submittals: Provide product data and manufacturer's certifications as requested by the Architect.

1.5 QUALITY ASSURANCE

A. Single Source Responsibility: Provide primary materials from a single manufacturer. Secondary and accessory materials by other manufacturers shall be approved for compatibility by the primary

manufacturer.

B. Manufacturer Qualifications: Minimum 5 years experience manufacturing similar products.

C. Installer Qualifications: Experienced contractors who have received appropriate training for the installation of pre-insulated ducts and approved by the manufacturer or manufacturer's representative.

D. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship is approved by Architect.
   3. Refinish mock-up area as required to produce acceptable work.
   4. Accepted mock-up may be included in the final work and shall establish relationships between adjacent materials and the standard of workmanship for the final installation.

1.6 PRE-INSTALLATION MEETINGS

A. Convene the manufacturer's authorized technical representative, general contractor, and related trades minimum two weeks prior to starting work of this section to discuss project conditions, manufacturer's warranty requirements, and installation procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.

B. Handling: Handle materials to avoid damage.

1.8 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.9 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Kingspan Insulation LLC, 2100 RiverEdge Pkwy. Suite 175; Atlanta, GA 30328; (800) 241-4402; www.kingspaninsulation.us

B. Acceptable Supplier: PTM Manufacturing, LLC. Newark, DE 19713. (800) 455-1402. www.ptmmanufacturing.com

C. Substitutions: Not permitted.

2.2 PRE-INSULATED HVAC DUCTWORK SYSTEM

A. Pre-Insulated HVAC Ductwork System: Provide Kingspan KoolDuct System for supply, return, fresh, and exhaust air ductwork as shown on the Drawings. System shall include panels, fabrication methods, coupling systems, and accessories to provide a complete system to meet the following performance criteria:
   1. Classification: UL Listed as a Class 1 Air Duct, to UL 181, NFPA 90A and NFPA 90B
   2. Fire and Smoke Performance when tested in accordance with ASTM E84 or UL 723:
      a. Flame Spread: <=25
      b. Smoke Developed: <=50

3. Materials: CFC/HCFC free, zero Ozone Depletion Potential (ODP), fiber-free rigid thermoset phenolic insulation core faced with 1 mil low vapor permeability aluminum foil reinforced with glass scrim. Foil is branded on inside of duct and plain on the outer facing.
4. Nominal Density: 3.4 to 3.75 pcf (55 to 60 kg/m3).
5. Closed Cell Content: minimum 90 percent
6. Compressive Strength: Minimum 29 psi (200 kPa) at 10 percent compression.
7. Air Leakage: SMACNA Air Leakage Class 3.
8. Mean Air Velocity: Maximum 5000 fpm (25.4 m/s) with all joints sealed.
9. Design Pressures:
    a. Positive Pressure: Maximum 4 inch w.g. (1000 Pa).
    b. Negative Pressure: Maximum 3 inch w.g. (750 Pa).
10. Commissioning Pressures - As designed to, max commissioning 4 inch w.g. (1000Pa.).
11. Temperature Range: Internal air temperature range -15 to 185 deg. F (-26 to 85 C) during continuous operation, inside ducts or ambient surrounding temperature.
12. Thermal Resistance, Wall Thickness and R-Value:
    a. 7/8 inch (22 mm) thick, R 6.0 square feet per hour F/Btu (1.047 square meter K/W).
    b. 1-3/16 inch (30 mm) thick, R 8.1 square feet per hour F/Btu (1.428 square
    c. meter K/W).
    d. 1-25/32 inch (45mm) thick, R 12 square feet per hour F/Btu (2.15 square
    e. meter K/W).
13. Thermal Conductivity: at 50 to 74 deg. F (10 to 23 deg C), mean 0.146 Btu inch per square foot per hour deg. F (0.021 W/m K) per ASTM C518.
14. Typical Configuration: Rectangular.

2.3 ACCESSORIES

A. Fittings: In accordance with SMACNA Phenolic Duct Construction Standards or the ASHRAE Design Fundamentals Handbook Chapter 35 or the SMACNA HVAC Duct Systems Design Manual.

B. Support Systems:
1. Tiger Support and Wire Hanger Assembly.
2. Steel Channel Support and Threaded Rods.

C. Coupling Systems:
1. Tiger Clip Coupling System.
2. Aluminum Grip Coupling System.
3. 4-Bolt Coupling System.

D. Plenum Boxes:
1. Lightweight and easy to install.
2. For use with either pre-insulated duct or sheet metal systems.

E. Dampers:
1. Volume Control Dampers.
2. Fire Dampers.

F. Access Doors:
1. Metal insulated access doors.
2. Fabricated from the Kingspan KoolDuct System including the same insulation system, and to ensure a continuous vapor barrier.

G. Turning Vanes.

H. Reinforcement Systems.

I. Tools.

J. V-Groove sealant: Silicone with VOC content of 250 g/L or less.

K. Tape: Comply with UL 181A.
1. Product: Pressure-sensitive aluminum foil tape imprinted with manufacturer with UL markings,

manufacturer name, and date.
2. Minimum Width: 3 inch (75 mm).
3. Water, mold, and mildew resistant.

L. Self-Adhesive Gaskets.

M. Closures and Flanges.

2.4 FABRICATI0N

A. Fabricate ductwork with panels, joints, seams, transitions, reinforcements, supports, elbows, connections, and accessories in accordance with SMACNA Phenolic Duct Construction Standards and the manufacturers' guidelines.
1. 90 degree mitered elbows shall include turning vanes.

B. Fabricate ductwork with branded foil facing consistently inside the duct system.

2.5 FINISH

A. Interior Ductwork - Standard Finish: Factory-applied aluminum foil vapor barrier facing.

B. Exterior Ductwork – Dual-Tech pre-fabricated, double layer ducting system.
1. Inner layer shall be R-8 Kingspan Koolduct.
2. Outer layer shall be R-8 Kingspan Koolduct.
3. Assembled R-value of R-16.
4. Exterior jacket shall be .032 aluminum in a standard satin white finish (other finishes available).
5. Acceptable Supplier: PTM Manufacturing, LLC. Newark, DE 19713. (800) 455-1402. www.ptmmanufacturing.com

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

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

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions using the fewest joints practical. Unless otherwise indicated, install tight to the building structure, parallel or perpendicular to building lines.

B. Support: Installer is responsible to ensure duct system is properly and adequately supported using materials that are compatible with the duct system, with supports typically located in straight runs, changes in direction, at branch connections, tee fittings, and in accordance with industry best practices.
1. Dampers and accessories shall be independently supported.
2. Provide flexible connections between ductwork and adjacent materials subject to vibration or movement.
3. If noise and vibration generated by the fan is likely to cause an issue, metal support members shall be separated from ductwork with soft gasket material.

C. Join sections in accordance with SMACNA Phenolic Duct Construction Standards or using manufacturers system.

D. Reinforce sections in accordance with SMACNA Phenolic Duct Construction Standards or as recommended by the manufacturer to prevent side deformation from positive or negative pressure.

E. Apply Kingspan KoolDuct silicone sealant at each internal seam to ensure minimum air leakage.

F. Tape external seams to ensure a permanent, smooth, wrinkle-free bond.

G. Install control devices and equipment to allow access for operation, repair, and maintenance.

H. Install access doors where indicated and where required for concealed equipment, seal air tight.

3.4 FIELD QUALITY CONTROL

A. Commissioning: Include testing and verification of functional and operational performance at intended pressure and temperature ranges, training for operations and maintenance, and documentation. Commissioning test pressure shall not exceed the pressure rating to which the ductwork has been designed and fabricated; max commissioning 4 inch w.g. (1000Pa.)

B. Air Leakage Testing: Test in accordance with ASHRAE 90.1 and with SMACNA HVAC Air Duct Leakage Test Manual., including operation at static pressure on at least 25 percent of the total installed duct area.

3.5 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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SECTION 233113 - AIR DISTRIBUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of all air distribution items as indicated on the drawings and as specified.

B. Work Included:

1. Ductwork.
2. Access Doors.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials and methods meet or exceed minimum requirements as specified.

D. **Under no circumstances shall OBD's or butterfly dampers be used on any registers. In accessible areas manual dampers shall be used. In hard lid ceiling areas, remote cable dampers shall be used. Access panels shall not be used to access any damper in a hard lid ceiling.**

E. Mechanical rooms and Electrical rooms shall not be used as return air plenums. Hard duct OSA & R/A directly into FCU's.

F. **Return Air, Exhaust, Air Make-up & OSA ducts shall be steel duct work connections. Flexible duct shall not be used for these types of terminations**.

G. Exterior Duct & Serviceability

1. Exterior duct shall have a minimum 18" clearance from the roof deck.
2. Provide engineered stamped & OSHA approved steps over duct to easily access all areas of the roof.

1.4 SUBMITTALS

A. **Provide submittals as required in section 230010, "Submittal Process."**

PART 2 – PRODUCTS

2.1 SHEET METAL DUCTWORK

A. Ducts shall be constructed of new-galvanized steel sheets and erected in a first class manner, straight and smooth, with joints neatly finished, anchored securely to the building and free from vibration.

B. All ducts penetrating fire walls shall be minimum **26-gauge** galvanized steel regardless of SMACNA Standards.

C. All elbows shall be curved elbows with a centerline radius equal to 1-1/2 times the width of the duct. Air turns consisting of curved metal vanes, arranged to permit the air to follow abrupt turns without appreciable turbulence shall be installed in square elbows, only where approved by the engineer. Air turns shall be the manufacturer's standard products, and shall be quiet and free from vibration.

D. All primary and secondary ductwork of constant volume, shall be fabricated in accordance with the Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA) "HVAC Duct Construction Standards, Metal and Flexible, Second Edition, 2005". The duct static pressure rating for this duct shall be two times the external static pressure of the system fan. The requirements for the seal class corresponding to the above static pressure shall be met.

E. Longitudinal joints shall be Pittsburgh lock or Acme grooved seam. Side panels greater than 10 inches in depth shall be cross-broken for added stiffness.

F. **Transverse joints (With a side wall larger than 14") shall be Ductmate, TDC or types**

fabricated according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

G. **Round steel duct shall be spiral duct construction in all commercial applications. Snap lock round duct is acceptable in residential construction only.** Round or oval ductwork shall be fastened together with a minimum of three sheet metal screws (1 every 12") equally spaced around the perimeter of the duct. Ductwork shall be furnished complete with all factory fabricated starting collars, Saddle taps, Y shaped branch takeoffs, adjustable elbows, etc.

H. At each major branch from a primary rectangular or square trunk duct, and where shown on the drawings, install a splitter damper or multiblade adjustable air pickup. Splitter damper shall have end bearings and consist of a blade constructed of 20 gauge-galvanized steel securely riveted or welded to a square operating rod. The length of the splitter blade shall be 1-1/2 times the width of the split in the main duct, but in no case less than 12". Multi-blade adjustable pickup shall be as manufactured by Titus Model AG-45 or approved equal with operator adjustable from the duct exterior.

I. Each individual air supply duct tap shall be equipped with a volume control device for the manual adjustment of airflow in each tap. Face bars, blanks, and equalizing grids shall not be used to regulate airflow.

J. Volume dampers shall have end bearings and be multi-blade type with opposed acting blades linked together and controlled by a single operator. Multi-blade dampers shall be not less than No. 16-gauge galvanized steel mounted to plenum or ductwork per SMACNA requirements.

K. Regulators shall be stamped galvanized steel, lever type with locking screw mounted on face of ductwork or concealed type with adjustable cover plate as manufactured by Young Regulator Model No. 315 with 2-1/4" diameter cover plate or approved equal.

L. Damper quadrants, volume dampers and other duct flow control quadrants shall be as manufactured by Young Regulator or approved equal.

M. For all areas where damper adjustments cannot be accessed through the ceiling, Bowden cable controls shall be used. Damper controller and cable shall be concealed above the ceiling. Cable shall consist of Bowden cable 0.054" stainless steel control wire encapsulated with 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of 270-896 bracket with a 7/8" diameter cold rolled steel zinc plated threaded cap suitable for painting, and 14 gauge steel rack and pinion gear drive converting rotary motion to push-pull motion. Control shafts shall be D-style flatted ¼" diameter with 265 degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability. Control kit shall be manually operated using Young Regulator Model 030-12 wrench. Provide a wrench for each cable control system installed. Control kit shall be Young Regulator Model 270-896P with tamper proof screws or prior approval equal.

N. On the inlet and outlet of each piece of air moving equipment or terminal unit, unless noted otherwise, install a flexible connection made with sufficient slack to render it flexible.

O. Furnish and install 26 gauge galvanized steel counter flashings for all ducts penetrating roofs and for all roof mounted equipment unless directed otherwise by the Architect.

P. All duct penetrations through the floor to another level must be sealed with 24 gage sheet metal fastened to the floor and duct sealing the hole. No open areas are acceptable. All Standards for penetrations through floors and fire safety must be followed.

Q. All exposed duct shall be fabricated with paint grip duct and shall be painted with

2.2 PRE-INSULATED HVAC DUCTWORK SYSTEM (Contractors Alternate)

A. Pre-Insulated HVAC Ductwork System: Provide Kingspan KoolDuct System for supply, return, fresh-air and exhaust air duct as shown in the contract drawings. System shall include panels, fabrication methods, coupling systems, and accessories to provide a complete system to meet the following performance criteria.

1. Classification: UL listed as a Class 1 Air Duct, to UL 181, NFPA 90A and NFPA 90B.
2. Fire & Smoke Performance must meet ASTM E84 or UL 723.
   b. Flame Spread <=25
   c. Smoke Developed <=50
3. Materials: CFC/HCFC free, zero Ozone Depletion Potential, fiber free rigid thermoset phenolic insulation core faced with 1mil low vapor permeability aluminum foil reinforced with glass scrim.
4. Nominal Density: 3.4 to 3.75 pcf (55 to 60 kg/m3).

5. Closed Cell Content: minimum 90 percent
6. Compressive Strength: Minimum 29 psi (200 kPa) at 10 percent compression.
7. Air Leakage: SMACNA Air Leakage Class 3.
8. Mean Air Velocity Maximum 5000 fpm (25.4 m/s) with all joints sealed.
9. Design Pressures:
    a. Positive Pressure: Maximum 4 inch w.g. (1000 Pa).
    b. Negative Pressure: Maximum 3 inch w.g. (750 Pa).
10. Commissioning Pressures - As designed to, max commissioning 4 inch w.g. (1000Pa.).
11. Temperature Range: Internal air temperature range -15 to 185 deg. F (-26 to 85 C) during continuous operation, inside ducts or ambient surrounding temperature.
12. Thermal Resistance, Wall Thickness and R-Value:
    a. 7/8 inch (22 mm) thick, R 6.0 square feet per hour F/Btu (1.047 square meter K/W).
    b. 1-3/16 inch (30 mm) thick, R 8.1 square feet per hour F/Btu (1.428 square
    c. meter K/W).
    d. 1-25/32 inch (45mm) thick, R 12 square feet per hour F/Btu (2.15 square
    e. meter K/W).
13. Thermal Conductivity: at 50 to 74 deg. F (10 to 23 deg C), mean 0.146 Btu inch per square foot per hour deg. F (0.021 W/m K) per ASTM C518.
14. Typical Configuration: Rectangular.

B. ACCESSORIES
1. Fittings: In accordance with SMACNA Phenolic Duct Construction Standards or the ASHRAE Design Fundamentals Handbook Chapter 35 or the SMACNA HVAC Duct Systems Design Manual.2.
2. Support Systems: Tiger Support and Wire Hanger Assembly. Steel Channel Support and Threaded Rods.
3. Coupling System: Tiger Clip Coupling System. Aluminum Grip Coupling System. 4-Bolt Coupling System.
4. Access Doors: Metal insulated access doors. Fabricated from the Kingspan KoolDuct System including the same insulation system, and to ensure a continuous vapor barrier.
5. Turning Vanes
6. V-Groove Sealant: Silicone with VOC content of 250 g/L or less.

C. FABRICATION
1. Fabricate ductwork with panels, joints, seams, transitions, reinforcements, supports, elbows, connections, and accessories in accordance with SMANCA Phenolic Duct Construction Standards and the manufacturer guidelines.
    a. 90 degree mitered elbows shall include turning veins.
    b. Interior Ductwork: Standard finish.
    c. Exterior Ductwork: Dual-Tech pre-fabricated, double layer ducting system.
        1. Inner layer shall be R-8 Kingspan KoolDuct
        2. Outer layer shall be R-8 Kingspan KoolDuct
        3. Exterior layer shall be .032 aluminum.

2.3 EXTERIOR DUCTWORK
A. Exterior duct system shall be Dual-Tech system, by PTM Manufacturing, LLC. Newark, DE, 19713. (302) 455-9733. PTM design guidelines shall be strictly adhered too. Duct work shall be Double Wall Kingspan KoolDuct encased with PTM beaded and silicone sealed white .032 Aluminum.
B. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
C. Outdoor Ductwork Insulation Material:
1. Duct work shall be double wall R8 (30mm) Kingspan KoolDuct. The panels used in the fabrication of Dual-Tech ductwork from the Kingspan KoolDuct System shall be Kingspan KoolDuct rigid phenolic insulation panels of nominal dimensions 12.89 ft

x 3.94 ft and minimum compressive strength 29 psi, as manufactured by Kingspan Insulation Ltd and detailed in App. A1.

2. Kingspan KoolDuct rigid phenolic insulation panels shall comprise a 3.4–3.75 pcf nominal density CFC/HCFC–free rigid phenolic insulation core with zero Ozone Depletion Potential (ODP), autohesively bonded on both sides to a 1 mil low vapor permeability aluminum foil facing reinforced with a 0.2" glass scrim.
3. Kingspan KoolDuct rigid phenolic insulation panels are available in thicknesses of 1 3/16" (R-8.1 ft2.hr.ºF/Btu), as per design Thermal Requirements for double wall and a combined R16 thermal value.
4. All other components required for the fabrication of ductwork from the Kingspan KoolDuct System including the silicone sealant, contact adhesive, aluminum tape, self–adhesive gasket, ductwork reinforcements, closures, connectors and flanges shall be as approved / supplied by Kingspan Insulation Ltd.
5. Weather barrier shall be fabricated of mill finished white aluminum sheeting, 0.032" in thickness. Exposed seems to be covered with 1" butyl and a 8" embossed aluminum beaded bands, secured with #10 self tapping, stainless screws with weather seal washers.
6. At weather barrier abutment locations, an industrial grade RTV silicone caulk shall beutilized, where applicable.
7. Seams exposed to the weather shall be covered and sealed with a 1" wide by 1/8" thick butyl compound.
8. All screws utilized to fasten panel system together shall be #10 x 1/2" self-tapping, stainless steel, weather seal washer screws painted white.
9. Contact cement or 2-sided adhesive tape shall be utilized for laminating insulation material to the weather barrier sheeting.
10. 8. Foil tape used for sealing the insulation edges shall be a minimum thickness of 1.25 mil.

C. Fabrication

1. Sizing: Panel system shall be sized in four overlapping sections to provide a complete seal surrounding KoolDuct ducting. Shall be laminated to the weather barrier and sized to allow for sufficient overlap as indicated in section 3.0 above. Second wall ducting shall be adhered utilizing appropriate contact method.
2. Where feasible all general fabrication shall be performed in the shop and be based off of approved project drawing or direct field measurements.
3. Field fabrication should be limited to routing and sealing of the ducting sections to allow for duct angle, supports, gauges or other duct related necessities. All routed areas shall be resealed with appropriate foil faced cast tape. No insulation/phenolic material shall be exposed to the environment.

D. Fire & Smoke Performance

1. The rigid phenolic insulation panels used in the fabrication of KoolTech ductwork and / or ductwork sections fabricated from the Kingspan KoolDuct System shall achieve the following fire and smoke performance requirements:
   a. ASTM E 84–08a – unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke Developed indices;
   b. UL 723 – unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke Developed indices; and
   c. UL 181 – UL/ULC classification as a Class 1 Air Duct to NFPA Standards 90A & 90B.

E. Sealants

1. All internal seams must be fully sealed with an unbroken layer of silicone sealant.
2. Each ductwork section must be duly connected with a jointing system approved Kingspan Insulation Ltd., and sufficient silicone sealant should be applied in order to seal the rigid phenolic insulation panel and ensure minimum air leakage.
3. Ductwork reinforcement, if necessary, shall be applied to protect against side deformation from both positive and negative pressure.

4. All external seams where two separate panels join must be taped to achieve a permanent bond and a smooth wrinkle free appearance.

F. Hangers & Supports
   1. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
      a. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick.
      b. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick.
   2. Hanger Materials: Galvanized sheet steel or threaded steel rod.
      a. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
      b. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards—Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
      c. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

2.4 FLEXIBLE DUCTWORK

A. Core material shall be a PVC Coated Fiberglass reinforced fabric supported by helically wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesive.
B. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2-1/2 times the working pressure.
C. The duct shall be rated for a velocity of at least 5500 feet per minute.
D. Suitable for operating temperatures of at least 250 degrees F.
E. Factory insulate the flexible duct with flexible fiberglass insulation. The R value shall be at least 6.0 at a mean temperature of 75 degrees F. (R4.2 not acceptable)
F. Cover the insulation with a reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, procedure A.
G. The ductwork shall be UL 181 listed, Class 1 Air Duct and comply with NFPA 90A and NFPA 90B.
H. Duct shall be secured with metal bands.
I. Duct shall be Flexmaster Type 8M or pre-approved equal

2.5 ACCESS DOORS

A. Provide access doors equal to Nailor-Hart Ind., Inc. Series 0800.
B. Access doors are not permitted in public areas of buildings.

2.6 FIRE AND SMOKE DAMPERS

A. Provide combination fire and smoke dampers where shown on the drawings. Dampers shall meet all requirements of fire dampers and additionally shall include an operating shaft, which, when rotated 90 deg., causes the damper to operate between closed and open. All dampers shall comply with the requirements of UL-555S, 350°F temperature rating and with pressure and velocity levels as required by the installation. Provide breakaway duct connects as required by UL.
B. **Each damper shall be provided with and end switch**.
C. **Each damper shall have a duct door with-in 6" of the outlet of each damper. The minimal size duct door shall be no less 8x8**.
D. Each damper shall be furnished complete with 18 gauge galvanized factory sleeve and damper operator (pneumatic or electric to conform to control system) factory installed on exterior of sleeve and properly linked to damper operating shaft. Operators shall be UL listed and labeled as Fire Damper Operators.
E. Each damper shall be activated by a duct smoke detector provided by Division 26.
F. Dampers shall be as manufactured by Ruskin, Nailor-Hart or approved equal.
G. Wiring
   1. Each smoke zone shall be wired on a separate circuit.
      a. Each fire/smoke damper shall be wired on a separate circuit in each designated zone.
      b. Each smoke damper for make-up air shall be wired on a separate circuit in each

designated zone, separate from the fire/smoke damper and the exhaust damper.

c. Each smoke damper for smoke exhaust shall be wired on a separate circuit in each designated zone, separate from the fire/smoke damper and make-up air damper.

PART 3 - EXECUTION

3.1 INSTALLATION - METAL DUCTS

A. All ductwork shall be installed as recommended by SMACNA and as shown or indicated on the drawings. Coordinate ductwork with all other trades and elements of the building construction.

B. All ductwork accessories shall be provided as specified or shown or indicated on the drawings, install as recommended by SMACNA and the manufacturer.

C. Ductwork shall be installed in a neat, workmanlike manner with ducts generally parallel to structure and tops of ducts as high as possible against building construction. Provide offsets as necessary to avoid obstructions, piping, or structural members.

D. Flexible ductwork shall be installed and supported as recommended by SMACNA and the manufacturer.

E. At each major branch from a primary rectangular or square trunk duct, and where shown on the drawings, install a splitter damper or multi-blade adjustable air pickup.

F. **Each individual air supply duct tap shall be equipped with a volume control device for the manual adjustment of airflow in each tap. Face bars, blanks, and equalizing grids shall not be used to regulate airflow.**

G. Volume dampers shall be installed within ducts or plenums where shown on the drawings and on all supply/return/exhaust taps for balancing of system.

H. **All Dampers shall be marked with a flag for easy identification of location.**

I. Round or oval ductwork shall be fastened together with a minimum of three sheet metal screws equally spaced around the perimeter of the duct and taped with an approved duct sealing tape. Ductwork shall be furnished complete with all factory fabricated starting collars, Y shaped branch takeoffs, adjustable elbows, etc.

J. Where ducts are in mechanical rooms or unfinished areas, or where dampers occur above lift out ceilings, regulators shall be stamped galvanized steel, lever type with locking screw mounted on face of ductwork. For all other areas, where damper adjustments cannot be accessed through the ceiling, regulators shall be the concealed type with adjustable cover plate.

K. On the inlet and outlet of each piece of air moving equipment, unless noted otherwise, install a flexible connection made with sufficient slack to render it flexible.

L. Where air intakes and/or discharges are indicated on the drawings and no air device is indicated, install 1/4" bird screens over each duct opening set in galvanized steel frames and securely attach to the openings.

M. Furnish and install 26 gauge galvanized steel counter flashings for all ducts penetrating roofs and for all roof mounted equipment unless directed otherwise by the Architect.

N. Provide concentric taps on all connections from the main duct to branch ducts.

O. Provide stamped steel duct access doors at each fire damper, fire and smoke damper, where control devices occur within ductwork, and as indicated on the drawings. Access doors shall be fully insulated where duct is lined internally. Provide with mounting flange, double thickness door with cam latch, gasket and retaining wire. No tools shall be required to open the access door.

P. The minimum size of each access door shall be sufficient to provide adequate access for the intended purpose of installation.

3.2 INSTALLATION – (Contractors Alternate)

A. Clean & Prepare surfaces using methods recommended by the manufacturer.

B. Install in accordance with manufacturer's instructions using the fewest joints as possible.

C. Support: Installer is responsible to ensure duct system is properly and adequately supported using materials that are compatible with the duct system, with supports typically located in straight runs, changes in direction, branch connections, tee fittings, and with SMANCA practices.

D. Install joint sections in accordance with SMANCA Phenolic Duct Construction Standards.

E. Tape External seams to ensure a permanent, smooth, wrinkle-free bond

F. Apply Kingspan silicone sealant at each internal seam to ensure minimum air leakage.

3.3 FIELD QUALITY CONTROL

A. Commissioning: Include testing and verification of functional and operational performance at intended pressure and temp ranges, training for operations maintenance and documentation. Commissioning test pressure shall not exceed the pressure rating to which the ductwork has been designed and fabricated.

B. Air Leakage Testing: Test in accordance with ASHRAE 90.1 and with SMANCA HVAC Air Duct Leakage Test Manual, including operation at static pressure on at least 25 percent of the total installed duct area.

3.4 DUCT SEALING

A. **All exposed duct shall be internally sealed, or gasket sealed fittings shall be used.**

1. Duct sealer on exposed joints will not be acceptable.

B. All seams, joints and taps must be sealed with a water and air tight sealant.

C. Sealer must be a Water Based Duct Sealer designed for use in high velocity air conditioning, refrigeration, ventilating, and air distributing systems up to 15w.g.. It must be suitable for use in both indoor and outdoor applications and exceeds all SMACNA Pressure and Sealing Classes.

1. Duct tape and Foil tape is not an approved sealer.

END OF SECTION

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SECTION 233150- HANGERS AND SUPPORTS FOR DUCK WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary identification items as indicated on the drawings and as specified.

B. Contractor shall field verify and coordinate all ductwork hangers and supports, dimensions, clearances, and ductwork elevations with new and existing building structures.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. All duct shall be installed in a quality workmanship. Ductwork shall be straight and level.

D. Methods of supporting ductwork shall be in accordance with the SMANCA Manual, Section 1 – Low Velocity Systems, unless otherwise shown on the drawings or specifications herein.

E. SMANCA – Sheet Metal and Air Conditioning Contractors National Association Inc.

F. Electrically operated and power actuated tools for installing welded studs and power driven fasteners, shall be listed by a nationally recognized testing agency.

1.3 SUBMITTALS

A. **Provide submittals as required in section 230010, "Submittal Process."**

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. 233113: Air Distribution

B. 230700: HVAC Insulation

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Type 1: Hangers shall be rod type hangers: Mild Carbon steel, unless otherwise specified: fully threaded with (2) removeable nuts on each end for positioning and locking rod in place. Rods must be galvanized or Cadmium plated.

B. Type 2: 1"-1.5" 24 gage galvanized strap. Strap must be fastened to SMANCA standards.

C. Type 3: Dyna-Tite Suspension system: Using aviation grade galvanized wire rope and cable locks. This application shall only be acceptable for round exposed duct.

D. Hangers for ducts shall be as specified in the SMANCA Manual, with the following exceptions.

1. Lower hanger attachments for rectangular duct with any dimensions 36" wide and above shall be trapeze hangers, supported by minimal 3/8 threaded galvanized rod.
2. Trapeze hangers shall be a minimum 1-1/2 x 1-1/2 x ¼" angle or 1-5/8 Unistrut larger size as required by larger or heavier ductwork.
3. Lower hanger attachments for rectangular duct maximum dimensions less than 30" 24 gage flat strap attached directly to duct. Fasteners penetrating duct must be completely sealed.
4. Wire used as supports or as banding shall not be acceptable.
5. Threaded support rods shall utilize sufficient support, jamb, and lock nuts to allow adjustment for duct heights.

E. **Exposed duct hangers shall be: Duct Mate Round duct hangers, Model: GRDM4703GA or similar.**

2.2 MISCELLANIOUS FASTENERS AND UPPER HANGER ATTACHMENTS

A. Machine Bolts and Nuts: Galvanized or cadmium plated steel.
B. Steel “C” clamps with lock nuts. Elcen Co. No. 29L, with 25B steel retaining clips.
C. Hilti KH-EZI All-thread concrete screw anchor
D. Hilti HMN nail in anchor.
E. Hilti HDI-P Threaded rod expansion fitting.
F. Sheet metal fasteners shall be a minimum #10x3/4 sheet metal screw.

2.3 BRANCH FITTINGS, JOINTS & TURNING VANES

A. Provide supports necessary for lengths over 16” or heights over 8”.

PART 3 - EXECUTION

3.1 UPPER HANGER ATTACHMENTS

A. General Note: Upper hanger attachments for ductwork shall be secured to overhead structural steel or steel bar joists wherever possible, unless otherwise specified.
B. When required by ductwork support spacing schedules, provide intermediate structural steel members, framed to span the structural steel or steel bar joists. The minimum size of structural steel members, for the use of intermediate steel framing, shall be 2-1/2 x 2-1/2 x ¼” steel angles. Steel members shall be shop primed prior to installation. Intermediate steel shall be sized for span and load to show no deflection.
C. Secure upper hanger attachments to bar joists at the panel points of joists.
D. Under no circumstance shall any hole be drilled in structural steel members.
E. Exercise extreme caution in the field drilling of holes in precast concrete work, to avoid damage to reinforcing. Power driven types of fasteners shall be utilized in the attachment of hangers to precast concrete work.
F. Upper hanger attachments shall be specified in the manual, with the following exceptions:
    1. Do not use flat bar, bent rod, or power activated drive pins as upper hanger attachments in concrete construction. Expansion nails or concrete screws shall be the only approved product.
G. Attachments to structural steel: Secure to steel beams with beam clamps, welded studs, or “C” clamps with locking nuts and safety bars.
H. **Under no circumstances shall power activated fasteners be used unless with prior written consent from the Mechanical Engineer’s Representative.**
I. Do not attach welded studs or power activated fasteners to steel less than 3/16” in thickness.
J. Attachments to Cellular Steel or Fluted Metal Decks: Do not support ductwork from cellular or fluted metal roof decks. Attach hangers to structural steel members wherever possible.
K. Riser Supports: Support vertical ducts by means of two steel angles or channels, anchor bolted to the floor slab or adjacent structural member at every floor through which the riser passes.
L. Steel angle or channel support sizes shall be as follows:

Max Side Dimension	Support Angle	Support Channel
36”	1 x 1x 1-1/8	1 x ½ x 1/8
48”	1-1/2 x 1-1/2 x 1/8	1-1/2 x ¾ x 1/8
60”	2 x 2 x 1/8	2 x 1 x 1/8
Over 60”	2-1/2 x 2-1/2 x 3/16	2 x 1 x 3/16

3.2 DUCT HANGER SPACING

A. Duct hanger spacing shall be in strict accordance with SMANCA and as follows:
    1. Rectangular Duct Hangers Minimum Sizes:

Max. Side of Duct Perimeter	Rod Pair at 10' Spacing	Rod Pair at 8' Spacing	Rod Pair at 4' Spacing
0-72	¼"	¼"	¼"
73-96	3/8"	¼"	¼"
97-120	3/8"	3/8"	¼"
121-168	½"	3/8"	3/8"
169-192	½"	½"	3/8"

2. Round Hanger Strap.

Duct Diameter	Strap Hangers	Max Spacing
4-26	(1) 1" x 22 Ga.	10'
27-36	(1) 1" x 18 Ga.	10'
37-50	(1) 1" x 18 Ga.	10'
51-60	(2) 1" x 18 Ga.	10'

END OF SECTION

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SECTION 233423 - HVAC POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary air handling items as shown on the drawings and/or specified.

B. Work Included:

1. Fans

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents. When requested, provide Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

1.4 ENVIRONMENTAL REQUIREMENTS

A. Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

1.5 EXTRA MATERIALS

A. Provide two sets of belts for each fan, not including the set installed on the fans. Tag sets to identify fan.

1.6 SUBMITTALS

A. **Provide submittals as required in section 230010, “Submittal Process.”**

PART 2 - PRODUCTS

2.1 GENERAL

A. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.

B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.

C. Fabrication: Conform to AMCA 99.

D. Performance Base: Sea level conditions.

E. Temperature Limit: Maximum 400 degrees F.

F. Static and Dynamic Balance: Eliminate vibration or noise transmission to occupied areas.

G. Greenheck, Cook or Penn may be used if they are equal in all respects to those specified. Provide manufacturers accessories as scheduled. Provide extra sheaves and belts if required to meet scheduled performance.

H. Base fan performance at standard conditions (density 0.075 Lb/ft^3).

I. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

2.2 SPUN ALUMINUM CENTRIFUGAL UPLBAST:

A. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum

with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curbcaps with a leakproof, continuously welded seam.

B. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

C. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

D. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

E. Standard with UL Listing for "Power Ventilators for Smoke Control Systems" for 500 degrees F for 4 hours and 1,000 degrees F for 15 min. Units have centrifugal backward inclined steel wheels with embossments on the blades and cooling fins for added strength and cooling. Flange Safety Vibration Isolators are oversized to accommodate the added heat and weight. Unit has heat baffle to reduce motor compartment temp. Unit shall have Dual Belt and Pulley System.

2.3 ROOF MOUNTED CENTRIFUGAL SUPPLY BELT DRIVE

A. Fans selected shall be capable of accommodating static pressure and flow variations of +/-10% of scheduled values.

B. Each fan shall be belt driven in AMCA arrangement 9 only with wheel secured to the fan shaft.

C. Fans are to be equipped with lifting lugs.

D. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be industrial gray. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

E. Fan housing to be aerodynamically designed with punched inlet and outlet flanges for ductwork connection on inline fans. Fan housing shall be constructed of rolled steel with a continuous seam weld. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings. OSHA compliant weatherhood, or an OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

F. Curb cap shall be constructed of painted steel and welded to the fan housing. Hoods shall be inter-locking panel style for superior strength. Hood construction shall be painted steel. One-half inch galvanized mesh bird screen shall be horizontally mounted in the intake perimeter of the hood.

G. The fan wheel shall be of the non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19. Wheel shall be constructed with completely welded aluminum. The maximum pressure capabilities shall be 4.5 inches W.G.

H. Aluminum parts shall not require protective coating.

I. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

J. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.

K. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.

L. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.

M. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.

N. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.

O. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.

P. Roof exhaust fans shall be upblast centrifugal belt driven type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curb caps with a leakproof, continuously welded seam.

Q. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

R. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

S. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

T. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment.

U. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.

2.4 ROOF MOUNTED UPBLAST BELT DRIVE

A. Fans selected shall be capable of accommodating static pressure and flow variations of +/-15% of scheduled values.

B. Each fan shall be belt driven in AMCA arrangement 9 only with wheel secured to the fan shaft.

C. Fans are to be equipped with lifting lugs.

D. After fabrication all carbon steel components shall be cleaned and chemically treated by a phosphatizing process to insure proper removal of grease, oil, scale, etc. Fan shall then be coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be industrial gray. Coating must exceed 1,000-hour salt spray under ASTM B117 test method.

E. Fan housing to be aerodynamically designed with punched inlet and outlet flanges for ductwork connection on inline fans. Fan housing shall be constructed of rolled steel with a continuous seam weld. Housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings. OSHA compliant weatherhood or an OSHA compliant belt guard shall be included to completely cover the motor pulley and belt(s).

F. Curb cap shall be constructed of painted steel and welded to the fan housing.

G. Windbands shall be constructed of heavy gauge painted steel with reinforced edges and bolted seams.

H. Butterfly dampers are to be supplied on all fans size 18 and greater. For fans smaller than size 18, stack cap dampers shall be provided. All dampers shall be constructed of aluminum.

I. The fan wheel shall be of the non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19. Wheel shall be constructed with completely welded aluminum. The maximum pressure capabilities shall be 4.5 inches W.G.

J. Aluminum parts shall not require protective coating.

K. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

L. Motors shall meet or exceed EPACT (Energy Policy ACT) efficiencies. Motors to be NEMA T-frame, 1800 or 3600 RPM, Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor.

M. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.

N. Fan shaft to be turned and polished steel that is sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.

O. Fan shaft bearings shall be Air Handling Quality, bearings shall be heavy-duty grease lubricated, self-aligning or roller pillow block type.

P. Air Handling Quality bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearings shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.

Q. Bearings shall be selected for a basic rating fatigue life (L-10) of 80,000 hours at maximum operating speed for each pressure class Bearings shall be fixed to the fan shaft using concentric mounting locking collars, which reduce vibration, increase service life, and improve serviceability. Bearings that use set screws shall not be allowed. Bearings shall have extended lube lines with Zerk fittings to allow for lubrication.

R. Roof exhaust fans shall be upblast centrifugal belt driven type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curbcaps with a leakproof, continuously welded seam.

S. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.

T. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts.

U. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.

V. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment

W. A fan conduit chase shall be provided through the curb cap to the motor compartment for ease of installation.

2.5 UTILITY SET FANS

A. Description: Direct-drive centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

B. Housing: Fabricated of galvanized steel with side sheets fastened with a deep lock seam or welded to scroll sheets.
   1. Housing Discharge Arrangement: Adjustable to eight standard positions.

C. Fan Wheels: Single-width, single inlet; welded to cast-iron or cast-steel hub and spun-steel inlet cone, with hub keyed to shaft.
   1. Blade Materials: Aluminum.
   2. Blade Type: Backward inclined.

D. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.

E. Shaft Bearings: Pre-lubricated and sealed, self-aligning, pillow-block-type ball bearings with ABMA 9, L50 of 200,000 hours.

F. Accessories: Provide as scheduled for each individual fan.
   1. Inlet and Outlet: Flanged.
   2. Companion Flanges: Rolled flanges for duct connections of same material as housing.
   3. Backdraft Dampers: Gravity actuated with counterweight and interlocking aluminum blades with felt edges in steel frame installed on fan discharge.
   4. Access Door: Gasketed door in scroll with latch-type handles.
   5. Scroll Dampers: Single-blade damper installed at fan scroll top with adjustable linkage.

6. Inlet Screens: Removable wire mesh.
7. Drain Connections: NPS 3/4 threaded coupling drain connection installed at lowest point of housing.
8. Weather Hoods: Weather resistant with stamped vents over motor and drive compartment.
9. Discharge Dampers: Assembly with parallel blades constructed of two plates formed around and to shaft, channel frame, sealed ball bearings, with blades linked outside of airstream to single control lever of same material as housing.

2.6 V-BELT DRIVES

A. All v-belt drives shall be designed for a minimum of 50% overload. Where more than one belt is required, matched sets shall be used. All belt drives shall be furnished with belt guards. **Belts on fans 10hp and over shall be Gates Poly-Chain.**

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. Install units with manufacturer recommended clearances for service and maintenance.
C. Install fans with resilient mountings and flexible electrical leads.
D. Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
E. Install fan restraining snubbers as required. Adjust snubbers to prevent tension in flexible connectors when fan is operating.
F. Install vent sets on equipment rails.
G. Provide fixed sheaves and belts if required to meet design conditions for final air balance.
H. Provide safety screen where inlet or outlet is exposed.
I. Provide backdraft dampers on discharge of exhaust fans where indicated.
J. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment".
K. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

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SECTION 233516 - VEHICLE EXHAUST REMOVAL/FILTRATION SYSTEM

PART 1 - GENERAL

1.1 SYSTEM DESCRIPTION

A. General
1. The ambient overhead vehicle exhaust air filtration system shall be manufactured in NJ Contact Air Technology Solutions 800-743-3323; Air Hawk 3000XL.
2. The air filtration units and activation systems shall work together to eliminate, capture, reduce the vehicle exhaust produced by apparatus in addition to contaminants generated from other sources. Sources of bay contamination may consist of airborne engine vapors, apparatus leaking seals, diesel and gas exhaust, soot, gas, carbon monoxide, nitrous dioxide, turn-out gear-out gassing, power saw or any other on-board emergency gasoline or diesel powered equipment. The system must be capable of the capture of intermittent exhaust migration due to apparatus or other internal combustion equipment being run on the facility tarmac or apron. Additional toxins to be captured must include Volatile Organic Compounds (VOCs), particulate, and lung damaging dust.

B. System:
1. The air filtration system shall be a totally automatic activated system that also contains a manual override system. The system shall be hands free, to allow emergency personnel to respond to the emergency at hand. The system shall automatically activate when the bay doors open, when apparatus egress and ingress the fire station or by means of several other methods as stated within. The filtration system shall operate for a minimum of twenty (20) minutes to complete station air cleaning. The system shall have the capability to increase this time to a maximum of one hundred (100) minutes on an initial activation. Additional manual override switches shall allow for each individual unit to operate on a 24/7 basis as deemed necessary by the end user initiate all units to operate on a predetermined set time; a reset to bypass the timer and terminate activation with a cascading down of units as they turn off.
2. The timer control shall be designed to sequentially start and stop the exhaust capture air filtration units to avoid power surges and contain only UL approved components. The timer control box shall be one hundred (100) percent low voltage (24V max) to eliminate shock hazards to personnel.

C. Test Data:
1. The system shall have documented evidence of having been successfully tested to meet regulatory health and safety standards in no less than two (2) active Fire/EMS departments. Each test shall have been conducted by a different independent testing laboratory under the direction of an independent industrial hygienist. One of the submitted test must show, with no exceptions, as a matter of personnel health and safety, that the system meets and/or surpasses federal regulatory standards for ACGIH, NFPA, BOCA, ASHRAE, EPA, OSHA, PEL (short term), TLV/STEL, and NIOSH. Test parameters shall include VOCs, NO2, SO2, CO, Particulates and Diesel Exhaust Particulates as one of the standards of measurement. The testing shall have been performed by a certified industrial hygienist and shall verify performance standards with the fire apparatus idling in bays, on the tarmac, and entering/exiting bays as would occur during normal station operation.

D. Equipment:
1. The filtration equipment shall be delivered and installed as a turnkey system with no requirement for station personnel involvement. The exhaust capture equipment will be self-contained three stage progressive filtration designed system. The system filtration media must be verified by the manufacturer to be capable of capturing vehicle exhaust with a blower and with a motor capable of a delivered volume of 3,000 cfm (cubic feet per minute) meeting NFPA and OSHA Standards.
2. Clean, filtered air shall be returned to the apparatus bay areas from the rear of the same system. There will be no heat/air loss or air exhausted to the outside atmosphere. The system equipment will not require building structural modifications. The system shall not

contain a catalytic oxidizer so as to eliminate/avoid excess water and carbon dioxide by-products within apparatus bays.

E. Equipment Features: The following features and capabilities shall exist as part of the system:
   1. Ceiling suspended design evenly distributing the unit weight.
   2. 230v, 50/60Hz Power with no less than a 3,000 cfm blower driven by 1hp motor, Rotational Sensing.ECM Motor to be supplied. No PSC Motor allowed. Brush less-DC permanent magnet motor to be supplied.
   3. Utilize a horizontal pull-through design for optimum exhaust elimination.
   4. Include dual V-Bank 98% DOP, MERV 16, and Gas Phase carbon blended with alumina 50/50 filters.
   5. Relocation or re-positioning capabilities, not a permanent fixture type system.
   6. Access internally sealed filter replacement compartment door utilizing two (2) swell latch handles to ensure safety in filter access and replacement.
   7. Compartment door must provide swell latch handles, no bolts, to open on the door for safety in height access and expediency in filter replacement.
   8. Rear LED filter change indicator to be visible from the floor level.
   9. Visible breaker switch light.
   10. Capable of 24/7 operation
   11. Maximum 65db sound level when in operation.
   12. Accommodate any vehicle or vehicle arrangement.
   13. Accommodate any ceiling height or ceiling construction.
   14. Front directional grille intake direction must force the entering exhaust into the filtration media.
   15. Units with no intake louvers are unacceptable due to lack of directional filtration intake.
   16. Must have rear baffle box to exhaust clean air back into bay areas through a minimum of more than 300 directional ports so as to evenly distribute return clean air and provide a fan sound control system for apparatus bay areas.

F. Equipment Activation: The air filtration system shall work in tandem with and include an automatic, hands-free, activation system featuring:
   1. Operation engineered through a wall mount Timer Control Maintenance Monitor (TCMM).
   2. No maintenance will be required over the entire life of the system. Excluding filters
   3. Housed in a NEMA 1 enclosure complying with UL and CSA specifications.
   4. TCMM to contain a 100-minute timer adjustable to operate in 10-minute increments from 10-100 minutes.
   5. TCMM switches to allow individual unit manual bypass opting for 24/7 operation.
   6. TCMM to have an external timer Bypass switch for immediate system shutdown. System to automatically reactivate under any normal activation inputs.
   7. A photoelectric eye to span up to 200 contiguous feet of bay doors and be able to operate at least seven (6-7) feet off the floor. Doors not in line with other doors or having obstructions with over four (4) feet of wall or barrier protrusions eliminating a clear line of site will require a separate photoelectric eye beam.
   8. Apparatus leaving bays must activate all units within the apparatus bay.
   9. TCMM engineering to sequentially start and stop filtration units with two (2) second and one (1) second delay respectively to avoid station power surges.
   10. TCMM must have the capability to accommodate up to six (6) filtration units per control unit for future system expansion.
   11. System shall be able to accept up to three (3) alternate methods of activation including:
      a. Apparatus ignition activation, Kussmaul Model #091133 or equivalent
      b. Activation in response to signal from CO/NO2 monitor utilizing Honeywell Model E 3 Point or equivalent

G. Equipment Safety: The system shall include the following safety features:
   1. All TCMM control wiring shall be low voltage (24 VAC max) to eliminate electrical hazard.
   2. TCMM will house internal visible LED indicators for all “ON” units.
   3. All components must be UL registered.
   4. Filtration units shall have an integral overload breaker switch to work in tandem with electrical panel breakers.
   5. Filtration unit blower and wiring to be contained in a single blower box compartment, inaccessible to personnel.
   6. TCMM shall have an input to disable all filtration units during a building fire alarm and then

return the filtration units to normal operation after the alarm situation is resolved or turned off.

7. System shall be capable of cycling down or up when turned ON or OFF to avoid power surges.
8. Filter tracks to ensure safe filter replacement.
9. System shall not house a catalytic convertor to avoid excess carbon dioxide and water by products in the bay areas.

H. Equipment Filters:

1. All filtration media shall be separately housed in a self-contained compartment with sealing on the filter door to avoid gas/particulate bypass, tight fit, slide track, filter compartment to eliminate diesel and contaminant bypass of the individual filters. The filter door closure shall contain seals to avoid bypass air.
2. Prefilter Panel:
    a. Filter shall be capable of providing a minimum efficiency reporting value of MERV 8 when evaluated under the guideline of ASHRAE Standard 52.2.19.
    b. Filter placement shall follow the front directional louver grille and fit snugly within a track.
    c. Filter shall be no less than 24”x24”x4” (nominal), including frame, incorporating filtration media no less than 26.6 ft2.
    d. Initial filter airflow resistance shall be maximum 0.25 in w.g.
    e. Filter airflow capacity at 300 fpm (feet per minute) shall be 1200 cfm.
    f. Filter airflow capacity at 500 fpm shall be 2000 cfm at 0.25 in w.g.
    g. Filter frame shall be composed of moisture resistant heavy duty beverage board frame.
    h. Filter shall be two (2) piece construction with double wall thickness around the outer edge and integral die cut cross member.
    i. Filter pleats shall have individual die cut fingers.
    j. Adhesive used shall be highly water repellent and cover the entire inside of the die cut frame.
    k. Filter pleat supports shall be composed of galvanized steel.
    l. Filter shall be classified by Underwriters Laboratories as UL Class 2.
    m. Filter shall be designed to perform up to six (6) to twenty-four (24) months and longer, based on environmental conditions and use.
3. High Efficiency Particle Filter Second Stage
    a. No less than 98% DOP MERV 16 ASHRAE rating, V-bank foundation DOP design to encompass a minimum surface of 200 ft2 and capable of removing particulate as small as 0.3µ in size.
    b. Filter shall be enclosed in a heavy-duty, moisture resistant die cut frame to eliminate warping, cracking, or distortion under normal operation conditions.
    c. Filter shall have integral pleat separators to provide pleat stabilization. Filter shall not contain aluminum or steel separators in between filter strata of each V bank section.
    d. Filter shall be effective at 100% relative humidity, turbulent air flow, intermittent exposure to water and repeated fan shutdowns.
    e. Initial filter airflow resistance at 500 fpm shall be 0.80 in w.g.
    f. Filter shall be rated to work from 0°F to 180°F.
    g. Filter shall be able to handle airflow volumes up to 3000 cfm.
    h. Filter perimeter header shall be secured by standard latches or clamping devices.
    i. Filter shall be leak free around the entire perimeter.
    j. Each mini-pleat pack shall be sealed within the heat resistant plastic end panels and galvanized steel support struts.
    k. Mini-pleats are to be separated by continuous beads of thermo-setting adhesive, not steel separators between mini-pleats.
    l. Filter shall measure no less than 24”x24”x12” (nominal), including frame and fit snugly into the track.
    m. Filter cannot be a flat face filter to avoid intense filter blockage.
    n. Filter shall be classified by Underwriters Laboratories as UL 900 Class 2.
    o. Filter shall be designed to perform up to twenty-four (24) to forty-eight (48) months and longer, based on environmental conditions and use.

4. Gas Phase Carbon/Alumina Filter:
    a. Filter shall contain a minimum of 26 lbs. of carbon blend with alumina, to include fifty (50) percent active premium grade coconut shell carbon blended with fifty (50) percent active alumina.
    b. Filter frame weight shall be separately calculated.
    c. Filter shall measure no less than 24”x24”x12” (nominal), including frame.
    d. Filter shall have V-bank design, not flat face surface, to provide extensive capture, extended life and fit snugly into the track.
    e. Filter shall ship with an after filter to prevent carbon duct from migrating downstream.
    f. Filter shall have galvanized steel support struts on both sides of the filter.
    g. Filter end caps shall be made from resilient ABS plastic.
    h. The honeycomb panels containing the carbon granules shall be water resistant.
    i. Non-volatile hot melt glue shall be used to bond the carbon panels, end caps and steel support members.
    j. Initial filter airflow resistance at 500 fpm shall be 0.38 in w.g.
    k. Filter cannot show evidence of air pockets between absorbent carbon/alumina.
    l. The gas phase filter shall be capable of controlling and eliminating VOCs, chemicals and gas of diesel contamination within the apparatus bays.
    m. Manufacturer shall provide evidence of facility certification to ISO 9001:2000.
    n. Filter shall be designed to perform up to twenty-four (24) to forty-eight (48) months and longer, based on environmental conditions and use.
    o. Automatic Activation Equipment
5. Carbon Monoxide/Nitrogen Dioxide (CO/NO2) Activation:
    a. The Honeywell E 3 Point, or equivalent, shall be integrated into the system for additional safety operation. The CO/NO2 monitor must be connected to the TCMM to engage the air filtration units automatically once the gas detector measures unsafe levels of CO and/or NO2 in the apparatus bays. The air filtration units are to operate until these gases are reduced to OSHA acceptable levels. These are two (2) separate monitor sensors. The CO monitor shall be installed within the Breathing Zone Five to Six Feet from the floor. The NO2 monitor sensor shall be installed a minimum of One to Four Feet from the Ceiling.
    b. When the sensors are activated, they shall be interlocked to have overhead grilles 154 and 155 to close and overhead sectionals doors 142 and 145 to open half-way till such time that the sensors are no longer activated or 10 minutes, whichever is longer.
6. Warranty shall be of at least two (2) years on all system parts and labor, excluding filters.
    a. Installation of the entire vehicle exhaust/air filtration system shall be performed by the successful manufacturer, or approved manufacturer’s qualified installers with experience of a minimum of Ten (10) similar department installations of the same type of equipment. Successful vendor is required to coordinate installation with the project mechanical and electrical contractors. The electrical contractor shall only be responsible for the electrical energy source to each filtration unit which shall be capable of providing the proper voltage and current requirements of the electrical components within the system. The vendor shall provide complete Installation, Operation and Service Instruction Manuals for each installation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of all necessary air handling items as shown on the drawings and/or specified.

B. Work Included:

1. Air Supply, Returns, Exhaust GRD's
2. Louvers.

C. **Submittals: Provide submittals as required in section 230010, "Submittal Process."**

1. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
2. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. **Under no circumstances shall OBD's or butterfly dampers be used on any registers. In accessible areas manual dampers shall be used. In hard lid ceiling areas remote cable dampers shall be used. Access panels shall not be used to access any damper in a hard lid ceiling.**

C. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents. When requested, provide Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

D. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

E. Test and rate performance of louvers in accordance with AMCA 500.

F. Exposed duct.

1. All exposed drops shall use round diffusers. Under no circumstances shall square diffusers be used on exposed duct.

G. Samples

1. Provide (1) Sample with specified factory finish as requested by Owner, Architect, Engineer prior to submitting. Approval of submittal contingent on approval of sample.

PART 2 - PRODUCTS

2.1 AIR SUPPLIES AND RETURNS:

A. Grilles, registers and ceiling outlets shall be as scheduled on the Drawings. Devices shall be the type, size, capacity, performance, and by the manufacturer scheduled or approved equal. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five foot occupancy zone will be not more than 50 FPM nor less than 25 FPM. Noise levels shall not exceed those published in the ASHRAE Guide for the type of space being served (NC level).

B. Locations of outlets on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan. Where called for on the schedules, the grilles, registers and ceiling diffusers shall be provided with deflecting devices and manual damper. These shall be the standard product of the manufacturer, subject to review by the Architect, and equal to brand scheduled.

C. All adjustable pattern lay-in type-ceiling diffusers shall be adjustable without the use of tools.

D. All ceiling mounted devices shall be provided with frames compatible with the ceiling type. Coordinate air device frame type and color with architectural reflected ceiling plans and Architect's room finish schedule to match adjacent surface in which the device will be installed.

E. Acceptable Manufacturers or as approved by Engineer
   1. Price
   2. Titus
   3. Krueger

2.2 LOUVERS

A. Aluminum fixed blade louvers shall be extruded aluminum, stationary stormproof type, with a drain gutter in each blade. Blades and frames shall be minimum 0.1 inch thick with reinforcing bosses and shall be of 6063-T5 alloy. Head, jamb and sill shall be of one piece structural member of 6063-T5 Alloy with integral calking slot and retaining bead. Supports and blades shall have provision for expansion and contraction. All fastenings shall be stainless steel or aluminum. Louvers shall be free of all scratches, blemishes and defects. Sizes shall be as shown on the Drawings. Louvers shall have a minimum free area of 50% and a maximum pressure drop of 0.02 inches of water at 500 feet per minute air velocity.

B. Structural supports shall be provided and designed by the louver manufacturer to carry a windload of not less than thirty-five pounds per square foot (35 psi).

C. Provide louvers with removable bird screens, consisting of aluminum frame with mitered corners and 0.063 inch (1.6 mm) diameter 1/2 inch aluminum wire mesh. Bird screen shall be attached to interior of louver with sheet metal screws or clips.

D. Provide backdraft dampers adjacent to each wall louver in all cases with exception of louvers that provide the introduction of combustion air .

E. Louver finish shall be as directed by Architect.

F. Acceptable Manufacturers:
   1. Greenheck
   2. Ruskin
   3. Pottorff

2.3 LOW SILHOUTTE ROOF HOODS

A. Gravity roof ventilators shall be constructed of heavy gauge aluminum. Hoods shall be constructed of precision formed, arched panels with interlocking seams. Bases shall be constructed so that the curb cap is 8 in. larger that the throat size. Hood support members shall be constructed of galvanized steel and fastened so that the hood can be either removed completely from the base or hinged open.

B. Birdscreens constructed of 0.5 in. galvanized steel mesh shall be mounted horizontally across the intake area of the hood. Intake units with throat widths through 42 in. shall ship assembled when throat lengths do not exceed 84 in.

C. Mount unit on minimum 12 inch high curb base with insulation between duct and curb. Bases shall be furnished for intake applications to restrict entry of moisture and for all applications where rain and snow may accumulate on the roof deck.

D. Make hood outlet area minimum of twice throat area.

E. Acceptable Manufactures
   1. Greenheck
   2. Kees, Inc.
   3. Penn Venilation
   4. COOK

PART 3 - EXECUTION

3.1 INSTALLATION

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

B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

C. Install diffusers to ductwork with air tight connection.

D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.

E. Paint ductwork visible behind air outlets and inlets matte black. If grille is not ducted then provide insulated boot with side opening in order to prevent visible systems above the ceiling.

END OF SECTION

SECTION 235000 - HEAT GENERATION EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. All other Sections of Division 23

B. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings for all requirements.

1.3 SCOPE

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of the heating system as indicated on the drawings and as specified. Provide factory trained start-up service for all equipment.

B. Work Included
1. Water heaters.
2. Flue pipe.
3. Electric Unit Heater.
4. Infrared Radiant heaters.

C. Submittals: **Provide submittals as required in section 23 00 10, "Submittal Process."**

1.4 QUALITY ASSURANCE

A. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 – PRODUCTS

2.1 Tankless Gas Water Heaters
A. Compliance: ANSI Z21.10.3/CSA 4.3.

B. Type:
1. Installation: Indoor or outdoor, wall hung.
2. Air Supply/Exhaust: Power vented, 4-inch flue.

C. Ignition: Direct ignition.

D. Operating Water Pressure: 15 to 150 psi.

E. Gas Supply Pressure:
1. Natural Gas: 5.0 to 10.5 inches.

F. Power:
1. Supply: 120 VAC, 60 Hz.

G. Temperature Settings:
1. Settings: 110°F Hot Water Outlet.

H. Material:
1. Casing: Zincified steel plate with acryl coating.

2. Flue Collar: Stainless steel.
3. Heat Exchanger: Copper sheeting, copper tubing.

I. Safety Devices: Flame rod, thermal fuse, pressure relief valve, wind pressure switch, lightning protection device (ZNR), electric leakage prevention device (GFCI), overheat prevention device, freezing prevention device, fan rotation detector.

J. Accessories:
1. Remote controller.
2. Remote controller cord.
3. Exhaust adapter.
4. Anchoring screws.
5. Outdoor vent cap.
6. Quick-connect cable.
7. Isolator valves.

K. Provide water heater as manufactured by A.O. Smith, Nortiz., or Rinnai.

2.2 TUBULAR INFRARED HEATERS

A. Fuel type: Burner shall be designed for natural gas having characteristics some of those of gas available at project site.

B. Gas control: Operation shall include a defined input differential. Heater must be CSA Design Certified to operate to on input differential of to least 30% between the low and nominal rated input modes.
1. The heater’s control system shall be designed to shut off the gas flow to the main burner in the event either a gas supply or power supply interruption occurs.

C. Combustion chamber: Shall be 4 inch O.D. 16 gauge titanium stabilized aluminized sheet (150-200 MBH to allow for the operating temperature to exceed the 1030"F as set forth in the ANSI 283.20 Standard) or aluminized steel (below 150 MBH), finished with a high emissivity rated corrosion resistant, block coating with on emissivity level documented at .92 or higher. (A 409 grade stainless steel chamber shall be used when specified for harsher environments).

D. Emitter tube: Shall be 4 inch O'D. 16 gauge aluminized steel finished with a high emissivity rated, corrosion resistant, block coating with on emissivity level documented to .92 or higher. (A 304 grade stainless steel emitter tube shall be used when specified for harsher environments).

E. Burner type: Unit shall be a positive pressure power burner with a combustion fan upstream of the burner and exhaust gases for component longevity, maximum combustion efficiency, and energy transfer. Negative pressure (pull through) type appliances will not be allowed.

F. Fan enclosure: Combustion fan shall be totally housed inside burner control box and not exposed. Appliances with exposed combustion/exhauster fans shall not be permitted.

G. Burner: Stainless-steel venturi burner. The flame anchoring screen shall have a minimum temperature rating equivalent to 304 grade stainless steel. Non stainless steel burners shall not be permitted.

H. Tube connections: The heater’s combustion chamber and radiant emitter tube shall incorporate a 4 inch slip fit, interlocking connection in which the upstream tube slides into the next tube and is held by a bolted clamp. A butted tube connection system shall not be permitted.

I. Ignition system : Hot surface silicon carbide capable of temperatures achieving 2400 F. Igniter shall be readily accessible and serviceable without the use of tools. Spark ignition systems shall not be permitted.

J. Reflectors: Shall be .025 polished aluminum with a multi-faceted design which includes reflector end

caps. Reflector shall have a polished bright finish with clear visual reflection ability. (A sample will be required at time of submittal). Reflector shall have a minimum of 7 sheet metal bends in its fabrication to optimize downward radiation. Reflectors shall be rotatable from 0 to 45 degrees when required. The heater's reflector hanging system shall be designed to permit expansion while minimizing noise and/or rattles. (A 304 grade stainless steel reflector material shall be used when specified for harsher environments).

K. Control box: Heater's exterior control chassis shall be constructed of corrosion resistant enameled steel. (A 304 grade stainless steel housing shall be used when specified for harsher environments).
   1. The heater's top cover shall be constructed of ABS plastic material.
   2. Air intake: An air intake collar shall be supplied as part of the burner control assembly to accept a 4 inch O.D. supply duct.
   3. The heater's control comportment shall be accessible without the use of tools and serviceable while heater is operating.
   4. Outdoor modifications are required for any application that will be placed in space defined as outdoors. The rating label shall bear the outdoor certification approval.

L. Heaters shall be equipped with a sight glass allowing a visual inspection of igniter and burner operation from the floor. Sight glass visible only at appliance level shall not be permitted.

M. The heaters shall utilize a downstream turbulator baffle for maximum heat transfer.

N. Heater shall be supplied with a stainless steel flexible gas connector.

O. Burner Safety Controls:
   1. Heater controls shall include a safety differential pressure switch to monitor combustion air flow, as to provide complete burner shutdown due to insufficient combustion air or flue blockage.
   2. The heater shall incorporate a self-diagnostic ignition module, and recycle the heater after an inadvertent shutdown.
   3. The heater's control system shall be designed to shut off the gas flow to the main burner in the event either a gas supply or power supply interruption occurs'
   4. The heater's blower motor shall be thermally protected and the motor's impeller shall be balanced.
   5. Heater control assembly shall include three indicator lights that define the units operating input ranges' One indicator shall validate air flow. Two indicator lights shall indicate low and high firing stages.
   6. The heater's air flow control system shall provide a 45 second pre-purge prior to initiating burner operation and a 90 second post-purge upon completion, effectively removing all products of combustion from heat exchanger and/or radiant tubes.
   7. No condensation shall form as a result of combustion in the combustion chamber or radiant tubes while at operating temperatures'
   8. Thermostat control shall be two-stage operating on 24 volts.

P. Venting: Shall be per manufacturer approval and specifications.

Q. Thermostat: Devices and wiring as specified
   1. Thermostat: 2-stage, digital programmable wall mounting type with 50 to 90 deg F (10 to 32 deg C) operating range.
   2. Control Transformer: integrally mounted.

R. Provide units as manufactured by Superior Radiant Systems, Co-Ray-Vac, Reflect-O-Ray or Reverber Ray.

2.3 HEATER FLUES

A. Flue shall be double wall with galvanized finish, UL listed Type B as manufactured by Metalbestos or approved equal with AGA approved vent cap, roof flashing and storm collar.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed in accordance with the manufacturer's recommendations.

B. Vent Piping:
1. Install vent piping in accordance with manufacturer’s instructions.
2. Maintain same vent pipe diameter to end.
3. Ensure vent pipe is gas tight and will not leak.
4. Do not common vent or connect more than 1 appliance to venting system.
5. Terminate horizontal or vertical vent in accordance with manufacturer’s instructions.
6. Slope horizontal vent 1/4 inch downwards for every 12 inches.
7. Supply combustion air to units in accordance with ANSI Z223.1/NFPA 54.

C. Gas Piping:
1. Install gas piping in accordance with manufacturer’s instructions.
2. Leak test gas appliances and its gas connections before placing in operation.
3. Size gas piping in accordance with UPC or other accepted engineering method.

D. Electrical Wiring:
1. Install electrical wiring in accordance with manufacturer’s instructions.
2. Do not connect electrical power to unit until electrical wiring has been completed.

E. Start up on the equipment shall be performed by factory trained and authorized personnel. A copy of the startup report shall be provided to the owner and submitted in the O&M Manuals.

3.2 EQUIPMENT START-UP

A. Prior to operation, the factory start-up representative shall, in the presence of the Architect's representative perform all system and equipment checks as prescribed by the manufacturer in his written start-up procedures.

B. The factory start-up representative shall place the equipment in operation and record all start-up data. Three copies of all data shall be given to the Architect.

END OF SECTION

SECTION 238149 - VARIABLE REFRIGERANT AIR CONDITIONING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of a complete and operating refrigeration and air handling system as indicated on the drawings and as specified.

B. **Contractor Qualifications:**

1. **The contractor installing this system shall have installed a minimum of five (5) VRF systems of similar size or larger within the past three (3) years. Installation of one-to-one mini-splits is not considered equal to the experience of installing multi-zone VRV systems.**
2. **A list of projects, year project was installed and commissioned, installed tonnage (indoor units and outdoor unit), and reference contact information shall be provided in the submittal.**
3. **If this information is not provided Contractor may be disqualified or required to provide additional warranty including labor for a total of three years after substantial completion.**

C. Work included:

1. Variable Refrigerant Flow System

D. Submittals: **Provide submittals as required in Section 230010, "Submittal Process". in addition, and specifically related to the VRV/VRF portion of work:**

1. Equipment and total system capacities shall show the actual Total And Sensible capacities of all equipment after the following design considerations have been taken into account:
   a. Outdoor Ambient Conditions
   b. Altitude
   c. Entering Air Temperature into the FCU
   d. Refrigerant line diameters and length
   e. Refrigerant line diameters and length
2. Certifications form manufacturer showing trained workmen.

E. Installation and Commissioning

1. Manufacturer software shall be used to produce piping tree and shall be submitted (1) before ordering material, (2) confirmed/revised for actual field dimensions before welding/pressure testing, and (3) submitted after pressure testing to document final pipe sizes and lengths and shall be included as "As-Builts".
2. After the final piping connection is made, confirm that all valves within the refrigerant circuit are open, date/time stamped photos of the pressure gauge(s) at both the beginning and ending of a successful pressure test OR documented observation by a 3rd party along with ambient temperatures for the same period shall be submitted. The subcontractor shall be knowledgeable of the Ideal Gas Law to be able to judge a successful pressure test while ambient conditions vary. A pressure test shall be considered "successful" when it has held the manufacturer's stated PSI for the manufacturer's stated minimum duration. Additionally, the refrigerant circuit shall remain under pressure until the refrigerant circuit is prepared for start-up at which point it shall be measured and documented to match that of the original successful pressure test. **THE INSTALLER IS CHARGED WITH NOTIFYING THE JOBSITE OF SAFETY REQUIREMENTS CONCERNING WORKING NEAR PIPING UNDER PRESSURE.**
3. BEFORE START-UP, the installer shall purge the refrigerant circuit of nitrogen and pull a vacuum on the entire open circuit down to 500 microns and shall hold for 1 hour. It shall be measured and documented by Factory Authorized Commissioning Agent.
4. WARRANTY: VRF equipment shall come with a 10 year parts and compressor warranty. This warranty includes all the components that are factory installed within the VRF condensing units, fan coil units, branch selector boxes and wall mounted controllers. To ensure viability of the warranty it shall be supplied, in writing, by the equipment manufacturer and not the local sale representative. Warranty is parts only and does not include troubleshooting or labor. Other items shall have a 1 year parts warranty.

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section. At all times, their there shall be 1 manufacturer trained workman to every 5 untrained on site.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that the equipment meets or exceeds minimum requirements as specified.

D. All equipment shall have a minimum EER in accordance with ASHRAE 90.1 unless specified otherwise.

E. The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

F. All wiring shall be in accordance with the National Electric Code (NEC).

G. The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

H. All VRV/VRF equipment shall be stored protected from weather, extreme temperature, etc. as suggested by the manufacturer. All VRV/VRF equipment shall be moved, lifted, etc. as suggested by the manufacturer.

PART 2 - PRODUCTS

2.1 VARIABLE CAPACITY, VARIABLE REFRIGERANT VOLUME/VARIABLE REFRIGERANT FLOW SERIES

A. System Description: The variable capacity, heat recovery air conditioning system shall be a Variable Refrigerant Flow Series (simultaneous heat/cool model) system or equal as approved by Architect. The system shall have all components required by the plans and specifications so that once properly installed will create an operational Heat Pump (HP) or Heat Recovery (HR) as required by plans and specifications to operate in accordance with manufacturers listed performance. If required to meet capacities scheduled the system shall include multiple evaporators using PID control. The system shall consist of the following from the same manufacturer:

   a. R410A condensing units with inverter driven compressor(s)
   b. Multiple evaporator Fan Coil Units (FCUs) for use in VRF systems
   c. Refrigerant piping network “Y” branches as required.
   d. Refrigerant heat/cool change over boxes, as required
   e. DDC Control boards with PID loop, wall mounted FCU controllers, centralized touchscreen controller, as required.
   f. The system may connect up to 150% the nameplate tonnage of FCUs to condensing unit nameplate tonnages without effecting the ability for the system to operate as scheduled.
   g. For Heat Recovery systems, every indoor unit shall be independently capable of operating in either heating or cooling mode regardless of the mode of other indoor units. The system shall be capable of changing mode of individual indoor units (cooling to heating or heating to cooling) within a maximum time of 5 minutes to ensure indoor temperature can be properly maintained.

B. The outdoor unit shall be interconnected to indoor units in accordance with the manufacturer’s engineering data book detailing each available indoor unit. The indoor units shall be connected to the outdoor utilizing the manufacturers specified piping joints and headers.

C. Heat Pump systems shall consist of one (1) liquid refrigerant line and one (1) gas refrigerant line.

D. Heat Recovery system shall consist of (1) liquid refrigerant line and one (1) gas refrigerant line and (1) medium pressure gas line. System that attempt to use only 2 refrigerant lines in heat recovery mode shall provide heating scheduled in the units at the design conditions listed in ASHRAE for project location even if this requires an increase in quantity or size condensing units.

E. Units shall be as manufactured by Samsung or Daikin

2.2 CONDENSING (OUTDOOR) HEAT RECOVERY UNIT

A. General: Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter driven twin rotary compressors.

1. The maximum sound pressure rating for s single module shall not exceed 63.5dBa sound pressure in cooling and 65.5dBa in heating. For twinned systems the sound pressure numbers should not exceed 66.5 dBa and 68.5 dBa.
2. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV valve (metering device) to shut off completely when a zone is satisfied.
3. The outdoor unit shall be protected by a High-pressure switch, High-pressure sensor, Low-pressure sensor, Fusible plug, PC board fuse, and an inverter overload protector.
4. The outdoor unit shall be capable of operating in cooling mode down to 14°F ambient air temperature and down to -4°F WB ambient air temperature in heating. For simultaneous heating and cooling the unit shall be capable of operating between 14°F and 60°F ambient air temperature.
5. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows to move oil and refrigerant between twinned units if required even if one of the units is not running.

B. Unit Cabinet**:**

1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fans:

1. Outdoor fan shall discharge air vertically and be driven by a DC inverter variable speed motor with 64 steps that is capable of running down to 60 RPM.
2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
3. Motor shall be protected by internal thermal overload protection.
4. Fan blade shall be non metallic and shall be statically and dynamically balanced.
5. Outdoor fan shall be protected by a raised non metallic protective grille.

D. Compressors**:**

1. Each outdoor unit module shall be equipped with two or three inverter driven screw compressors with full range control to a level of 0.1 Hz.
2. Compressor shall be totally enclosed in the machine compartment.
3. Compressors shall be equipped with factory mounted crankcase heaters.
4. Internal overloads shall protect the compressor from over-temperature operation.
5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
6. Compressor assembly shall be installed on rubber vibration isolators.
7. To maximize compressor reliability, multiple compressors, within a module, shall be started and operated in variable patterns to ensure equal run time on all compressors.
8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.

E. Outdoor Coil:

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
2. The coil configuration shall be 4 sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.

F. Electrical Requirements:

1. All sizes shall utilize 208/230-3-60 or 460-3-60 field power supply.
2. Twinned systems shall have separate field power supply to each module.

3. Two core shielded low voltage cable is shall be required for communication between outdoor and indoor unit.
4. All power and control wiring must be installed per NEC and all local electrical codes.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
1. Controls: Compressor speed to match the refrigerant flow and capacity with the system requirements.
a. Outdoor fan motor speed for higher efficiency and lower sound.
b. Oil control for improved system reliability and comfort
c. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.
d. Control of compressor staging to maximize reliability and minimum run time on all compressors.
e. Module control of compressor operation, compressor speed, and outdoor heat exchange surface to maximize efficiency and sound level and reliability across the entire operating range of the system.
f. Control of the outdoor heat exchanger surface (main vs. sub heat exchangers) for maximum efficiency and comfort.
2. Safeties: The following safety devices shall be part of the condensing unit:
a. High pressure switch
b. Fuses
c. Crankcase heater
d. Fusible plug
e. Over current relay for the compressor
f. Thermal protectors for compressor and fan motor
g. Compressor time delay
h. Oil Recovery system
i. Oil level sensor
j. Over-current sensor
k. Compressor suction and discharge temperature sensor
l. Compressor suction and discharge pressure sensor

H. Refrigerant Piping and Line Lengths:
1. Piping connections shall be from the front or the bottom of the unit.
2. The unit shall be capable of operating with maximum connected refrigerant line lengths of 985 ft.
3. The outdoor unit should have the ability to operate with a maximum height of 165 ft. between the outdoor and the lowest indoor unit.
4. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 575 ft. No line size changes or oil traps shall be required.
5. The system should be capable of operating when the height difference between the upper and the lower fan coil is 130 ft.

I. Auxiliary Refrigerant Components:
1. All field supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
2. To ensure piping flexibility the system shall allow having Y joints or headers downstream of another header.
3. When twinning two modules, and in order to maximize efficiency and comfort, a 3/8” oil balance line shall be used to allow the flow oil and refrigerant between the two units even when one of the units is not running.
4. A refrigerant box will be required regulate the flow of high pressure hot gas or high pressure liquid to the fan coil requiring heating or cooling.
5. Up to 8 fan coils, all requiring same duty cycle, maybe connected to a single refrigerant box.
6. A fan coil that runs in cooling only will not be required to connect to a refrigerant box.
7. The refrigerant box can be installed up to 49 feet away from the indoor unit.
8. The flow selector box shall be wired from the indoor unit using a factory supplied power and control wire harness.
9. The refrigerant box shall not require a drain connection.

10. The refrigerant box shall include a galvanized steel enclosure, full interior insulation, and shall be tested prior to shipment.

2.3 CONDENSING (OUTDOOR) HEAT PUMP UNITS FOR HEATING OR COOLING

A. General: Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the multiple inverter driven twin rotary compressors.

1. The maximum sound pressure rating for s single module shall not exceed 62 dBa sound pressure in cooling and 63dBa in heating. For twinned systems the sound pressure numbers should not exceed 65 dBa and 66 dBa.
2. The outdoor unit shall include an oversized accumulator and a liquid tank for proper heating performance while allowing the indoor unit PMV valve (metering device) to shut off completely when a zone is satisfied.
3. The outdoor unit shall be protected by a High-pressure switch, High-pressure sensor, Low-pressure sensor, Fusible plug, PC board fuse, and an inverter overload protector.
4. The outdoor unit shall be capable of operating in cooling mode down to 23°F ambient air temperature and down to 5°F WB ambient air temperature in heating.
5. The outdoor unit shall include a total oil management system that balances oil between compressors within a module, replenishes compressor oil to the compressors in a module from the oil separator if required, and allows to move oil and refrigerant between twinned units if required even if one of the units is not running.

B. Unit Cabinet**:**

1. Unit cabinet shall be constructed of pre-coated steel, finished on both inside and outside.
2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressors, fan, and control components.
3. Compressors shall be isolated in a compartment and have an acoustic wrap to assure quiet operation.
4. The outdoor unit control panel shall include a sliding window to access adjustable controls and an LED display for setup and diagnostics.
5. Unit cabinet shall be capable of withstanding 500-hour salt spray test per Federal Test Standard No. 141 (method 6061).

C. Fans:

1. Outdoor fan shall discharge air vertically and be driven by a DC inverter variable speed motor with 64 steps that is capable of running down to 60 RPM.
2. Outdoor fan motor shall be totally-enclosed with permanently-lubricated bearings.
3. Motor shall be protected by internal thermal overload protection.
4. Fan blade shall be non metallic and shall be statically and dynamically balanced.
5. Outdoor fan shall be protected by a raised non metallic protective grille.

D. Compressors**:**

1. Each outdoor unit module shall be equipped with two or three inverter driven twin rotary compressors with full range control to a level of 0.1 Hz.
2. Compressor shall be totally enclosed in the machine compartment.
3. Compressors shall be equipped with factory mounted crankcase heaters.
4. Internal overloads shall protect the compressor from over-temperature operation.
5. Motor shall be suitable for operation in an R-410A refrigerant atmosphere.
6. Compressor assembly shall be installed on rubber vibration isolators.
7. To maximize compressor reliability, multiple compressors, within a module, shall be started and operated in variable patterns to ensure equal run time on all compressors.
8. To ensure maximum efficiency throughout the system operation range, no compressor is required to run at maximum speed under any condition.

E. Outdoor Coil:

1. Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.
2. The coil configuration shall be 4 sided and fully separated from the machine compartment for more effective heat transfer and sound isolation.
3. The coil fins shall have a factory applied corrosion resistant blue-fin finish.

F. Electrical Requirements:

5. All sizes shall utilize 208/230-3-60 or 460-3-60 field power supply.
6. Twinned systems shall have separate field power supply to each module.

7. Two core shielded low voltage cable is shall be required for communication between outdoor and indoor unit.
8. All power and control wiring must be installed per NEC and all local electrical codes.

G. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
1. Controls: Compressor speed to match the refrigerant flow and capacity with the system requirements.
a. Compressor speed to match the refrigerant flow and capacity with the system requirements.
b. Outdoor fan motor speed for higher efficiency and lower sound.
c. Oil control for improved system reliability and comfort
d. Pulse modulating valve control for precise control of the refrigerant distribution and accurate capacity management to avoid starving any units.
e. Control of compressor staging to maximize reliability and minimum run time on all compressors.
f. Module control of compressor operation, compressor speed, and outdoor heat exchange surface to maximize efficiency and sound level and reliability across the entire operating range of the system.
g. Control of the outdoor heat exchanger surface (main vs. sub heat exchangers) for maximum efficiency and comfort.
2. Safeties: The following safety devices shall be part of the condensing unit:
a. High pressure switch
b. Fuses
c. Crankcase heater
d. Fusible plug
e. Over current relay for the compressor
f. Thermal protectors for compressor and fan motor
g. Compressor time delay
h. Oil Recovery system
i. Oil level sensor
j. Over-current sensor
k. Compressor suction and discharge temperature sensor
l. Compressor suction and discharge pressure sensor

H. Refrigerant Piping and Line Lengths:
1. Piping connections shall be from the front or the bottom of the unit.
2. The unit shall be capable of operating with maximum connected refrigerant line lengths of 985 ft.
3. The outdoor unit should have the ability to operate with a maximum height of 165 ft. between the outdoor and the lowest indoor unit.
4. The maximum distance between the outdoor unit and the furthest fan coil shall not exceed 575 ft. No line size changes or oil traps shall be required.
5. The system should be capable of operating when the height difference between the upper and the lower fan coil is 130 ft.

I. Auxiliary Refrigerant Components:
1. All field supplied copper tubing connecting the outdoor unit to the indoor unit shall use factory supplied branching kits consisting of either Y joints or headers to ensure even refrigerant flow.
2. To ensure piping flexibility the system shall allow having Y joints or headers downstream of another header.
3. When twinning two modules, and in order to maximize efficiency and comfort, a 3/8” oil balance line shall be used to allow the flow oil and refrigerant between the two units even when one of the units is not running.

2.4 4-WAY CEILING CASSETTE INDOOR UNIT

A. General: Indoor, direct-expansion, low profile (10.1”) in-ceiling fan coil. Unit shall be complete with a coil, fan, DC inverter driven fan motor, PMV valve, piping connectors, electrical controls, microprocessor control system, integral temperature sensing, condensate pump with a lift capability of 26” (661 mm), and hanging brackets.

B. Unit Cabinet: Cabinet shall be constructed of zinc-coated steel. Fully insulated discharge and inlet grilles shall be attractively styled, high-impact non- metallic material. The inlet grille shall have hinges and can be opened to obtain access to the cleanable filters, indoor fan motor and control box. Fresh air can be introduced in two ways:
   1. Use an auxiliary fresh air intake flange to condition the outside air before it is introduced into the space.
   2. Use a fresh air inlet and filter chamber to introduce unconditioned outside into the space.

C. Fans:
   1. Fan shall be centrifugal direct-drive blower type with air intake in the center of the unit and discharge at the perimeter. Automatic, motor-driven vertical air sweep shall be provided standard. Automatic motor-driven louvers shall be provided standard and shall be adjustable for 2, 3 or 4-way discharge.
   2. Air sweep operation shall provide three user selectable modes.

D. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wet-ability. A drip pan under the coil shall have a factory installed condensate pump and drain connection for hose attachment to remove condensate. A replaceable element in the condensate disposal system provides antibacterial protection.

E. Motors: Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be inverter controlled variable speed.

F. Controls: The system shall be microprocessor controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control, and shall have an accuracy of 0.9 ^{O}F (+ 0.5 ^{O}C). Any of the following user interface accessories shall be compatible with the unit.
   1. Local Controller: Either a wired or a wireless controller can be used to control the system. The wireless kits shall have a remote receiver not integral to the unit. Wired remote controller shall communicate over two core shielded wire up to 1640ft/500m. It shall be capable of controlling groups of up to 8 indoor units. It shall be able to operate as a primary or secondary controller when two remote controllers are connected to a single indoor unit or group. The system shall be able to be configured so that the return air (TA) can be sensed at the unit, at the remote controller or through a remote sensor. The local controller shall minimally be able to control On-OFF, set point, mode, and be able to display system generated error codes.
   2. Central Controller: Central controller shall communicate over two core shielded wire up to 6562ft/2000m and use existing Indoor – Outdoor communication protocol to communicate. A Single Central Controller shall be capable of controlling up to 128 Indoor Units individually. It shall be able to create 4 Zones without any extra wiring. The Central Controller shall be equipped with digital input points for Force-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be capable of restricting Local Remote Control operation. It shall be able to facilitate Indoor operation without local remote controller(s).
   3. Advance Central Controller: The Advanced Central Controller shall be able to control up to 128 Indoor Units Individually. It shall also be able to create up to 128 Zones without any extra wiring. The Controller shall be equipped with digital input points for Force-OFF & External ON-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be able to restrict Local Remote Control operation and allow Set Back temperature. It shall provide a web interface for remote monitoring, control, and scheduling. It shall be able to create up to 10 programs per day. It shall facilitate Indoor operation without local remote controller(s). It shall be capable of monitoring energy consumption for each tenant and generate monthly billing reports.
   4. Building Management Systems
      a. The system shall be able to be controlled by BACnet, or Lon Works either directly or through an external gateway.
      b. BACnet shall be able to control: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation

c. BACnet shall be able to monitor: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation, Room temperature, Error status, Error code.

G. The unit shall have the following functions as a minimum:
1. Selectable automatic restart, after power failure the system will restart at the same operating conditions as before the failure.
2. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
3. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
4. Automatic air sweep control to provide multiple operating modes of the air sweep louvers.
5. Dehumidification mode shall provide increased latent removal through total system modulation.
6. Fan-only operation to provide room air circulation when no cooling is required.
7. Fan speed control shall be user-selectable: high, medium, low, or microprocessor determined (Auto) based on the differential between the room temperature and the set point during all modes of operations.
8. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
9. Cold blow prevention in heating.
10. Adjustable compensation for air stratification in heating.

H. Filters: Unit shall have factory-supplied resin net (cleanable) type filters. The return air filter material shall have the following characteristics:
1. Odorless
2. Temperature resistant to 185°F (85°C)
3. Humidity resistant up to 95% RH

I. Electrical Requirements:
1. Indoor units are 208/230-1-60.

2.5 HIGH STATIC CEILING-CONCEALED DUCTED INDOOR UNIT

A. General: Indoor, direct expansion, high static ducted fan coils. Unit shall be complete with a coil, fan, AC induction fan motor, PMV valve, piping connectors, electrical controls, microprocessor control system, integral temperature sensing, and hanging brackets.

B. Unit Cabinet: Cabinet shall be constructed of zinc-coated steel and configured for rear return.

C. Fans: The fan shall be of the multi-blade type with its performance designed to match the coil performance. The fan shall be statically and dynamically balanced to ensure low noise and vibration and capable of up to 1.18 In. WG external static pressure.

D. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wet-ability. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate.

E. Motors: Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection.

F. Controls: The system shall be microprocessor controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control, and shall have an accuracy of 0.9 ^{O}F (+ 0.5 ^{O}C). Any of the following user interface accessories shall be compatible with the unit.
1. Local Controller: Either a wired or a wireless controller can be used to control the system. The wireless kits shall have a remote receiver not integral to the unit. Wired remote controller shall communicate over two core shielded wire up to 1640ft/500m. It shall be capable of controlling groups of up to 8 indoor units. It shall be able to operate as a primary or secondary controller when two remote controllers are connected to a single indoor unit or group. The system shall be able to be configured so that the return air (TA) can be sensed at the unit, at the remote controller or through a remote sensor. The local controller shall minimally be able to control On-OFF, set point, mode, and be able to display system generated error codes.
2. Central Controller: Central controller shall communicate over two core shielded wire up to 6562ft/2000m and use existing Indoor – Outdoor communication protocol to communicate. A Single Central Controller shall be capable of controlling up to 128 Indoor

Units individually. It shall be able to create 4 Zones without any extra wiring. The Central Controller shall be equipped with digital input points for Force-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be capable of restricting Local Remote Control operation. It shall be able to facilitate Indoor operation without local remote controller(s).

3. Advance Central Controller: The Advanced Central Controller shall be able to control up to 128 Indoor Units Individually. It shall also be able to create up to 128 Zones without any extra wiring. The Controller shall be equipped with digital input points for Force-OFF & External ON-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be able to restrict Local Remote Control operation and allow Set Back temperature. It shall provide a web interface for remote monitoring, control, and scheduling. It shall be able to create up to 10 programs per day. It shall facilitate Indoor operation without local remote controller(s). It shall be capable of monitoring energy consumption for each tenant and generate monthly billing reports.
4. Building Management Systems
    a. The system shall be able to be controlled by BACnet, or Lon Works either directly or through an external gateway.
    b. BACnet shall be able to control: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation
    c. BACnet shall be able to monitor: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation, Room temperature, Error status, Error code.

G. The unit shall have the following functions as a minimum:
1. Selectable automatic restart, after power failure the system will restart at the same operating conditions as before the failure.
2. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
3. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
4. Dehumidification mode shall provide increased latent removal through total system modulation.
5. Fan-only operation to provide room air circulation when no cooling is required.
6. Fan speed control shall be user set to one of three speeds by using the taps on the motor.
7. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
8. Cold blow prevention in heating.
9. Adjustable compensation for air stratification in heating.

H. Condensate Pump:
1. The unit shall include a factory installed condensate pump that will be able to raise drain water a minimum of 20 inches above the ceiling cassette face.

I. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 Hz.
2. The indoor unit shall be capable of operation within voltage limits of +/-10% rated voltage.

2.6 WALL-MOUNTED INDOOR UNIT

A. General: Indoor, direct-expansion, wall-mounted fan coil. Unit shall be complete with coil, fan, DC inverter driven fan motor, PMV valve, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.

B. Unit Cabinet: Cabinet discharge and inlet grilles shall be attractively styled, high-impact non metallic material.

C. Fans:
1. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be standard.

2. Vertical air sweep operation shall be user selectable using the remote control and the horizontal air direction may be set manually.

D. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion and specially coated for enhanced wet-ability. A drip pan under the coil shall have a factory installed drain connection (on both ends) for hose attachment to remove condensate.

E. Motors: Motors shall be totally enclosed, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be inverter controlled variable speed.

F. Controls: The system shall be microprocessor controlled to maintain precise room temperature and minimum power consumption. The controls system shall employ a genetic algorithm for temperature control, and shall have an accuracy of 0.9 ^{O}F (+ 0.5 ^{O}C). Any of the following user interface accessories shall be compatible with the unit.

1. Local Controller: Either a wired or a wireless controller can be used to control the system. The wireless kits shall have a remote receiver not integral to the unit. Wired remote controller shall communicate over two core shielded wire up to 1640ft/500m. It shall be capable of controlling groups of up to 8 indoor units. It shall be able to operate as a primary or secondary controller when two remote controllers are connected to a single indoor unit or group. The system shall be able to be configured so that the return air (TA) can be sensed at the unit, at the remote controller or through a remote sensor. The local controller shall minimally be able to control On-OFF, set point, mode, and be able to display system generated error codes.
2. Central Controller: Central controller shall communicate over two core shielded wire up to 6562ft/2000m and use existing Indoor – Outdoor communication protocol to communicate. A Single Central Controller shall be capable of controlling up to 128 Indoor Units individually. It shall be able to create 4 Zones without any extra wiring. The Central Controller shall be equipped with digital input points for Force-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be capable of restricting Local Remote Control operation. It shall be able to facilitate Indoor operation without local remote controller(s).
3. Advance Central Controller: The Advanced Central Controller shall be able to control up to 128 Indoor Units Individually. It shall also be able to create up to 128 Zones without any extra wiring. The Controller shall be equipped with digital input points for Force-OFF & External ON-OFF. It shall provide operation monitoring, and generate a digital output signal in response to an alarm. It shall be able to restrict Local Remote Control operation and allow Set Back temperature. It shall provide a web interface for remote monitoring, control, and scheduling. It shall be able to create up to 10 programs per day. It shall facilitate Indoor operation without local remote controller(s). It shall be capable of monitoring energy consumption for each tenant and generate monthly billing reports.
4. Building Management Systems
   a. The system shall be able to be controlled by BACnet, or Lon Works either directly or through an external gateway.
   b. BACnet shall be able to control: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation
   c. BACnet shall be able to monitor: On / OFF, Operation mode, Fan speed, Louver, Set temperature, Permit / Prohibit of Local Operation, Room temperature, Error status, Error code.

G. Electrical:
1. The unit electrical power shall be 208/230 volts, 1-phase, 60 Hz.
2. The indoor unit shall be capable of operation within voltage limits of +/-10% rated voltage.

H. The unit shall have the following functions as a minimum:
1. Selectable automatic restart, after power failure the system will restart at the same operating conditions as before the failure.
2. Temperature-sensing controls shall sense return air temperature at the unit or at the remote control
3. Indoor coil freeze protection in both cooling and heating (reversing valve failure) modes.
4. Automatic air sweep control to provide multiple operating modes of the air sweep louvers.

5. Dehumidification mode shall provide increased latent removal through total system modulation.
6. Fan-only operation to provide room air circulation when no cooling is required.
7. Fan speed control shall be user-selectable: high, medium, low, or microprocessor determined (Auto) based on the differential between the room temperature and the set point during all modes of operations.
8. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature in heating.
9. Cold blow prevention in heating.
10. Adjustable compensation for air stratification in heating.

I. Accessories:
1. A condensate pump.
2. Programmable wired remote control
3. Refrigeration Lines
   a. All refrigeration lines must be hidden
      a. Through the wall entering through the back of the unit.
      b. Covered by a refrigeration wall escutcheon.

2.7 CONTROLS

A. General
1. Communication daisy chain wiring to be 2-conductor, twisted pair shielded cable throughout the system.
2. **All low voltage control wiring shall inside walls shall be installed into rigid conduit.**
3. **All exterior low voltage control wiring shall be installed in a liquid tight conduit.**

B. Central Control
1. The building shall be installed with a web-enabled factory native central controller. The controller shall provide web users to manipulate the following functions:
   a. On/Off Control
   b. Schedule-Adjustment
   c. Mode Selection
   d. Setpoint Control (Independent heating and cooling setpoints available)
   e. Operational Status and Alarm Notifications
   f. Provide with battery backup and USB port for software updates
   g. User and Administrator Levels with password protection.
   h. Customize groups and zones
2. The manufacturer or authorized agent shall commission the central controller to provide a dedicated login and password so that each resident is capable of web access to their A/C system and the building maintenance staff shall have access to the entire HVAC system. (Provide multiple Central Controllers as required for the number of fan coil units.)
3. The owner shall provide the manufacturer's agent with an IP address for each central controller.
4. CONTROL FOR NON-VRF EQUIPMENT – The VRF Central controller shall provide a fully integrated connection to the 100% DOA's units. If the 100% DOA's units are not compatible with the VRF Central controller, then a BACnet interface shall be provided for both VRF and OA units and the VRF supplier shall provide a web based central control interface with user interface to control the system. The central controller shall be capable of controlling the following functions of the 100% OA unit:
   a. Manual Start/Stop
   b. Setting of operation schedule
   c. Alarm notification and display of alarms
   d. Status

C. Individual Indoor Unit Controller - Wired Wall Mounted Controller (Thermostat)– Each zone/FCU shall include a 7-Day Programmable controller with the following features.
1. Backlit LCD display. Display information shall be selectable from English, French, or Spanish. Day of the week as well as time of day configurable for 12/24 hour clock shall be displayed. Display of temperature information shall be Fahrenheit. The controller shall be able to display and adjust room temperature in one degree increments.
2. Room temerature sensing Thermistor shall be included in the Zone Controller

3. The controller shall have COOL, HEAT, FAN ONLY, DRY (dehumidification), and AUTO-CHANGE-OVER modes.
4. For AUTO change over mode, the controller shall allow independent setpoints for heating and cooling to eliminate wide swings in temperature and unnecessary change over.
5. Setback function shall be included with adjustable setback temperature override.
6. The programmable controller shall have the capability of individually disabling the following buttons:
   a. Menu/OK
   b. ON/OFF
   c. Mode
   d. Fan Speed
   e. Setpoint Adjustment (Up/Down Keys)
7. The controller shall allow for a local (controller-level) adjustable limitation of user setpoint range.
8. SCHEDULING: The following scheduling capability shall be available:
   a. 7-Day, Weekday/Weekend, or Weekday/Saturday/Sunday schedule formats
   b. 5 Schedule events per day with independent heat/cool setpoints and/or setback.
   c. Off-Timer override function that will turn off the system at a set interval when scheduled to be off and a user enables the system
9. The Remote Controller shall display error codes on the screen in the event of a system error.
10. The following Fan Coil Unit sensor values shall be available at the wall mounted remote controller:
    a. Controller thermister temp
    b. (Refrigerant) Liquid line temperature
    c. (Refrigerant) Gas line temperature
11. 48 Hour battery back up of clock/date. All other settings shall be stored in non-volatile memory to ensure that settings are not lost upon power failure.

2.8 REFRIGERANT PIPING:

A. All refrigeration piping shall be installed per the standards of the “Piping Handbook”, and per specification 23 23 00.
B. Refrigerant piping shall comply with all other project specifications.
C. Refrigerant piping shall be installed in a neat and orderly fashion taking care to avoid to unnecessary traps, bends, elbows, kinks, etc.
D. Refrigerant piping shall be supported and secured at proper intervals as determined by code and saddled or otherwise installed such that the pipe insulation is protected from compressing by more than 50% of its original dimension.
E. The installer is responsible for strictly following the manufacturer’s guidelines for piping; including the angle and direction of manufacturer supplied fittings, observing rules pertaining to bends before and after manufacturer supplied fittings, and keeping within line length limitations between all equipment and manufacturer supplied fittings.
F. Pipe sizes, lengths, and elbows shall match exactly to the final piping tree produced by the manufacturer’s software and provided in approved submittals and shop drawings.
G. Piping shall be brazed while maintaining at least 2 psi of flowing nitrogen.
H. Flaring shall be performed as stated by the manufacturer and produced with tools recommended by the manufacturer.
I. Pipe insulation shall be a thickness as determined by the applicable code, but never less than the manufacturer’s stated guideline and shall be installed completely and without air gaps. Insulation shall be installed on ALL refrigerant pipes. Insulation on pipes exposed to weather shall be protected against UV radiation by coating or jacketing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment shall be installed as shown or indicated on the drawings and as recommended by the manufacturer.

B. Variable Refrigerant Flow (VRF) systems use a high pressure refrigerant and have unique installation procedures and requirements. It is imperative that the installation of these systems meet factory specifications in order for the systems to meet the expected performance and efficiency.

1. Factory training for installing technicians. – Prior to installation, the installing mechanical contractor must provide written proof that all installing technicians have received adequate training by the equipment manufacturer or approved alternate. Approved contractors who are awarded this project may contact the manufacturer to arrange training prior to installation for any unqualified technicians. The mechanical contractor's installation price shall be inclusive of the manufacturer's installation requirements including the cost of training, specialty tools, and cost charged by the manufacturer for technical assistance.
2. Job installation support and certification. – In order to assure properly installed system components and approved installation procedures, the specified manufacturer or approved alternate must provide installation technical support for the installing contractor via telephone and the internet, and job site supervision. Upon completion of installation and prior to factory startup, a factory authorized commissioning agent must inspect the installation of each system to verify proper installation. Upon verification of proper installation, the manufacturer is to submit a letter of certification approving the installation of their respective systems.
3. Factory Startup and Warranty Approval – Upon verification and written receipt of proper installation, a factory authorized commissioning agent is to perform a factory approved initial startup of all system components. Such that the requirements to receive the maximum manufacturer's warranty are met and confirmed with the manufacturer.

3.2 PRODUCT SUPPORT

A. Maintain a fully staffed service office within 400 miles (1 day drive) of the job site. Fully staffed means a full time secretary, complete service library, at least 2 factory trained service technicians and the factory recommended spare parts inventory.
B. Provide a 24 hour/7 day technical support phone number to factory service office. Support shall be for all components including controls, mechanical components, system operation and alarm codes, etc.
C. The Manufacturer or local representative shall maintain a complete parts inventory for all systems that will allow for 24 hour receipt of any necessary part.
D. Provide owner/operator and service training both on line and at designated training centers.

3.3 EQUIPMENT START-UP

A. The VRF system must be installed by a factory trained contractor/dealer.
B. The VRF manufacturer's rep shall witness and record 15% of the piping pressure tests. This shall include the first system installed. The contractor is responsible for recording all pressure tests and submitting in the O&M manual.
C. Equipment start up shall be by factory trained personnel. The startup shall be attended by the controls contractor and Test and Balance contractor.

3.4 PIPING SCHEMATIC

A. The VRF piping system must be installed by a factory trained contractor/dealer.
B. The VRF piping system must be installed by a factory trained contractor/dealer based on the manufacturers sizing recommendations.
C. Heat Pumps shall have full port refrigerant valves at each indoor unit and outdoor unit.
D. Heat Recovery shall have full port refrigerant valves on each side of the refrigerant box

END OF SECTION

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SECTION 23 82 39 - UNIT HEATERS

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. Electric unit heaters.
   2. Gas-fired, power vented, cabinet unit heaters.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Cabinet unit heater filters: Furnish one spare filter(s) for each filter installed.

1.5 SUBMITTALS

A. **Provide Submittals as required in section 23 00 10, “Submittal Process”.**

PART 2 - PRODUCTS

2.1 ELECTRIC UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. QMark (Marley Engineered Products).
   2. Chromalox, Inc.; a division of Emerson Electric Company.
   3. Redd-I (Division of TPI Corp.)

B. Description: A factory-assembled and -tested unit complying with ARI 440 and UL 2021.

C. Enclosure: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.

D. Configuration as scheduled:
   1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners. Minimum 0.0528-inch thick steel, finished to match cabinet, 4 inches high with leveling bolts. Minimum 0.0428-inch thick steel false back, finished to match cabinet.
   2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

F. Fan and Motor Board: Removable.
   1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: Permanently lubricated, multispeed, resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

G. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."
H. Electrical Connection: Factory wire motors and controls for a single field connection.

2.2 GAS-FIRED, POWER VENTED, CABINET UNIT HEATERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Reznor.
2. Modine.
3. Trane.
B. Description: A factory-assembled and -tested unit certified by the CSA to ANSI Z83.8b.
C. Cabinet: Galvanzied steel with powder coat finish with manufacturer's standard paint, in color selected by Architect.
D. Burner: One piece assembly with a single venture orifice, natural gas burner.
E. Heat Exchanger: Stainless steel tubes, four-pass serpentine style, fabricated with no welding or brazing, only tool pressed mechanical joints.
F. Category I combustion air/venting system shall include a vibration isolated power vented motor and wheel assembly, flame rollout switch and a combustion air pressure switch.
G. Electrical Connection: Factory wire motors and controls for a single field connection.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.
B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."
B. Install cabinet unit heaters to comply with NFPA 90A.
C. Install propeller unit heaters level and plumb.
D. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
E. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS
A. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."
B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL
A. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

END OF SECTION

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SECTION 26 00 10 – ELECTRICAL SUBMITTAL PROCESS

PART 1 – GENERAL

1.1 SUBMITTALS

A. Comply with all submittal provisions of Division 01.

B. Submit electronic copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Division 1 and 26 submittal requirements. Architects and consultants are to submit all submittals and RFI's to the mechanical engineer electronically. Send to **"mdengca@md-eng.com".** Submittals shall be labeled by their project specification section or CSI specification section if not listed in project specifications.

C. Contractor is responsible to separate submittals per specification section. Unseparated submittals are subject to rejection without review.

D. Allow a minimum of ten (10) working days for the review of submittals and each re-submittal.

E. Submittals that have been reviewed and marked as REJECTED (REJ) or REVISE & RESUBMIT (RES) should be resubmitted within 10 days to be reviewed again by engineer.

F. Compliance with the Contract documents shall be the sole responsibility of the Contractor. Items on equipment that are were not accepted by the Architect in writing as an approved equal shall be replaced or revised to comply with the contract documents at the Contractor's expense.

G. Resubmission of rejected submittals shall be limited to one (1) in number. Costs for processing subsequent resubmittals in excess of the first resubmittal, resulting from the Contractor's disregard of Architect/Engineer's primary submittal rejection comments, shall be borne by the Contractor. Costs shall be based on Architect/Engineer's hourly rates as published in their current professional fee schedules and shall also include reimbursable costs for delivery, mailing, and photocopies at direct cost-plus ten percent (10%).

1.2 REQUIRED SPECIFICATIONS (Project specific)

A. The chart below are the submittals required for the project.
   1. Submittals marked with an "**X**" are required for this project.
   2. Submittals without an "**X**" are not required for this project.

See required specifications on next page

Required X	Submittal Name	Spec Reference
X	**Common Work Results for Electrical** *-Submittals, Shop Drawings.*	26 05 00
	Electrical Demolition *-See Specification for information*	26 05 01
	Electrical Work in Existing Facilities *-Site Inspection Report*	26 05 02
X	**Fire Stopping** *-Materials*	26 05 03
X	**Low Voltage Electrical Power Conductors** *-Conductors, Cables*	26 05 19
X	**Grounding & Bonding** *-Materials, Chemical ground rod*	26 05 26
X	**Hangers & Supports for Electrical** *-Hanger & clamps, Fabricated devices*	26 05 29
X	**Conduit for Electrical Systems** *-Conduit & fittings, Supports*	26 05 33.13
X	**Boxes for Electrical Systems** *-Boxes, Floor Boxes*	26 05 33.16
	Cable Trays for Electrical Systems *-Cable Trays*	26 05 36
	IN-Floor Walker duct *-In-floor Duct Systems*	26 05 39
X	**Identification for Electrical Systems** *-Submit all marking systems per spec.*	26 05 53
	Overcurrent Protective Device Corr. Study *-Final Report*	26 05 73
	Electrical Testing *-Final Report*	26 05 93
X	**Disconnect Switches** *-Manufacturer, Switches, Components*	26 06 20
	Lighting & Receptacle (Relay) Panelboards *-Product Data per specification*	26 09 26
X	**Lighting Control System** *-Product Data per Specification*	26 09 23
X	**Occupancy Sensors** *-Sensor, Shop Drawing for sensor layout.*	26 09 55
X	**Low Voltage Underground Service** *-Metering Equipment, Raceways& Fittings*	26 21 16
	Low Voltage Transformers *-Product Data per Specification*	26 22 00
	Switchboards *-Manufacturer, Bus, Feeder protective devices* *-Metering, Enclosures, Name plates,*	26 24 13

Required X	Submittal Name	Spec Reference
X	**Panelboards** *-Manufacturer, Panelboards, Distribution* *-Lighting, Circuit breakers*	26 24 16
	Motor Starters *-Manufacturer, Manual, Combination* *-Magnetic*	26 24 22
	Tenant Metering *-Product Data per Specification*	26 25 00
X	**Electrical Cabinets & Enclosures** *-Hinged cover enclosures, cabinets, Fab.*	26 27 16
X	**Wiring Devices** *-Receptacles, Switches, Wall plates*	26 27 26
	Enclosed Switches *-Components*	26 28 16
	Package Engine Generators -Propane *-Rating, Engine, Alternators, Controls*	26 32 13.11
	Package Engine Generators - NG *-Rating, Engine, Alternators, Controls*	26 32 13.22
X	**Diesel Fuel Generator** *-Rating, Engine, Alternators, Controls*	26 22 13.33
	Uninterruptible Power Supply *-See Spec for all submittal information*	26 33 53
X	**Automatic Transfer Switch** *-Transfer Switch*	26 36 23
	Quick Disconnect Switch *-Heavy-Duty Double Throw Safety Switches*	26 36 33
X	**Facility Lightning Protection** *-Components*	26 41 00
X	**Surge Protection Devices** *-General Info, Design, Performance* *-Testing, Warranty*	26 43 00
	Lighting *-Shop drawings, Lamps, Fluorescent Ballast* *-Recessed, lenses, parts.*	26 50 00
	Digital Network Lighting Control System *-Qualifications, Products, Warranty.*	26 50 90
X	**LED Lighting** *-Product Data per Specification*	26 55 00
	Detention Lighting *-Fixtures, components, Security, Ballasts,* *-Exit signs, Emergency lighting, Lenses,*	26 55 63
X	**Telephone Data-Raceway System** *-Raceways*	26 55 64

Required X	Submittal Name	Spec Reference
	Disposal of Lamps *-Qualifications, Disposal data*	26 57 00
	Provisions of Elevators *-Qualifications, Power switch module* *-Pits, Elevator cabs.*	26 60 00
	Conduits and Backboxes for Communications *-Conduits, Boxes, Raceways.*	27 05 23
	Grounding & Bonding for Communications *-Product Data per Specification*	27 05 26
	Telecom Hangers & Supports *-Product Data per Specification*	27 05 28
	Cable Trays for Communications *-Product Data per Specification*	27 05 29
	Comm Cabinet Racks & Enclosures *-Product Data per Specification*	27 11 16
	Comm Termination Blocks & Patch Panels *-Product Data per Specification*	27 11 19
	Comm Cable Management & Cable Runway *-Product Data per Specification*	27 11 23
	Communication Copper Horizontal Cabling *-Product Data per Specification*	27 15 13

Required X	Submittal Name	Spec Reference
	Communication Faceplates & Connectors *-Product Data per Specification*	27 15 43
	AV Control Syatems & Antenna Systems *-Product Data per Specification*	27 41 00
	TV Broadband Distribution System *-Product Data per Specification*	27 41 33
	Sound Systems *-Product Data per Specification*	27 51 16.13
	Common Work Results for Security System *-Shop drawings, Computer equipment,* *-Grounding, Wiring & Cabling, Raceways* *-Boxes, Fittings*	28 05 10
	Digital Video Manage & Recording System *-Product Data per Specification*	28 23 00
X	**Fire Detection & Alarm Systems** *-FA Control panel, Devices, Detectors, GFCI* *-Contacts, Grounding, Operations*	28 31 10
	Sampling Type Smoke Detector Systems *-Detector assembly, Display, Networking,*	28 31 11

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SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. General Requirements for Electrical Work are intended to be complementary to General Requirements of Construction Contract.

B. Work Included: Provide complete electrical systems where shown on Drawings, as specified herein, and as needed for complete and proper installation including, but not necessarily limited to following summary of Work.

1. Interior and exterior lighting
2. Emergency exit and egress lighting
3. Fire detection and alarm system
4. Telephone raceway system
5. Switchboard and Panelboards
6. Power feeds to mechanical, plumbing and fire protection equipment:
   a. Provide conduit, wire, disconnect switch, overcurrent and short circuit protection for all equipment, whether shown on the drawings or not, including, motorized dampers, smoke dampers, electric heat trace, power for energy management system, water softening equipment, water treatment systems, air dryers, electric flush valves, electric trap primers, electric solenoids, shower valves, and other miscellaneous equipment.
7. Surge protective devices
8. Occupancy sensors
9. Packaged generator set
10. Automatic transfer switch
11. Electrical service entrance
12. Other items and services required to complete electrical systems

1.3 QUALITY ASSURANCE AND APPLICABLE STANDARDS

A. Use adequate numbers of skilled workers thoroughly trained and experienced in necessary crafts and completely familiar with specified requirements and methods needed for proper performance of Work of this Division. Ensure that there is a minimum of one journeyman electrician, on job site whenever Division 26 Work is being performed.

B. Without additional cost, provide labor and materials as required to complete Work of this Division in accordance with requirements of Governmental Agencies having jurisdiction, regardless of whether materials and associated labor are called for elsewhere in these Contract Documents.

C. Codes: Electrical and fire alarm work shall conform to requirements and recommendations of the following codes. Refer to the most recent code adopted by the Authority Having Jurisdiction (AHJ).

1. National Electrical Code
2. International Energy Code
3. International Fire Code
4. International Building Code
5. Local amendments to the above codes

D. Standards: Specifications and Standards of following organizations are by reference made part of these Specifications. Electrical Work, unless otherwise indicated, shall comply with requirements and recommendations wherever applicable:

1. Association of Edison Illuminating Companies (AEIC)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. American Society for Testing and Materials (ASTM)
5. Certified Ballast Manufacturers (CBM)
6. Electrical Testing Laboratories (ETL)
7. Institute of Electrical and Electronic Engineers (IEEE)
8. Insulated Power Cable Engineers Association (IPCEA)

9. National Bureau of Standards (NBS)
10. National Electrical Contractors Association (NECA)
11. National Electrical Manufacturer's Association (NEMA)
12. National Fire Protection Association (NFPA)
13. Radio-Television Manufacturer's Association (RTMA)
14. Reflector Luminaire Manufacturers (RLM)
15. Underwriters' Laboratories, Inc. (UL)

1.4 REQUIREMENTS OF REGULATORY AGENCIES

A. Requirements and recommendations of latest editions of Occupational Safety and Health Act (OSHA), and Americans with Disabilities Act (ADA), are by reference made part of these Specifications. Work shall comply with requirements and recommendations wherever applicable.

1.5 DEFINITIONS

A. Terms furnish, install, and provide are used interchangeably and shall mean to furnish and install, complete and ready for intended use.

1.6 SUBMITTALS

A. Comply with pertinent provisions of Division 01.
B. Engineer will review electronically transmitted submittals only. Submit copies of the submittal to the prime consultant (i.e. architect) in order to process and track the submittals properly in accordance with Divisions 01 and 26 submittal requirements.
C. Submittals required of materials and equipment include following:
   1. Materials list of items proposed to be provided under Division 26.
   2. Manufacturer's specifications and other data needed to prove compliance with specified requirements. Term "Compliance" is understood to mean that Contractor certifies that submitted equipment meets or exceeds Contract Document requirements. Items that do not clearly meet this definition should be identified and explained as required in following paragraph.
   3. Identify difference between specified item and proposed item. Explain with enough detail so that it can easily be determined that item complies with functional intent. List the disadvantages or advantages of proposed item versus specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in clear and concise format. Substitutions shall be approved in writing by Engineer. Engineer’s decision shall be final.
   4. Allow minimum of 10 working days for review of each submittal and re-submittal.
   5. Items of equipment that are not accepted in writing as approved equal shall be replaced or revised to comply with Contract Documents at Contractor's expense.
   6. The manufacturers recommended installation procedures shall become basis for accepting or rejecting actual installation procedures used on Work.
   7. Shop drawings shall consist of detailed drawings with dimensions, schedules, weights, capacities, installation details and pertinent information needed to describe the material or equipment.
D. Submittals required of materials and equipment under this Division include following listed items not supplied by Owner. These submittal requirements are intended to be complimentary to requirements that may be listed in individual sections. In event of conflict, more stringent requirement shall apply.
   1. Conductors and Cables:
      a. Submit product data for each specified product.
      b. Submit tabular list of wire and wiring systems that will be increased in capacity or size to comply with Section 26 0519 and/or similar requirements shown on Drawings. List shall include size shown on Drawings, proposed increase to comply with Section 26 0519, and proposed installed length.
   2. Raceways and Boxes:
      a. Submit product data for surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
      b. Submit Shop Drawings including layout drawings showing components and wiring for nonstandard boxes, enclosures, and cabinets.
   3. Wiring Devices:
      a. Submit product data for each specified product.
      b. Submit operation and maintenance data for wiring devices, for inclusion in "Operating and Maintenance Manual" specified in this Section.

c. Submit dimension plan for locations of all non-standard devices including but not limited to floor boxes, ceiling boxes, cord reels and welding boxes.

4. Switchboards:
   a. Submit product data for each product and component specified.
   b. Submit Shop Drawings for each switchboard including dimensioned plans and elevations, component and device lists, and single-line diagram showing main and branch bus current ratings and short-time and short-circuit ratings of switchboard.
   c. Submit schedule of features, characteristics, ratings, and factory settings of individual protective devices.
   d. Submit manufacturer's schematic wiring diagram.
   e. Submit point-to-point control wiring diagram, differentiating between manufacturer-installed and field-installed wiring.
   f. Submit qualification data for field-testing organization certificates, signed by Contractor, certifying that organization complies with requirements specified in Quality Assurance below. Include list of completed projects with project names, addresses, names of Engineers and Owners, plus other information specified.
   g. Submit maintenance data for materials and products, for inclusion in Operating and Maintenance Manual as specified in this Section.
5. Grounding:
   a. Submit product data for grounding rods, connectors and connection materials, and grounding fittings.
6. Switchboard/Panelboards:
   a. Submit product data for each type panelboard, accessory item, and component specified.
   b. Submit Shop Drawings prepared by the manufacturers including dimensioned plans, sections, and elevations. Show tabulations of installed devices, major features, and voltage rating. Include enclosure type with details for types other than NEMA Type 1; bus configuration and current ratings; short-circuit current rating of panelboard; and features, characteristics, ratings, and factory settings of individual protective devices and auxiliary components.
   c. Submit typewritten panelboard schedules to the Engineer for approval prior to installation.
   d. Submit maintenance data for panelboard components, for inclusion in Operating and Maintenance Manual specified in this Section. Include instructions for testing circuit breakers.
7. Disconnect Switches:
   a. Submit product data for disconnect switches and specified accessories.
8. Automatic Transfer Switches:
   a. Submit Shop Drawings or product data for each transfer switch, including dimensioned plans, sections, and elevations showing minimum clearances; conductor entry provisions; gutter space; installed features and devices; and materials lists.
   b. Submit wiring diagrams, elementary or schematic, differentiating between manufacturer-installed and field-installed wiring.
   c. Submit operation and maintenance data for each type of product, for inclusion in Operating and Maintenance Manual specified in this section. Include features and operating sequences, both automatic and manual. List factory settings of relays and provide relay setting and calibration instructions.
   d. Submit manufacturer's certificate of compliance to referenced standards and tested short-circuit closing and withstand ratings applicable to protective devices and current ratings.
9. Engine-Generator Set:
   a. Submit exhaust emissions. Submit prototype test data.
   b. Submit wiring diagrams for system, showing power and control connections and distinguishing between factory-installed and field-installed wiring.
   c. Submit product data for products specified in this Section. Include data on features, components, ratings, and performance. Include a dimensioned outline plan and elevation drawings of the engine generator set, the weatherproof enclosure, sub-base fuel tank and other system components.
   d. Submit maintenance data for system and components for inclusion in Operating and Maintenance Manual specified in this Section.

e. Submit detailed operating instructions, covering operation under both normal and emergency conditions and sound test reports.
f. Submit certification of torsional vibration compatibility: Conform to NFPA 110.
g. Submit factory test reports for units to be shipped for this Project showing evidence of compliance with specified requirements.

10. Motor Controllers:
    a. Submit product data for specified products. Include dimensions, ratings, and data on features and components.
    b. Submit maintenance data for products for inclusion in Operating and Maintenance Manual specified in this Section.
11. Lighting:
    a. Submit product data describing fixtures, lamps, ballasts, and emergency lighting units. Arrange product data for fixtures in order of fixture designation. Include data on features and accessories.
    b. Submit outline drawings indicating dimensions and principal features of fixtures, including color.
    c. Submit electrical ratings and photometric data including certified results of laboratory tests for fixtures and lamps.
    d. Submit battery and charger data for emergency lighting units.
    e. Submit Shop Drawings detailing nonstandard fixtures and indicating dimensions, weights, and methods of field assembly, components, features, and accessories.
    f. Submit wiring diagrams detailing wiring for control system showing both factory-installed and field-installed wiring for each specific system which differentiates between factory-installed and field-installed wiring.
    g. Submit maintenance data for fixtures to include in operation and maintenance manual specified in this Section.
    h. Submit lamp data for each fixture.
12. Fire Alarm System:
    a. Submit product data for each type of system component specified including dimensioned plans and elevations showing installed features and devices. Include list of materials and nationally recognized testing laboratory-listing data. Submit to Engineer after being reviewed and approved by local authority having jurisdiction.
    b. Submit wiring diagrams from manufacturer differentiating clearly between factory- and field-installed wiring. Include diagrams for equipment and for system with terminals and interconnections identified. Make diagrams specific to this Project and distinguish between field and factory wiring.
    c. Submit device address list.
    d. Submit system operation description covering this specific 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 unacceptable.
    e. Submit operating instructions for mounting at fire alarm control panel.
    f. Submit battery hours of operation calculations for loss of normal power operation.
    g. Submit maintenance data for fire alarm systems to include in operation and maintenance manual specified in this Section. Include data for each type of product, including features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at site. Provide names, addresses, and telephone numbers of service organizations that carry stock of repair parts for system to be furnished.
    h. Submit design drawings approved by local authority having jurisdiction.
13. Provide a dimension layout of electrical rooms(s) and elevator equipment room(s) if applicable.

1.7 SUBSTITUTIONS

A. The Contract Documents list manufacturers' names and catalog numbers followed by phrase "or equal" are to establish a standard of quality and utility for the specified items and to provide a dimensional reference to the scaled drawings.
B. Submittals for "equal" items shall include the following data, which is not necessarily required for specified items, which list the manufacturer and catalog number:
    1. Performance characteristics

2. Materials
3. Finish
4. Certification of conformance with specified codes and standards
5. Manufacturer's specifications and other data needed to prove compliance with specified requirements. Term "compliance" is understood to mean that the submitted equipment will meet or exceed the Contract Document requirements. Items that do not clearly meet this definition shall be identified and explained as required in following Paragraph.
6. Identify all differences between the specified item and proposed item. Explain all differences with sufficient detail to permit the Engineer to easily determine that the substituted item complies with the functional intent. List disadvantages and advantages of proposed item versus specified item. Submit technical data sheets and/or pictures and diagrams to support and clarify. Organize in clear and concise format. Engineer shall approve substitutions in writing. Engineer's decision shall be final.

C. Submittals of "equal" components or systems may be rejected if:
1. Material or equipment would necessitate alteration of mechanical, electrical, architectural, or structural design
2. Dimensions vary from specified material or equipment so that accessibility or clearances are impaired or Work of other trades is adversely affected

D. Proposed substitutions for materials or equipment must be submitted 10 days prior to final bid date for consideration as approved equals. Otherwise, substitutions will not be permitted. Only the prime bidders shall be permitted make proposals for substitutions.

E. No substitution shall be made unless authorized in writing by the Engineer. Should substitution be accepted, and should substitute material prove defective or otherwise unsatisfactory for service intended, and within guarantee period, replace this material or equipment with material or equipment specified, to satisfaction of Engineer and at no cost to Owner.

1.8 ORDINANCES, PERMITS, METERS, UTILITIES AND ROYALTIES

A. Purchase all necessary permits and licenses necessary for completion of the Work. Pay all lawful fees required and necessary pursuant in obtaining said permits and licenses. Required certificates of approvals and inspections by local governing and regulating authorities.

B. Pay all fees required for connection of utility power and telephone services required for the Work.

C. Pay royalty payments or fees required for use of patented equipment or systems. Defend lawsuits or claims for infringement of patent rights and hold Owner and/or Engineer harmless from loss as result of said suits or claims.

1.9 COMPATIBILITY OF EQUIPMENT

A. Assume full responsibility for satisfactory operation of component parts of electrical systems. Assure compatibility of equipment and performance of integrated systems in accordance with requirements of the Construction Documents. Notify the Engineer before submitting a bid should Specifications or Drawings make acceptance of responsibility impossible, prohibitive, or restrictive. The bid shall be accompanied by a written statement listing any objections or exceptions to the applicable specification section and/or drawing.

1.10 UTILITIES AND TEMPORARY POWER

A. Verify location and capacity of all existing utility services before starting Work. The locations and sizes of electrical lines are shown in accordance with data secured from Owner's survey. The data shown is offered as estimating guide without guarantee of accuracy.

B. Pay all utility charges for temporary power. Provide temporary lighting and power required. Install in accordance with OSHA requirements and as described in General Requirements Division 01.

1.11 FLASHINGS, SLEEVES, AND INSERTS

A. Furnish and install flashings where conduits pass through outside walls. Flashings shall be properly formed to fit around conduit and shall be caulked, with 790 Silicone Building Sealant by Dow Corning Corporation, so as to make watertight seal between conduit and building.

B. Unless otherwise specified, install sleeves for each conduit where it may pass through interior walls or floors. Galvanized 22-gage sheet iron sleeves shall be used. Finish flush with each finished wall surface. In pipe chases, the sleeve shall extend 1-1/2 inches above floor slab and shall be watertight.

C. Raceways that pass through concrete beams or walls and masonry exterior walls shall be provided with galvanized wrought iron pipe sleeves, unless shown otherwise on drawings. Inside diameter of these

sleeves shall be at least 1/2 inch greater than outside diameters of service pipes. After pipes are installed in these sleeves, fill annular space between pipes and sleeves with 790 Silicone Building Sealant by Dow Corning Corporation. Completed installation shall be watertight.

D. Roof penetrations shall be provided with counter flashings arranged to provide weatherproof installation.

E. Penetrations through walls, floors and ceilings shall be done in manner to maintain integrity of fire rating of respective wall, floor, or ceiling.

F. Reference Division 7 for additional sealant requirements. Where conflicts occur with the specified requirements, the more stringent shall apply.

1.12 CUTTING AND PATCHING

A. Perform cutting and patching in strict accordance with provisions of these Specifications and following:
   1. Coordinate Work to minimize cutting and patching.
   2. Use adequate number of skilled workers who are thoroughly trained and experienced in necessary crafts and who are completely familiar with specified requirements and methods needed for proper performance of Work.

B. Request for Engineer's consent:
   1. Prior to cutting which affects structural safety, submit a written request to Engineer for permission to proceed with cutting.
   2. When conditions of Work or schedule require a change of materials or methods for cutting and patching, notify Engineer and secure written permission to proceed with the work.

C. Perform cutting and demolition using methods that will prevent damage to other portions of Work.

D. Perform fitting and adjusting to provide a finished installation complying with specified tolerances and finishes.

1.13 SURFACE CONDITIONS

A. Examine areas and conditions under which Work of this Division will be performed. Work required to correct conditions detrimental to timely and proper completion of Work shall be included as part of Work of this Division. Do not proceed until unsatisfactory conditions are corrected.

1.14 CONSTRUCTION REQUIREMENTS

A. Drawings show arrangements of Work. Rearrangement of spaces and equipment will be considered when Project conditions make this necessary and/or materials or equipment can be installed to better advantage. Prior to proceeding with Work, coordinate with various trades to prepare and submit five (5) copies of Drawings of proposed arrangement for Engineer's review. Allow minimum of 10 working days for review.

B. Installation or rearrangement of equipment and space for Contractor's convenience or to accommodate material or equipment substitutions will be considered. Assume responsibility for rearrangement of equipment and space and have Engineer review change before proceeding with Work. Request for changes shall be accompanied by Shop Drawings of affected equipment and space. Identify proposed monetary credits or other benefits. Allow minimum of 10 working days for review.

C. Properly locate and size all required pipe sleeves and slots, holes, or openings in structure.

1.15 PREPARATION AND COORDINATION

A. Coordinate the work in strict accordance with the Contract Documents as follows:
   1. Where lighting fixtures and other electrical items are shown in conflict with locations of structural members and mechanical or other equipment, provide required supports and wiring to clear encroachment.
   2. Install power and control wiring for installation of equipment furnished under Divisions 21, 22 and 23. Furnish disconnect switches and other equipment as required for proper operation of equipment unless equipment is specified to be factory mounted.

B. Information on the Drawings and in these Specifications is as accurate as could be secured, but absolute accuracy is not guaranteed. The drawings are diagrammatic, and the exact locations, distances, levels, and other conditions shall be governed by actual construction. The drawings and specifications shall be for guidance.

C. Where receptacle locations are not dimensioned on either the Architectural or Engineering Drawings, the J-box may be located on the nearest stud. When receptacles are dimensioned on the Drawings, Provide a cross brace and mount the receptacle as dimensioned.

D. Field-verify measurements. No extra compensation will be allowed because of differences between Work shown on Drawings and actual site measurements.

E. Branch circuit wiring and arrangement of home runs have been designed for maximum economy consistent with adequate sizing and other considerations. Increase size of wiring and wiring systems to accommodate more stringent requirements listed in these Specifications or on Drawings. Install wiring with circuits arranged as shown on Drawings. Deviations shall be approved in advance by Engineer.

1.16 PROJECT RECORD DOCUMENTS

A. Provide Project record documents associated with Work in accordance with provisions of these Specifications. Refer to Division 1 for additional requirements.

B. Throughout progress of the Work, maintain accurate record of all changes in Contract Documents (Drawings and Specifications). Changes shall include Addendums issued during bidding and location of electrical service lines, receptacles, and outside utilities.

C. Delegate responsibility for maintenance of record documents to one person on Contractor's staff.

D. Accuracy of Records
   1. Thoroughly coordinate changes within record documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other documents where required to show change properly. Match symbology and format of base documents.
   2. Accuracy of records shall be such that future searches for items shown in Contract Documents may rely reasonably on information obtained from approved Project record documents.

E. Maintain a job set of record documents protected from deterioration and from loss and damage until completion of Work. Transfer all recorded data to final Project record documents.

F. Making Entries on Drawings
   1. Using erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   2. Date entries.
   3. Call attention to entry by "cloud" drawn around area or areas affected.
   4. In event of overlapping changes, use different colors for overlapping changes.
   5. Make entries within 24 hours after receipt of information that changes have occurred.
   6. Maintain base drawing format and use the same symbols.
   7. Convert field mark-ups to finished CADD record drawings when required in this Section.

G. Conversion of Schematic Layouts
   1. In some cases on Drawings, arrangements of conduits, circuits, and similar items, are shown schematically and are not intended to portray precise physical layout. Determine final physical arrangement, subject to Engineer’s approval. The design of future modifications of facility may require accurate information as to final physical layout of items that are shown only schematically on Drawings. Show by dimension accurate to within one inch, centerline of each run of sleeves and conduit below grade, in walls, or in concrete slab, etc. Surface mounted device indicates exact location:
      a. Clearly identify item by accurate note (e.g., "Rigid Conduit”).
      b. Show, by symbol or note, vertical location of item “under slab,” “in ceiling plenum,” “exposed,” etc.
      c. Make identification sufficiently descriptive that it may be related reliably to Specifications.

H. Final Project Record Documents
   1. The purpose of the final Project Record Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive site measurement, investigation, and examination.
   2. Provide CADD electronic files in dwg Format using AutoCAD Release 2002 or later software. Upon written request, completion of a release form, and payment of the Engineer’s standard fee of $200 plus applicable sales tax for a set-up charge and $50 per drawing plus applicable sales tax for copies of such files, Engineer will provide AutoCAD Release 2002 electronic files of base Contract Drawings in dwg format on compact discs. Engineer will also provide a list of drawing layers and names that shall be maintained.
   3. Provide completed record drawings on CD and one mylar film reproducible of each drawing.
   4. Refer to Division 01 for additional requirements.

1.17 OPERATION AND MAINTENANCE DATA

A. Submit two copies of preliminary draft of proposed manual or manuals to Engineer for review and comments. Allow minimum of 10 working days for review.

B. Submit approved manual to Engineer prior to indoctrination of operation and maintenance personnel.

C. Where instruction manuals are required for submittal, they shall be prepared in accordance with the following:

Format:	
Size:	8-1/2-inch by 11-inch
Paper:	White bond, at least 20 pound weight
Text:	Neatly written or printed
Drawings:	11 inches in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within Manual and provide drawing pocket inside rear cover or bind in with text.
Flysheets:	Separate each section of Manual with neatly prepared flysheets briefly describing contents of ensuing section; flysheets may be in color.
Binding:	Use heavy-duty plastic or fiberboard covers with binding mechanism concealed inside manual; 3-ring binders will be acceptable; binding is subject to Engineer's approval.
Measurements:	Provide measurements in U.S. standard units (e.g., feet, inches, and pounds). Where items may be expected to be measured within 10 years in accordance with metric formulae, provide additional measurements in "International System of Units" (SI).

D. Provide front and back covers for each manual, using durable material approved by Engineer, and clearly identified on or through cover with at least following information:
   OPERATING AND MAINTENANCE INSTRUCTIONS
   Name and Address of Work
   Name of Contractor
   General subject of this manual
   Space for approval signature of Engineer and approval date[s]

E. Contents: Include at least following:
   1. Neatly typewritten index near front of Manual, giving immediate information as to location within manual of emergency information regarding installation.
   2. Complete instructions regarding operation and maintenance of equipment involved including lubrication, disassembly, and reassembly.
   3. Complete nomenclature of parts of equipment.
   4. Complete nomenclature and part number of replaceable parts, name and address of nearest vendor and other data pertinent to procurement procedures.
   5. Copy of guarantees and warranties issued.
   6. Manufacturer's bulletins, cuts, and descriptive data, where pertinent, clearly indicating precise items included in this installation and deleting, or otherwise clearly indicating, manufacturers' data with which this installation is not concerned.
   7. Other data as required in pertinent Sections of these Specifications.

1.18 EQUIPMENT FOUNDATIONS

A. Provide equipment foundations in accordance with provisions of these Specifications.

B. Provide concrete bases for main switchboard, distribution panelboards, floor-mounted transformers and other equipment that is to be pad- or floor-mounted. Bases shall be 4 inches high above finished floors or grades (unless otherwise noted) and shall protrude 2 inches beyond sides of equipment and shall have exposed chamfered edges. Construct bases from ready-mixed hard rock concrete, ASTM C94, reinforced with #3 Rebars, ASTM A615, Grade 40. Rebars shall be located at 18 inches on center each way.

C. Field-verify exact location of outdoor pad mounted equipment with Engineer. Supply necessary fill and grade site to provide natural drainage away from equipment.

D. Provide structural concrete foundations for generator, pad mounted transformers and lighting pole bases.

1.19 TESTING AND INSPECTION

A. Provide personnel and equipment, make required tests, and secure required approvals from Engineer and Governmental Agencies having jurisdiction
B. Make written notice to Engineer adequately in advance of each of following stages of construction:
    1. When rough in is complete, but not covered
    2. At completion of Work of this Division
    3. In underground condition prior to placing backfill, concrete floor slab, and when associated electrical Work is in place
C. When material or workmanship is found to not comply with specified requirements, remove items from job site and replace them with items complying with specified requirements at no additional cost to Owner. This shall be performed within 3 days after receipt of written notice of noncompliance.
D. In Engineer's presence, test parts of electrical system and prove that items provided under this Division function electrically in required manner.

1.20 SITE VISITS BY FACTORY PERSONNEL

A. Pay for travel expenses, living expenses, and miscellaneous expenses associated with site visits of factory personnel to perform on site testing, inspections, and reviews.

1.21 WARRANTY

A. Warrant equipment and workmanship for period of one year after date of substantial completion and replace or repair faulty equipment or installation at no cost to Owner for service during this period, in accordance with requirements of Division 1.
B. Warranty shall not void specific warranties issued by manufacturers for greater periods of time or void rights guaranteed to Owner by law.
C. Warranties shall be in writing in form satisfactory to Owner, and shall be delivered to Owner before final payment is made.

1.22 PROJECT COMPLETION

A. Upon completion of Work of this Division, thoroughly clean exposed portions of electrical installation, removing traces of soil, labels, grease, oil, and other foreign material, and using only type cleaner recommended by manufacturer of item being cleaned.
B. Thoroughly indoctrinate Owner's operation and maintenance personnel in contents of operations and maintenance manual required to be submitted as part of this Division of these Specifications.

END OF SECTION

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SECTION 26 05 03 - FIRE STOPPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

Only tested firestop systems shall be used in specific locations as follows:

A. Penetrations for the passage of conduit and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
B. Completion of firestop installations to maintain the rating integrity of the barrier penetrated.

1.3 DEFINITIONS

A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, water and hot gases through penetrations in fire rated wall and floor assemblies.

1.4 REFERENCES

A. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).
B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
    1. UL Fire Resistance Directory:
        a. Through-Penetration Firestop Devices (XHCR)
        b. Fire Resistance Ratings (BXUV)
        c. Through-Penetration Firestop Systems (XHEZ)
        d. Fill, Voids, or Cavity Material (XHHW)
        e. Forming Materials (XHKU)
C. Inspection Requirements: ASTM E 2174-01 “Standard Practice for On-Site Inspection of Installed Fire Stops”.
D. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
E. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
F. All major building codes: ICBO, SBCCI, BOCA, and IBC. (Note to specifier: Retain or delete building codes listed above as applicable).
G. NFPA 101 - Life Safety Code
H. NFPA 70 – National Electric Code.

1.5 QUALITY ASSURANCE

A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
B. Firestop System installation must meet requirements of ASTM E-814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994 as may be amended from time to time).

1.6 SUBMITTALS

A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 1300.

B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineer judgment must include both project name and contractor's name that will install firestop system as described in drawing.
C. Submit material safety data sheets provided with product delivered to job-site.

1.7 INSTALLER QUALIFICATIONS
A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary experience, staff, and training to install manufacture's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
E. Do not use damaged or expired materials.

1.9 PROJECT CONDITIONS
A. Do not use materials that contain flammable solvents.
B. Scheduling
1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 – PRODUCTS

2.1 FIRESTOPPING, GENERAL
A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
B. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
C. Firestopping materials are either "cast-in-place" (integral with concrete placement) or "post installed". Provide cast-in-place Firestop devices prior to concrete placement.

2.2 ACCEPTABLE MANUFACTURERS
A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
1. Hilti, Inc., Tulsa, Oklahoma (800) 879-8000
2. Tremco Sealants & Coatings, Beechwood, Ohio (216) 292-5000
3. 3M Fire Protection Products, St. Paul, Minnesota (612) 736-0203
4. Johns-Manville Firetemp
5. Other manufacturers listed in the U.L. Fire Resistance Directory – Volume 2

2.3 MATERIALS
A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
B. Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic conduit penetrating concrete floors, the following products are acceptable:
1. Hilti CP 680 Cast-In Place Firestop Device

2. Hilti CP 681 Tub Box Kit
3. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

C. Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
1. Hilti FS-ONE Intumescent Firestop Sealant
2. Hilti CP 604 Self-leveling Firestop Sealant
3. Hilti CP 620 Fire Foam
4. 3M Fire Stop Sealant 2000
5. 3M Fire Barrier CP25 WB
6. Tremco Tremstop Fyre-Sil Sealant
7. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

D. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
1. Hilti CP 601s Elastomeric Firestop Sealant
2. Hilti CP 606 Flexible Firestop Sealant
3. Hilti FS-ONE Intumescent Firestop Sealant
4. Hilti CP 604 Self-leveling Firestop Sealant
5. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

E. Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
1. Hilti FS-ONE Intumescent Firestop Sealant
2. 3M Fire Barrier CP25 WB
3. Tremco Tremstop WBM Intumescent Firestop Sealant
4. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

F. Intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti FS-ONE Intumescent Firestop Sealant
2. Hilti CP 620 Fire Foam
3. Hilti CP 618 Firestop Putty Stick
4. 3M Fire Barrier CP25 WB
5. Tremco Tremstop WBM Intumescent Firestop Sealant
6. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

G. Non curing, re-penetrable intumescent sealants, caulking or putty materials for use with flexible cable or cable bundles, the following products are acceptable:
1. Hilti CP 618 Firestop Putty Stick
2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

H. Wall opening protective materials for use with U.L. listed metallic and specified nonmetallic outlet boxes, the following products are acceptable:
1. Hilti CP 617 Firestop Putty Pad
2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 1

I. Firestop collar or wrap devices attached to assembly around combustible plastic conduit, the following products are acceptable:
1. Hilti CP 642 Firestop Collar
2. Hilti CP 643 Firestop Collar
3. 3M Fire Barrier PPD Plastic Pipe Device
4. Hilti CP 645 Wrap Strip
5. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

J. Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti CP 637 Firestop Mortar
2. Hilti FS 657 FIRE BLOCK
3. Hilti CP 620 Fire Foam
4. 3M Firestop Foam 2001
5. 3M Fire Barrier CS-195 Composite Sheet
6. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

K. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following products are acceptable:
1. Hilti FS 657 FIRE BLOCK
2. Equivalent products listed in the U.L. Fire Resistance Directory – Volume 2

L. Provide a firestop system with an "F" Rating as determined by UL 1479 or ASTM E814, which is equal to the time rating of construction being penetrated.

PART 3 – EXECUTION

3.1 PREPARATION

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 penetrations are properly sized and in suitable condition for application of materials.
   2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
   3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
   4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
   5. Do not proceed until unsatisfactory conditions have been corrected.

3.2 COORDINATION

A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

3.3 INSTALLATION

A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
   1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
   2. Protect materials from damage on surfaces subjected to traffic.

3.4 FIELD QUALITY CONTROL

A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
B. Keep areas of work accessible until inspection by applicable code authorities.
C. Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard.
D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 ADJUSTING AND CLEANING

A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

END OF SECTION

SECTION 26 05 05 - SITE ELECTRICAL

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide labor, materials, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of all site electrical work.

B. The site electrical work shall include, but not be limited to, the furnishing and installation of necessary materials and making arrangements for:
   1. The connection of electrical, telephone, data and cable utilities.
   2. Underground conduit.

C. Meet with the electric utility company and all other utility provider's representative prior to bidding the project. Review the site plan and the load summary and verify the requirements for providing electric service to the building. Determine what work will be provided by the power company and what work will be performed by the contractor. Obtain copies of appropriate details, standards, and instructions. Utility locations are subject to change during this coordination. All changes must be accounted for in the bid. No additional funds will be provided for failing to coordinate this work. Request the amount of any utility charges to be charged to the project. Include these costs in the bid.

D. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of electrical service as directed by the utility company.

E. Work Includes, but is not limited to:
   1. Furnish and install underground primary trench, for the direct buried primary service conductors.
   2. Furnish and install conduits, wires, transformer pads and meeting equipment to provide an electrical service entrance as shown on the drawing and/or specified herein. Coordinate work with the electric utility company, verify all requirements, and install service entrance equipment in exact compliance with utility company and local governmental agency requirements.
   3. Arrange with the electric utility company to inspect the work.
   4. Include in the bid, all utility company charges and costs related to the installation of the electric service.

1.3 SUBMITTALS

A. Provide submittals as required in section 26 05 10, "Submittal Process."

1.4 REFERENCE STANDARDS

A. National Electrical Code (NEC), Article 300

B. Service installation standards of the serving utility company(s)

PART 2 – PRODUCTS

2.1 ELECTRICAL SERVICE

A. Coordination: The location of the electrical service entrance shall be coordinated with the electric utility company and with all other trades. Provide materials and equipment required to connect the electrical service.

B. Materials: Provide materials in accordance with other Sections of these Specifications.

PART 3 – EXECUTION

3.1 GENERAL

A. Underground installation of more than one conduit shall be in a "ductbank" arrangement. All conduits shall be laid so joints are staggered.

B. Pour a red colored concrete envelope minimum 3" thick over electrical, cable television, and telephone service conduit.

C. Where specifically indicated on the Drawings, a full concrete enclosed ductbank with reinforcing rods shall be installed.

D. Perform excavation, shoring, backfilling and concrete work in connection with electrical work in accordance with other Divisions of the Specifications.

E. All underground conduits shall be sloped away from the building to negate water entering the building through the conduit system.

F. Provide underground warning tape 6" to 12" below finished surface along entire length of underground conduit or ductbank. Provide a separate length of tape for every 24" in width of ductbank. Interface installation of underground warning tape with backfilling.

3.2 UTILITIES

A. The locations, elevations and voltage of electrical lines included within the area of this work are indicated on the Drawings or in the Specifications in accordance with information received by the Owner.
B. The Contractor shall examine the site and shall verify, to his own satisfaction, the location and elevation of all utilities, and shall adequately inform himself as to their relation to the work.
C. The work associated with existing utility lines to be abandoned or removed, shown within the scope of this project, will be arranged by the Owner with the respective utility.
D. Existing utility lines not indicated but encountered during construction shall be protected, relocated or capped as directed by the Owner's Representative. All precautions shall be exercised to prevent damage to existing lines not shown, but should work become necessary, it must be authorized prior to execution except in an emergency situation.
E. Before beginning excavations of any nature whatsoever, the Contractor shall make an attempt to locate all underground utilities of every nature occurring within the bounds of the area to be excavated. The Contractor shall then proceed with caution in his excavation work so that no utility shall be damaged with a resultant loss of service.
F. Should damage result to any utility through the Contractor's negligence or failure to comply with the above directive, he shall be liable for such damage and for all expense incurred in the expeditious repair or replacement of such damaged utilities.
G. Repair of damaged utilities shall be to a condition equal to or better than the adjacent undamaged portion of such utility and to the complete satisfaction of the Owner.

END OF SECTION

SECTION 26 05 19 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of conductors as indicated on the Drawings and as specified.

B. Work included:

1. Wiring connections and terminations, 600 Volt rating and below.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the manufacturer's certifications that confirm that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Provide conductors made of soft-drawn, annealed copper with conductivity not less than that of 98% pure copper.

B. Building Wire:

1. Thermoplastic-insulated building wire: NEMA WC 5
2. Feeders and branch circuits: Copper, stranded conductor, 600-volt insulation, THHN/THWN-2
3. Control circuits: Copper, stranded conductor 600-volt insulation, THHN/THWN-2
4. Where more than one conductor of the same phase or more than one neutral conductor occurs at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings
5. Type MC and AC cables shall not be used
6. Use the following color code system:

	240/120 Volt Systems	208Y/120 Volt Systems	480Y/277 Volt Systems
Phase A	Black	Black	Brown
Phase B	Orange	Red	Orange
Phase C	Blue	Blue	Yellow
Neutral	White	White	Gray
Ground	Green	Green	Green
Switch	Purple	Purple	Purple

C. Remote Control and Signal Cable:

1. Control cable for Class 2 or Class 3 remote control and signal circuits: Copper conductor, 300-volt insulation, rated 60-degree C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

2. Plenum cable for Class 2 or Class 3 remote control and signal circuits: Copper conductor, 300-volt insulation, rated 60-degree C, individual conductors twisted together, shielded, and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

2.2 ACCEPTABLE MANUFACTURERS

A. Provide products by the following manufacturers:
   1. Rome
   2. Cable
   3. Pirelli
   4. Belden
   5. Approved equal

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS (LESS THAN 600 VOLTS)

A. Install conductor sizes as indicated. Provide No. 10 AWG conductor for the entire circuit length for single-phase, 20-ampere circuits for which the distance from panelboard to the last outlet is more than 100 feet for 120-volt circuits or 200 feet for 277-volt circuits. The minimum wire size shall be 12 AWG for power and lighting circuits, and no smaller than 18 AWG for control wiring. Remote control wiring shall not be less than 14 AWG for installed lengths of 50 feet or less. Remote control conductors shall be increased one size (per NEC Table 310) for each additional 50 feet of length. Increase the raceway system to accommodate the increased wire size.
B. Provide an equal number of conductors of equal size for each phase of a circuit in same raceway or cable.
C. Splice only in junction boxes, outlet boxes, pullboxes, or manholes.
D. Neatly train and lace wiring inside boxes, equipment, and panelboards.
E. Make conductor lengths for parallel circuits equal.
F. Phasing shall be consistent throughout each installation from the service connection to every device connection and outlet. Where interface is made to an existing system, the existing phasing configuration shall be maintained.

3.2 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use UL listed wire-pulling lubricant for pulling 4 AWG and larger wires.
B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
C. Completely and thoroughly swab raceway system before installing conductors.

3.3 CABLE INSTALLATION

A. Provide protection for exposed cables where subject to damage.
B. Support cables above accessible ceilings. Do not rest on ceiling tiles, light fixtures or air devices. Use spring metal clips or metal cable ties to support cables from structure. Include bridle rings or drive rings.
C. Use suitable cable fittings and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible boxes or manholes.
B. Use solderless pressure connectors with insulating covers for copper wire splices and taps 8 AWG and smaller.
C. Use split bolt connectors for copper wire splices and taps 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.
D. Thoroughly clean wires before installing lugs and connectors.
E. Make splices, taps and terminations to carry full capacity of conductors without perceptible temperature rise.
F. Terminate spare conductors with electrical tape.
G. Field Testing. Insulation resistance of all feeder conductors served by a protective device rated 200A or higher shall be tested. Each conductor shall have its insulation resistance tested after the installation is completed and all splices, taps and connections are made except connection to or into its source and point (or points) of termination. Insulation resistance of conductors which are to operate at 600 volts or less shall

be tested by using a Biddle Megger of not less than 1000 volts d-c. Insulation resistance of conductors rated at 600 volts shall be free of shorts and grounds and have a minimum resistance phase-to-phase and phase-to-ground of at least 10 megohms. Conductors that do not exceed insulation resistance values listed above shall be removed at Contractor's expense and replaced and test repeated. The Contractor shall furnish all instruments and personnel required for tests, shall tabulate readings observed, and shall forward copies of the test readings to the Owner in accordance with Section 26 0593. These test reports shall identify each conductor tested, date and time of test and weather conditions. Each test shall be signed by the party making the test.

3.5 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under applicable provisions of Division 26.
B. Inspect wire and cable for physical damage and proper connection.
C. Torque test conductor connections and terminations to manufacturers recommended values.
D. Perform continuity tests on all power and equipment branch circuit conductors. Verify proper phasing of all connections.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE

A. All locations: Building wire in raceways.

3.7 600-VOLT INSULATED CONDUCTORS

A. Size: Install conductor sizes as indicated. Provide No. 10 AWG conductor for the entire circuit length for single-phase, 20-ampere circuits for which the distance from panelboard to the last outlet is more than 100 feet for 120-volt circuits or 200 feet for 277-volt circuits.
B. Home Runs: Except where specifically indicated, provide branch circuit home runs with not more than two different line conductors and a common neutral in a single raceway for 3-wire, single-phase systems, nor more than three different line conductors and a common neutral in a single raceway for 4-wire, 3-phase systems. Use home run circuit numbers as indicated for panelboard connections.
C. Where more than one conductor of the same phase or more than one neutral conductor occurs at the same outlet or junction box, these conductors shall be identifiable from each other by use of stripes or distinguishing markings.

END OF SECTION

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SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of electrical systems grounding as shown or indicated on the Drawings and/or as specified.

B. Work Included:

1. Power systems grounding
2. Electrical equipment and raceway grounding and bonding

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Engineer with the manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide electrical grounding system indicated with assembly of materials, including but not limited to:

1. Wires and cables
2. Connectors
3. Terminals
4. Ground rods
5. Bonding jumper braid
6. Surge arrestors

B. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE, and established industry standards for applications indicated.

2.2 CHEMICAL GROUND ROD (IF REQUIRED)

A. Self-contained ground rod(s) using electrolytically enhanced grounding shall be provided for power system grounding where indicated on the drawings. The ground rod shall operate by hygroscopically extracting moisture from the air to activate the electrolytic process improving performance. The ground rod system shall be UL listed and have been manufactured for a minimum of 10 years. The ground rod system shall be 100% self activating sealed and maintenance free. The system shall not require the addition of chemical or water solutions.

B. Electrode unit

1. The copper ground rod shall consist of 2” nominal diameter hollow copper tube with a wall thickness of not less than .083”. The tube shall be permanently capped on the top and bottom. Air breather holes shall be provided in the top of the tube and drainage holes shall be provided in the bottom of the tube for electrolyte drainage into the surrounding soil. Shaft configuration: Straight Shaft Model No: K2-1020CS; UL Listing: 467.
2. The ground rod shall be filled from the factory with non-hazardous Calsolyte to enhance grounding performance.
3. Ground rod shall be twenty feet long for straight (vertical) installation.
4. A stranded 4/0 AWG Cu ground wire shall be Cadwelded to the side of rod for electrode conductor connection. A clamping “U-bolt” with pressure plate on the tip end of the tube shall be provided for testing and temporary connections.

C. Ground Access Box
   1. Provide a precast concrete box with slots for conduit entrances. Minimum size shall be ten-inch diameter by twelve high. Provide a cast iron, flush traffic rated cover with “breather” slots, XIT model #XB-12.
D. Backfill Material
   1. Natural volcanic, non-corrosive form of bentonite clay grout backfill material free of polymer sealant. XIT model #LNC.
   2. Shall absorb approximately 14 gallons of water per 50# bag for optimal 30% solids density.
   3. PH value 8-10 with maximum resistively of 3 ohm-m at 30% solids density.
E. Manufacturer: Lyncole XIT Grounding, 3547 Voyager St., Torrance, CA 90503, Phone (800) 962-2610; or approved equal.
F. Ground Wire Termination: Exothermic connection to 4/0 conductor. U-bolt with pressure plate provided as test point.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Install electrical grounding systems in accordance with applicable portions of NEC, with NECA's "Standard of Installation," and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.
B. Provide a separate, insulated equipment grounding conductor in feeder circuits. Terminate each end on a grounding lug, bus, or bushing.
C. Connect grounding electrode conductors to metal water pipe using a suitable ground clamp. Make connections to flanged piping at street side of flange. Provide bonding jumper around water meter.
D. Installation of Chemical Ground Rod
   1. Install a supplemental ground rod system in compliance with manufacturer’s instruction or recommendation.
   2. Bore minimum 6” diameter hole, 6” deeper than the length of rod to be buried. Insure that the top of the copper chemical ground rod will not come in contact with the metal grate of the protective box or hand-hole cover.
   3. Remove sealing tape from leaching holes
   4. Place chemical ground rod in hole, so that the top of unit is about 6” below grade.
   5. Backfill.
   6. Lynconite backfill is specific clay (bentonite clay) included with the system. Mix each 50# backfill grout material with 14 gallons water to form a slurry and pour around chemical ground rod up to “bury to here sticker”.
   7. Place protective box in accordance with the drawings
   8. Remove sealing tape from the top breather holes to activate.
   9. Connect grounding electrode conductor to ground rod pigtail exothermically (Cadweld or Thermoweld).
   10. Bury grounding conductor 30” below grade. Cover conductor with a small amount of backfill for protection against corrosion.

3.2 FIELD QUALITY CONTROL
A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
B. Electrical Tests:
   1. Perform fall-of-potential test or alternative in accordance with IEEE Standard 81-1991 on the main grounding electrode or systems.
   2. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
C. Test Values:
   1. The resistance between the main grounding electrode and ground should be no greater than two ohms. Install additional grounding electrodes, as required, to achieve the specified resistance value.
   2. Investigate point-to-point resistance values which exceed 0.5 ohm. Correct deficiencies at no additional cost. Retest to prove compliance

D. Provide written certification to the Engineer that the grounding system has been tested and complies with the specified requirements.
E. Provide a test report.

END OF SECTION

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SECTION 26 05 29 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of support systems as shown or indicated on the Drawings and/or as specified.

B. Work Included:

1. Conduit and equipment supports
2. Fastening hardware

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work in this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificates that confirm materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 HANGERS AND CLAMPS

A. Provide supporting devices of types, sizes, and materials indicated, and having the following construction features:

1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" diameter hole for round steel rod, approximately 54 pounds per units.
2. Riser Clamps: For supporting 5" rigid metal conduit; black steel; with 2 bolts and nuts, and 4" ears, approximately 510 pounds per 100 units.
3. Reducing Couplings: Steel rod reducing coupling, 1/2" x 5/8", black steel, approximately 16 pounds per 100 units.
4. C-Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2", approximately 52 pounds per 100 units.
5. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
6. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
7. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
8. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
9. Round Steel Rod: Black steel; 1/2" diameter; approximately 67 pounds per 100 feet.
10. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

B. Anchors: Provide anchors of types, sizes, and materials indicated, and having the following construction features:

1. Lead Expansion Anchors: 1/2", approximately 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.

C. Sleeves and Seals: Provide sleeves and seals, of types, sizes and materials indicated; and having the following construction features:

1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and

walls. Construct with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

D. Conduit Cable Supports: Provide cable supports with insulating wedging plug for non-armored type electrical cables in risers; construct for 2" rigid metal conduit; 3-wires, type wire as indicated; construct body of malleable iron casting with hot dip galvanized finish.

E. U-Channel Strut Systems: Provide U-channel strut system for supporting electrical equipment, 16-gage hot dip galvanized steel, of types and sizes indicated; construct with 9/16" diameter holes, 8" O.C. on top surface, with standard green finish, and with the following fittings which mate and match with U-channel:

Fixture hangers	Channel hangers
End caps	Beam clamps
Thin wall conduit clamps	Wiring stud
Rigid conduit clamps	Conduit hangers
U-bolts	

2.2 FABRICATED SUPPORTING DEVICES

A. Provide pipe sleeves of one of the following:
   1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gages: 3" and smaller, 20 gauge; 4" to 6", 16 gauge; over 6", 14 gauge.
   2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe, remove burrs.
   3. Iron Pipe: Fabricate from cast iron or ductile iron pipe; remove burrs.
   4. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs.

B. Sleeve Seals: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:
   1. Dow # 790 Silicone Building Sealant by Dow Corning Corporation.

PART 3 - EXECUTION

3.1 INSTALLATION OF SUPPORTING DEVICES

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts, or beam clamps.

B. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. Install supports with maximum spacing indicated.

C. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or present inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

E. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

F. Install freestanding electrical equipment on concrete pads.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

H. Bridge studs top and bottom with channels to support surface and flush-mounted cabinets and panelboards in stud walls.

I. Tighten sleeve seal nuts until sealing grommets have expanded to form watertight seal.

END OF SECTION

SECTION 26 05 33.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of a complete and operating electrical raceway system, as indicated on the Drawings and as specified.

B. Work included:

1. Rigid metal conduit and fittings
2. Electrical metallic tubing and fittings
3. Flexible metal conduit and fittings
4. Non-metallic conduit and fittings
5. Surface-mounted raceway

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 CONDUITS AND FITTINGS

A. Provide metal conduits, tubing, fittings, and couplings of types, grades, sizes, and weights (wall thickness) for each service indicated. Where types and grades are not indicated, provide proper selection determined by installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.

B. Rigid Metal Conduit and Fittings

1. Rigid steel conduit: ANSI C80.1
2. Fittings and conduit bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

C. Electrical Metallic Tubing (EMT) and Fittings

1. EMT: ANSI C80.3 galvanized tubing
2. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel compression type

D. Flexible Metal Conduit and Fittings

1. Conduit: FS WW-C-566; steel
2. Fittings and Conduit Bodies: ANSI/NEMA FB 1

E. Liquid tight Flexible Conduit and Fittings

1. Conduit: Flexible metal conduit with PVC jacket
2. Fittings and Conduit Bodies: ANSI/NEMA FB 1

F. Plastic Conduit and Fittings

1. Conduit: NEMA TC 2; Schedule 40 PVC
2. Fittings and Conduit Bodies: NEMA TC 3

2.2 CONDUIT SUPPORTS

A. Conduit Clamps, Straps, and Supports: Steel or malleable iron.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

A. Size of conduit shall be as indicated on the drawings or sized for conductor type installed, whichever is larger. Size all conduits in accordance with the NEC. Minimum conduit size shall be ¾ inch.
B. Arrange conduit to maintain headroom and present a neat appearance.
C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
D. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.
E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps.
G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

3.2 CONDUIT INSTALLATION

A. Cut conduit square using a saw or pipe cutter; de-burr cut ends.
B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
C. Use conduit hubs for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
D. Install no more than the equivalent of three 90-degree bends between boxes.
E. Use conduit bodies to make sharp changes in direction, as around beams.
F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inches in size.
G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
I. Provide a pull tape for spare empty conduits. The tape shall be fiberglass reinforced polyester tape with distance marking in feet continuous along its length. Furnish T&B or Greenlee products.
J. Install expansion joints where conduit crosses building expansion joints.
K. Where conduit penetrates fire-rated walls and floors, provide mechanical firestop fittings with UL listed fire rating equal to wall or floor rating. Seal opening around conduit with UL listed foamed silicone elastomer compound.
L. Route conduit through roof openings for piping and ductwork where possible; otherwise route through roof jack with pitch pocket.
M. Maximum size conduit in slabs above grade: 3/4 inch.
N. Use PVC-coated rigid steel factory elbows for bends in plastic conduit runs longer than 100 feet or in plastic conduit runs, which have more than two bends regardless of length.
O. Make joints in accordance with manufacturers' written instructions.
P. Provide plastic warning tape for underground conduit or duct bank installations. Install warning tape directly above conduit one foot below finished grade or as shown on drawings.
Q. Sand for intermediate fill around underground conduits shall be washed sand, suitable for concrete or masonry. Reference Section 26 0500 for additional backfill and excavation requirements.

3.3 CONDUIT INSTALLATION SCHEDULE

A. Underground installations more than two feet from foundation wall: Rigid steel conduit or Schedule 40 plastic conduit.
B. Installations in or under concrete slab, or underground within 2 feet of foundation wall: Rigid steel conduit.
C. In slab above grade: Rigid steel conduit.
D. Exposed outdoor locations: Rigid steel conduit.
E. Wet interior locations: Rigid Steel Conduit.
F. Concealed dry interior locations: Electrical metallic tubing.
G. Exposed dry interior locations: Electrical metallic tubing.

3.4 CONDUIT IN DETNTION AREAS

A. Conduits shall be concealed in CMU walls.
B. Conduits shall be concealed in concrete walls and ceilings.
C. conduits may be exposed in electric rooms, mechanical rooms and plumbing chases.

END OF SECTION

SECTION 26 05 33.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of outlets, pull and junction boxes as indicated on the Drawings and specified.

B. Work included:

1. Wall and ceiling outlet boxes
2. Pull and junction boxes

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Engineer with manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

A. **Provide submittals as required in section 26 05 10, “Submittal Process.”**

PART 2 - PRODUCTS

2.1 BOXES

A. Provide standard, stamped galvanized steel boxes except as hereinafter noted, by Steel City or approved equal.

B. Outlet Boxes

1. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel, with 1/2 inch male fixture studs where required.
2. Cast Boxes: Aluminum or cast ferroalloy, deep type, gasket and cover, threaded hubs.

C. Pull and Junction Boxes

1. Sheet metal boxes: ANSI/NEMA OS 1, galvanized steel.
2. Cast metal boxes for outdoor and wet location installation shall be NEMA 250;, Type 4 and Type 6, flat-flanged, surface-mounted junction boxes, UL listed as rain tight. Galvanized cast iron or cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
3. Cast Metal Boxes for Underground Installations: NEMA 250 Type 4, outside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron or cast aluminum box and plain cover with neoprene gasket and stainless steel cover screws.

2.2 FLOOR BOXES

A. Combination Flush Floor Boxes

1. Where indicated in plan, furnish and install Wiremold/Walker Resource RFB series four compartment floor boxes.
2. Boxes located on the First Floor shall be Cast Iron, with a maximum depth of 3-7/16”.
3. Boxes located on the Second Floor shall be Shallow Stamped Steel, with a maximum depth of 2-7/16”.

PART 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned.
C. Locate and install boxes to allow access.
D. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

A. Do not install boxes back-to-back in walls. Provide a minimum 6-inch separation between boxes. Provide a minimum 24-inch separation between boxes in acoustic-rated walls.
B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
C. Provide knockout closures for unused openings.
D. Support boxes securely and independently of conduit.
E. Use multiple gang boxes where more than one device is mounted together. Do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
F. Install boxes in walls without damaging wall insulation.
G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
H. Position outlets to locate luminaires as shown on reflected ceiling plans.
I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
L. Provide cast outlet boxes in exterior locations and wet locations.

3.3 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
B. Support pull and junction boxes independent of conduit.
C. Set underground pull and junction boxes level and flush with finished grade.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of identification for electrical equipment as shown or as specified.

B. Work Included:

1. Nameplates and tape labels
2. Wire and cable markers
3. Buried conduit markers

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

A. **Provide submittals as required in section 26 05 10, “Submittal Process”.**

PART 2 - PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.

B. Wire and Cable Markers: Clothe markers, split sleeve or tubing type.

C. Buried Conduit Marker: Continuous printed plastic tape.

D. Outdoor Equipment Cables: Manufacturer's Standards

1. Weather and sun resistant
2. Vandal resistant

2.2 EQUIPMENT AND RACEWAYS OVER 600 VOLTS

A. Provide “WARNING - HIGH VOLTAGE - KEEP OUT” signs on all equipment. With 2-inch high lettering, mark exposed raceways containing conductors operating in excess of 600 volts every 100 feet with the words “WARNING - HIGH VOLTAGE”.

2.3 SPECIAL RACEWAY IDENTIFICATION

A. Special Systems. Brady Series 55200, 2" wide, pipe banding tape or colored conduit.

1.	Fire alarm:	red
2.	Telephone:	blue
3.	Data/Communications:	blue
4.	Low voltage controls:	black
5.	Sound systems:	yellow
6.	Clock systems:	green

2.4 WIRE AND CABLE MARKERS

A. Lighting and Power Circuit Wire Markers.

1. Sizes #12 through 3/0 AWG. Brady SCN clip-sleeve wire markers.

2. Sizes 4/0 AWG and larger. Brady HSA heat shrink sleeves, custom printed.
3. Legends. Panel and circuit description; for example "EP1-1", "E1 - 2", "LPA-14".

2.5 EQUIPMENT AND WIRING DEVICE NAMEPLATES

A. General: White core laminated plastic. White lettering on black background, same style throughout project.
B. Emergency Equipment Nameplates: White lettering on red background.
C. Fasteners: Stainless steel self-tapping screws. Use epoxy adhesive only when NEMA enclosure rating is compromised by screws and for wiring device nameplates.
D. Switchboard, Motor Control Center, Panelboard, Dry-type Transformer and Control Panel Main Nameplate: 5/8" high block letters.
E. Other Nameplates: 3/8" high block or condensed letters.
F. Legends:
1. General. Description as indicated on drawings, i.e., "PANEL EP-1", "XFRM ET-1", “TS-1".
2. Voltage. Description of operating voltage, i.e., “120 Volts”, “120/208 Volts”, “208 Volts”, “277/480 Volts”, or “480 Volts”, “Single Phase” or “Three Phase”.
3. Source: Description of source; i.e., "FED FROM PANEL EP-1, CKT. #1".
4. Available fault current and data calculated.
G. AIC Rating: Short Circuit current rating, fully rated; i.e., “10,000 Amperes, Fully Rated”,

2.6 PANELBOARD CIRCUIT BREAKER IDENTIFICATIONS

A. Manufacturer's standard labels supplied with panelboard.
B. AIC Rating: Short circuit current rating, fully rated; i.e. “10,000 Amperes, Fully Rated”.

2.7 EQUIPMENT CONTROL PANEL NAMEPLATES

A. White core laminated plastic. White lettering on black background, same style throughout, 3/8" high block or condensed letters.
B. Legends:
1. Manufacturer’s Short Circuit Current Rating (SCCR).

2.8 TERMINAL IDENTIFICATIONS

A. Brady B-500 vinyl cloth pre-printed self-adhesive terminal markers. Legends: 1 through 96, A through Z.

2.9 FUSE IDENTIFICATION LABELS

A. Obtain original label from fuse box or carton or from fuse manufacturer, indicating manufacturer's name, fuse type, voltage and ampere rating. Attach with contact cement.

2.10 GROUND TERMINAL AND BUS IDENTIFICATION

A. Type: Green paint or dye, factory applied to terminal and bus.
B. Self-Adhesive Label Legend: "Ground", "Ground Bus", "Equipment Ground Bus" or "Isolated Ground Bus."

2.11 EMERGENCY FIXTURE AND OUTLET IDENTIFICATION

A. Self-adhesive red vinyl dots, 1/4" diameter. Brady QD-25-RD.

2.12 CONCEALED EQUIPMENT IDENTIFICATION

A. Brady ceiling tacks, 7/8" diameter with 7/16" long point.
1. Electrical equipment: #23255 (orange).
2. Fire alarm equipment: #23252 (red).

2.13 UNDERGROUND DUCT RUNS

A. Brady "Identoline" 6" wide over coated polyethylene film 3.5 mils thick, underground warning tapes.
1. Electric line: #91296 (red)
2. Telephone line: #91297 (orange)
3. Customized: Orange
a. Fire alarm line
b. Communications line
c. Data line
d. Data/communications line

e. Security line
f. CCTV line

2.14 DUCT RUN MARKERS
A. General.
1. Construction: Class A concrete.
2. Size: 6 inches square or round, 24 inches long. 45" chamfer on top edges.
3. Markings: Impressed or cast Letter "D" and two arrows. Locate one arrow below letter, pointing to duct run. Locate second arrow at right of letters, pointing parallel to duct run.
4. Marking sizes: V-shaped 1/4" wide at surface and 1/4" deep. 3" long for letter and arrow to right. 2" long for arrow below letter.
B. Change of Direction Markers: Angle arrow to right of letter to correspond to angular change of duct run direction.

2.15 DISTRIBUTION TRANSFORMER WARNING SIGN
A. Construction: Indoor/outdoor type, plastic or fiber glass, non-corrosive, impervious to weather.
B. Legend: "Danger" upper legend, white block letters on red panel on black panel. "High Voltage" lower legend, black condensed block letters on white.
C. Manufacturer: Brady, #71565.
D. Size: 7 inches high x 10 inches wide.

2.16 GENERATOR WARNING SIGNS
A. Construction: Indoor/outdoor type. Plastic or fiber glass, non-corrosive, impervious to weather.
B. Legend: "Danger" upper legend white block letters on red panel on black panel. "Warning" middle legend, red block letters on white panel, underlined in red. "This machine is automatically controlled" lower middle legend, black condensed block letters on white panel. "It may start at any time" bottom legend, red block letters on white panel.
C. Manufacturer: Brady, #47161.
D. Size: 7 inches high x 10 inches wide.

PART 3 – EXECUTION

3.1 GENERAL
A. Install nameplates, signs and labels, and engraved wall plates parallel to equipment lines. Embossed tape will not be permitted for any application.

3.2 INSTALLATION
A. Degrease and clean surfaces to receive nameplates.
B. Install nameplates parallel to equipment lines.
C. Secure nameplates to equipment fronts using stainless steel screws. Secure nameplate to inside face of recessed panelboard doors in finished locations.
D. Outdoor equipment labels shall be installed by the manufacturer as specified.

3.3 WIRE IDENTIFICATION
A. Provide wire markers on each conductor in panelboard gutters, pull boxes, and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.4 NAMEPLATE ENGRAVING SCHEDULE
A. Provide nameplates to identify all electrical distribution and control equipment, and loads served. Letter Height: 1/4 inch for individual switches and loads served, 1/4 inch for distribution and control equipment identification.

3.5 EQUIPMENT NAMEPLATES
A. General: Identify panelboards, dry-type transformers and control panels with nameplates showing descriptions or designations on Drawings.
B. Identify disconnect and transfer switches with nameplates describing loads served and panelboard circuit controlling load.

C. Identify conduits, connected to pull and junction boxes, with nameplates describing the complete circuit number of the conductors contained in each conduit.
D. Identify receptacles, where the nominal voltage between contact pairs is greater than 150 volts, with nameplates describing the complete circuit number, voltage, and phases.
E. Identify wall switches, where the equipment served is not in sight of the wall switch, with nameplates describing the equipment served by the wall switches.
F. Locations.
    1. Switchboards, Motor Control Centers, Distribution Panelboards. Locate main nameplate in center over top wiring gutter. Locate individual nameplates for switches and starters centrally on device doors. Locate individual nameplates adjacent and to the side of circuit breakers.
    2. Lighting and Appliance Panelboards. Locate main nameplate in center of cover approximately 2" down from top of panel.
    3. Dry-type transformers. In middle of front cover panel.
    4. Receptacles and Wall Switches. On wall directly above device plate.
    5. Other equipment: In middle near top of equipment.

3.6 PANELBOARD CIRCUIT BREAKER IDENTIFICATIONS

A. General. Attach numbered identification to each panelboard circuit breaker in space provided by manufacturer.
B. Sequence. Arrange numbering to correspond to panelboard pole positions. For two pole breakers, number according to the upper pole only. For three pole breakers, number according to middle pole only. For multiple breakers occupying poles on both left and right side, number according to left side only.
C. Numbering Convention. Number poles from top to bottom. Utilize consecutive odd numbers for left side and consecutive even numbers for right side.
D. Separate Sub-feed Breakers. Number with last number of panelboard sequence.
E. Circuit Directory. Prepare a neatly typed circuit directory behind clear heat resistant plastic in a metal frame attached to the inside of the door for each panelboard. Identify circuits by equipment served and by room numbers where room numbers exist. Indicate spares and spaces with light, erasable pencil marking. An adhesive mounted directory pocket is not acceptable.

3.7 BURIED CONDUIT OR DIRECT BURIED CABLE IDENTIFICATION

A. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick.
B. Provide tape with printing of "Buried Electrical Conduit" or other similar warning. Install directly above buried conduit or cable one half the distance to conduit below finished grade.

END OF SECTION

SECTION 26 05 93 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SCOPE

A. Provide all equipment, materials, labor, supervision, tools and services necessary for or incidental to the testing and inspecting of each new system and each new item of equipment provided or installed under this Division of the Specifications.

B. Tests and inspections for each new system and each new item of equipment shall be in accordance with the manufacturer's instructions.

C. Acceptance Tests shall be performed within twenty-four hours of receipt of equipment and shall prove that electrical equipment is operational within industry and manufacturer's tolerances and is acceptable for installation.

D. Field tests shall prove that the equipment is installed in accordance with the design drawings and specifications and the manufacturer's instructions.

E. Upon completion of tests and inspections specified, attach a label to each service device. Labels shall indicate the test date and test company.

F. Work Included:

1. Wire and cable (600 Volts and below)
2. Motor starters
3. Switchboards
4. Transformers
5. Automatic transfer switch
6. Life safety systems
7. Ballasts
8. Emergency battery packs
9. Grounding

G. Engage the services of a recognized testing laboratory with more than five (5) years of experience and certified by the National Electrical Testing Association (NETA) for the purpose of performing the inspections and tests specified. The testing laboratory shall perform tests and inspections designated to be performed by the Testing Laboratory (TL). All other Inspectors and Tests may be performed by the Contractor's qualified personnel. The testing laboratory's responsibility shall include the following:

1. Notification of the Engineer prior to the start of testing.
2. Specifying the power requirements for each test site.
3. Providing sufficient protective barriers and warning signs to conduct tests and inspections safely.
4. Reporting any material or workmanship found to be defective during tests and inspections to the Engineer.
5. Implementation of the final settings and adjustments on the electrical equipment in accordance with the values specified in the coordination study.
6. Maintaining written records of tests. Comply with the submittal requirements specified in this section.
7. Upon satisfactory completion of tests and related effort, apply label to tested components indicating results, person responsible and date.
8. Acceptable Testing Laboratories
   a. Southwest Energy Systems, LLC
   b. Shermco Industries
   c. ABB Service Engineering
   d. General Electric Service Engineering
   e. Square D Services

H. Engage the services of the manufacturer's service organization to perform the tests and inspections, as specified.

1.3 DIVISION OF RESPONSIBILITY - CONTRACTOR

A. Perform routine insulation resistance, continuity, and rotation tests for new distribution and utilization equipment as specified prior to, and in addition to, the tests specified to be performed by the testing laboratory. Responsibility shall include the following:
   1. Supply a suitable source of power to the testing laboratory or the manufacturer's representative at each site. Notify the testing laboratory or the manufacturer's representative when equipment becomes available for acceptance tests.
   2. Coordinate the work to expedite the project scheduling.
   3. Provide a complete set of electrical drawings and specifications, and pertinent change orders to the testing laboratory and the manufacturer's representative.
   4. Maintain records of all tests and inspections performed and assemble all information required to comply with the submittal requirements specified in this Section.

1.4 SUBMITTALS

A. Provide two (2) bound copies of a draft and final report, which shall contain the following information:
   1. An executive summary which identifies any significant problems encountered and corrective actions.
   2. A tabulation of all life safety system test results and certification including field measurements.
   3. A tabulation of all cable test data.
   4. Copies of all system certifications.

B. The Final and Draft Reports shall be prepared using the following format:

Format:	
Size:	8½" x 11"
Paper:	White bond, at least 20 lb. weight
Text:	Typewritten or printed
Drawings:	11" in height preferable; bind in with text; foldout acceptable; larger drawings acceptable but fold to fit within the Manual and provide a drawing pocket inside rear cover or bind in with text.
Flysheets:	Separate each section of the Manual with neatly prepared flysheets briefly describing contents of the ensuing section; flysheets may be in color.
Binding:	Use heavy-duty plastic or fiberboard covers with 3-ring binding mechanism concealed inside the manual. All binding is subject to the Owner's Representative's approval.
Measurements:	Provide all measurements in U.S. standard units such as feet-and-inches, lbs., and cfm. Where items may be expected to be measured within ten years in accordance with metric formulae, provide additional measurements in the "International System of Units" (SI).

   1. Provide front and back covers for each manual, using durable material approved by the Engineer, and clearly identified on or through the cover with at least the following information:
      a. Electrical Testing Adjusting and Balancing
      b. Owner's Name
      c. Project Title
      d. Space for approval signature of the engineer and approval date
   2. Contents: Include at least the following:
      a. Neatly typewritten index near the front of the Manual, giving immediate information as to location within the manual.
      b. Such other data as required in pertinent sections of these specifications.

C. Submit two (2) copies of a Draft Report to the engineer. Revise the report as required to accommodate the Engineer's comments.

D. Submit four (4) copies of the Final Report within 30 calendar days after approval of the Draft Report.

1.5 TEST INSTRUMENT CALIBRATION

A. The testing laboratory shall maintain test instruments, which have been calibrated within rated accuracy. Dated calibration labels shall be visible on the test equipment.
B. Instruments shall be calibrated in accordance with the following frequency schedule:
   1. Field instruments – 6 months maximum.
   2. Laboratory instruments – 12 months.
   3. Leased specialty equipment – 12 months.

1.6 SAFETY PRACTICES
A. Safety practices shall include, but are not limited to, the following requirements:
   1. Occupational Safety and Health Act of 1970 – OSHA.
   2. "Accident Prevention Manual for Industrial Operations," as published by the National Safety Council.
   3. Applicable safety operating procedures of the governing authorities.
   4. Division 26 specifications.
B. Perform tests with apparatus de-energized, except where otherwise specifically required.
C. Power circuits shall have conductors shorted to ground by a hot-line grounded device approved for that purpose.

1.7 QUALITY ASSURANCE
A. Use adequate numbers of skilled workmen thoroughly trained and experienced in necessary crafts and completely familiar with specified requirements and methods needed for proper performance of Work of this Section.
B. Without additional cost to Owner, provide labor and materials as required to complete the Work of this Section in accordance with requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
C. When requested, provide Architect with manufacturer's certificate that the test equipment meet or exceed minimum requirements as specified.

PART 2 – PRODUCTS – (Not Used)

PART 3 – EXECUTION

3.1 GENERAL PROCEDURES – ACCEPTANCE AND FIELD TESTS
A. Perform each test and inspection until acceptable results are obtained in accordance with the manufacturer's instructions, unless otherwise specified.
B. Perform the following tests and inspections for each system and item of equipment as applicable, unless otherwise specified:
   1. Inspect for physical damage and defective materials or installation work. Inspect for proper physical, electrical and mechanical conditions (materials and installation work).
   2. Inspect equipment and systems for compliance with requirements of the Drawings and Specifications. Compare equipment nameplate information with the latest one-line diagrams. Verify that connections and terminations are in accordance with the one-line diagrams.
   3. Check tightness of cable connections and bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper foot-pound levels. Place a mark on each tightened bolt to ensure completeness.
C. Promptly report any discrepancies or unsatisfactory conditions determined by test or inspection.
D. Perform insulation resistance tests for each applicable system and item of equipment. Do not perform this test on solid-state devices. Note: In some cases terminated cables cannot be tested unless disconnected from the end devices.
   1. Apply test voltages as follows:

Voltage Rating	Test Voltage
150 – 600 V	1000 V
601 – 5000 V	2500 V
5001 V & higher	5000 V

   2. Investigate values of insulation resistance less than the manufacturers recommended minimum, or less than a value equal to kV+1 in megohms.
E. Overpotential tests shall not proceed until resistance tests are satisfactorily performed. Perform overpotential tests for each system and item of equipment as specified.

3.2 CABLES (600 VOLTS AND LESS) – FIELD TESTING

A. Inspect for shield grounding, cable support and termination.
B. Check visible cable bends against ICEA and manufacturer's minimum allowable bending radius.
C. Inspect for fireproofing in common cable areas.
D. Where cables are terminated through window type cable trays, make an inspection to verify that neutrals and grounds are properly terminated for normal operation of protective devices.
E. Perform insulation resistance tests on each cable with respect to ground and adjacent cables. Record test results.
F. Perform continuity tests to confirm proper cable connections.

3.3 SWITCHBOARDS – FIELD TESTING

A. At the completion of the work the switchboard shall be field tested in the presence of the Engineer. Tests shall be conducted by the service organization of the manufacturer.
B. Tests shall include the following:
C. Operation of each disconnecting means under load.
D. Operation of all metering equipment.
E. The manufacturer shall observe all cable bracing both incoming and outgoing and certify that same is provided in accordance with the manufacturer's recommendations.
F. The ground fault system shall be set by the testing laboratory at the level specified by the approved coordination study. Each system shall be tested by checking coordination between ground fault and phase to ground fault of a 1P-20 ampere lighting branch circuit.
G. Bus joints shall be re-torqued in accordance with manufacturer's recommendations. Submit certification.

3.4 SOLID STATE MOLDED CASE CIRCUIT BREAKERS – 600 VOLTS AND LESS – FIELD TESTING

A. Perform insulation resistance tests from each pole-to-ground, from pole-to-pole, and across open contracts of each phase. Test values shall not be less than 50 meg-ohms. Record final test results.
B. Utilize primary current injection method to verify the following settings are in accordance with the coordination study.
    1. Minimum pickup current of trip devices, where possible
    2. Long time delay, using 300% pickup current
    3. Short time pickup and short time delay
    4. Instantaneous pickup current
    5. Ground fault pickup current and time delay
C. Verify trip unit reset characteristics.
D. Activate auxiliary protective devices, such as ground fault and under voltage relays, to insure operation of shunt trip devices.
E. Where charging motors are used, electrically operate circuit breaker to verify performance of limit switches.

3.5 MOLDED CASE CIRCUIT BREAKERS (600 VOLTS AND LESS) – FIELD TESTING

A. The testing lab shall check each circuit breaker for proper mounting, conductor size and feeder designation.
B. Operate circuit breaker to insure smooth operation.
C. Open unsealed breakers and check internal components for tightness, when applicable.
The testing lab shall measure contact resistance in micro-ohms for devices with full load ampere. ratings larger than 400 amperes. Investigate deviations greater than 50%, as compared to adjacent poles and similar breakers.

3.6 DRY TYPE TRANSFORMERS (Primary Rated 600 Volts)

A. Within five (5) days after delivery to the work site and prior to installation, perform the following field tests and inspections:
    1. Compare transformer and accessories nameplate information with the specification and report any discrepancies.
    2. Inspect transformer and accessories and report installation or shipping damage, loose material, shipping blocks or contamination. Correct deficiencies.
    3. Check operation of access covers. Correct deficiencies.
    4. Check air circulation for proper operation. Correct deficiencies.

3.7 AUTOMATIC TRANSFER SWITCH

A. Set the timers and test the start generator function.

B. Open the circuit breaker in the main switchboard serving the ATS and verify proper starting and load transfer of the ATS.

3.8 INSTRUMENT TRANSFORMERS – FIELD TESTING

A. The Testing Lab shall perform all work.
B. Verify proper operation of grounding and shorting devices.
C. Electrically confirm transformer polarity.
D. Verify connection at secondary current transformer leads by applying low current to leads and check for current contribution at applicable devices.
E. Confirm transformer ratio.
F. Verify connection of secondary power transformer and control transformer leads by applying low voltage to leads and check for voltage contribution at applicable devices.
G. Check power transformer secondary load with secondary voltage and current measurements to insure that load is less than the wattage of power transformer.

3.9 METERS – FIELD TESTING

The Testing Laboratory shall perform all work.

A. Check calibration of meters at five (5) points. Use full-scale instruments having precision not more than 50% of meter being tested. Apply test values, record data and plot curves from 0 to full-scale reading.
    1. Zero sequence system is grounded upstream from sensor
    2. Ground strap systems are grounded through sensing device
    3. Ground connection is made ahead of neutral disconnect link
B. Verify that control power transformer capacity is adequate for system
C. Manually operate monitor panels to test sequences for:
    1. Trip test
    2. No trip test
    3. Non-automatic reset
D. Insure control circuit has switchable fuse device with current limiting fuses.
E. Measure system neutral insulation resistance to insure no shunt ground paths exist. Remove neutral-to-ground disconnect link, and measure neutral insulation resistance, and then replace link. System neutral insulation shall be one (1) meg-ohm or greater. Record test results

3.10 GROUNDING SYSTEMS – FIELD TESTING

All work shall be performed by the Testing Laboratory.

A. Perform ground continuity tests between main ground system and equipment frames, and between main ground system and system neutral and/or derived neutral points. Make test by passing a minimum 10-amp DC current between the ground reference system and the ground point to be tested. Measure voltage drop and calculate resistance by voltage drop method.
B. Submit in a letter indicating the ohmic resistance of the service grounds and a statement that the grounding system is free of all defects, stray currents, shorts, etc.
C. Perform fall of potential tests on the main ground electrode system. The main ground electrode system resistance-to-ground shall be no greater than five (5) ohms.
D. Record final test results.

3.11 STARTERS

A. Motor Controllers:
    1. Submit with certification in tabular form a complete listing of all motors on the project for which motor controllers have been furnished. Include on this listing the nameplate full load amperes of each motor and the size overload heaters installed in each motor controller.
B. Motors:
    1. Test all motors under load and verify that motor rotation is correct
C. Chillers:
    1. Verify proper functioning of the wye-delta starter
    2. While the chiller is fully loaded, measure and record volts, amps, power factor of all three phases

3.12 SURGE ARRESTORS – FIELD TESTING

The Testing Laboratory shall perform all work.

A. Verify integrity of ground and discharge counter connections.
B. Perform a 60-hertz spark-over test. Record test results.

C. Perform a radio influence voltage test. Record test results.
D. Perform an insulation power factor test. Record test results.
E. Perform ground continuity test to ground grid system. Record test results.

3.13 LIFE SAFETY SYSTEMS

A. All wiring must be inspected and tested to insure that there are no grounds, opens or shorts. The minimum allowable resistance between any two conductors or between conductors and ground is ten (10) megohms as measured with a 500 volt megger after all conduit, conductors, detector bases, etc., have been installed, but before the detector devices are plugged into the bases or end-of-line devices installed.
B. Perform all electrical and mechanical tests required by the equipment manufacturer's form. A checkout report is to be prepared by the technician and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report is to include, but not be limited to:
    1. A complete list of equipment installed and wired
    2. Indication that all equipment is properly installed and functions and conforms to these specifications
    3. Tests of individual zones as applicable
    4. Serial numbers, locations by zone and model number for each installed detector
    5. Voltage (sensitivity) settings for each ionization detector as measured in place
    6. Response time of detectors
C. Submit a certified report indicating the following:
    1. 4 of the FACP

3.14 BALLASTS

A. Submit manufacturer's certification that ballasts and transformers for discharge type lamps comply with the latest C.B.M. specifications which have been issued.

3.15 EMERGENCY BATTERY PACKS

A. Each emergency battery pack shall be shown to operate satisfactorily. This shall be accomplished by the use of the unit mounted test switch as one test. The second test shall be the interruption of power to the unit.
B. Quartz standby lamps in H.I.D. luminaires shall be tested to show proper operation by testing as listed above.

3.16 CALIBRATION

A. Calibrate and adjust all components requiring same as directed, in accordance with manufacturer's procedures and recommendations or as required, for the following categories of equipment:
    1. Transformer taps
    2. Lighting fixtures (lamp positions, reflector positions, etc., as required)
    3. Motor starters
    4. Generator Controls and synchronization
B. Provide overloads in all motor starters, in accordance with motor nameplate data and as recommended by the manufacturer.

3.17 RE-TESTING

A. Correct deficiencies and re-test. Verify by re-tests that specified requirements are met.
B. Notify the Architect/Engineer seven (7) days prior to the testing dates. Should the Architect/Engineer elect not to witness a specific test a statement of certification shall be forwarded to the Architect/Engineer for his approval.
C. Conduct tests at a time agreeable to the Architect/Engineer. Provide premium labor as necessary.
D. Products which are found defective or do not pass such tests shall be removed and replaced. Tests shall be repeated.
E. Arrange for and conduct all test and inspections required by the authorities having jurisdiction. Pay all fees for testing and inspection.

END OF SECTION

SECTION 26 06 20 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. All other Sections of Division 26.
B. All other Divisions of the Contract Documents. Refer to each Division's Specifications and Drawings for requirements.

1.3 SCOPE

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of disconnect switches as shown or indicated on the Drawings and/or as specified.
B. Work Included:
   1. Circuit disconnects
   2. Motor disconnects

1.4 SUBMITTALS

A. Reference Section 26 00 10 for detailed requirements.

1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.
C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Provide disconnect switches manufactured by one of the following:
   1. General Electric Company
   2. Siemens Energy and Automation
   3. Square D Schneider Electric
   4. Eaton, Cutler Hammer

2.2 HEAVY-DUTY SAFETY SWITCHES

A. Provide surface-mounted, heavy-duty type, sheet-steel enclosed safety switches, of types, sizes and electrical characteristics indicated; fusible type, rated 600 volts, and incorporating quick-make, quick-break type switches; construct so that switch blades are visible in OFF position with door open. Equip with operating handle which is pad lockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips. Provide NEMA Type 3R enclosures at exterior equipment.

2.3 COMPONENTS

A. Motor and circuit disconnects shall have an Underwriters' Laboratory label.
B. Single Phase Disconnect Switches: Two pole toggle switch equal to Square D Type F with thermal overloads in appropriate enclosure.
C. Three Phase Motor Disconnect Switches: 3 pole heavy duty 250 or 600 volt as required in NEMA Type 1 or 3 enclosures as indicated and as required.

D. Enclosures
   1. Normal indoor locations – heavy duty NEMA 1
   2. Outdoor or wet locations – heavy duty NEMA 3R

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install circuit and motor disconnect switches as indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA, and NECA's "Standard of Installation", and in accordance with recognized industry practices.

END OF SECTION

SECTION 260800: COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Commissioning Lighting Control Systems

2. Photovoltaics

1.2 RELATED REQUIREMENTS

A. Section 019113 – General Commissioning Requirements

B. Section 220800 – Commissioning of Plumbing Systems

C. Section 230800 – Commissioning of HVAC Systems

1.1 DEFINITIONS

A. CxA: Commissioning Agent

B. GC: Contractor; General Contractor, not a Subcontractor

C. O&M: Operations and Maintenance

1.2 DESCRIPTION

A. This Section describes commissioning requirements applicable to commissioned items and systems specified in CSI Masterformat Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents.

B. Conform to commissioning requirements and the commissioning plan.

1.3 RESPONSIBILITIES

A. Construction and Acceptance Phases

1. Include the cost of commissioning in the contract price. Commissioned equipment is defined in section 019113.

2. In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

3. Conduct a commissioning scoping meeting and other meetings necessary to facilitate the Commissioning process.

4. Provide requested documentation to the CxA, developed for functional testing procedures.

5. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

6. Provide functional performance test procedures. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

7. Develop a full start-up and initial checkout plan using manufacturer's start-up procedures and the prefunctional checklists for all commissioned equipment. Submit to GC for review prior to startup. CxA will verify plan for compliance. Refer to Section 019113 for further details related to start-up.

8. During the startup and initial checkout process, execute and document the electrical-related portions of the prefunctional checklists provided by the CxA for all commissioned equipment.

9. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the GC.

10. Address current A/E punch list items before functional testing. Systems shall be completed with discrepancies and problems remedied before functional testing of the respective systems.

11. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

12. Provide all test equipment necessary to fulfill specified testing requirements.

13. Perform functional performance testing under the direction of the CxA for specified equipment. Assist the CxA in interpreting the monitoring data, as necessary.

14. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA and A/E, and retest the equipment.

15. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

16. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line as-built drawings for all drawings and final as-builts for contractor-generated coordination drawings.

17. Provide training of the Owner's operating personnel as specified.

18. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

B. Operation Manuals shall include:

1. A table of all set-points and implications when changing them.

2. Schedules.

3. Instructions for operation of each piece of equipment for emergencies.

4. Startup and shutdown.

5. Recommendations for re-commissioning frequency by equipment type.

C. Warranty Period

1. Execute deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

1.4 SUBMITTALS

A. Provide submittal documentation relative to commissioning as required in this Section, Section 019113 and other specified requirements.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 STARTUP

A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 019113. CSI Masterformat Division 26 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and GC. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.2 OPERATIONS AND MAINTENANCE (O&M) MANUALS

A. See Section 019113 for documentation requirements.

3.3 TRAINING OF OWNER PERSONNEL

A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed.

B. The GC shall be responsible for reviewing the content and adequacy of the training of Owner personnel for commissioned equipment or systems. CxA will verify compliance.

C. Electrical Contractor. The electrical contractor shall have the following training responsibilities:

1. Provide the GC with a training plan four weeks before the planned training.

2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.

3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, power failure, etc.

4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

7. Training shall include:

   a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.

   b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

   c. Discussion of relevant health and safety issues and concerns.

   d. Discussion of warranties and guarantees.

   e. Common troubleshooting problems and solutions.

   f. Explanation of information included in the O&M manuals.

   g. Discussion of any peculiarities of equipment installation or operation.

   h. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

9 Training shall occur after functional testing is complete, unless approved otherwise by the GC.

10. Minimum Duration of Training: The electrical contractor shall provide training on each piece of equipment according to the periods indicated in the individual CSI Masterformat Division 26. Provide a 4 hour training session to cover, As-builts, O&M's, and systems installed.

D. See additional training information in section 017900.

END OF SECTION

SECTION 26 09 23 - OCCUPANCY SENSORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. All other Sections of Division 26.

B. All other Divisions of the Contract Documents. Refer to each Division's Specifications and Drawings for requirements.

1.3 SCOPE

A. Provide all labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of a completely operational occupancy sensor lighting control system, as described herein.

B. Examine all general specification provisions and drawings for related electrical work required as work under Division 26.

C. Coordinate all work described in this section with all other applicable plans and specifications, including but not limited to wiring, conduit, fixtures, HVAC systems and building management systems.

1.4 EQUIPMENT QUALIFICATION

A. Products supplied shall be from a single manufacturer that has been continuously involved in the manufacturing of occupancy sensors for a minimum of five (5) years. Mixing of manufacturers shall not be allowed.

B. All components shall be U.L. listed, offer a five (5) year warranty and meet all state and local applicable code requirements.

C. Products shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.

D. Wall switch products must be capable of withstanding the effects of inrush current. Submittals shall clearly indicate the method used.

1.5 SYSTEM DESCRIPTION

A. Ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

B. The occupancy sensor based lighting control system shall accommodate all conditions of space utilization and all irregular work hours and habits.

C. Warrant all equipment furnished in accordance to this specification to be undamaged, free of defects in materials and workmanship, and in conformance with the specifications. The work shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier. The warranty shall commence upon the owner's acceptance of the project. Warranty on labor shall be for a minimum period of one (1) year.

D. Provide a light switch in each room as shown or as specified in Section 26 5000.

1.6 SUBMITTALS

A. Provide submittals as required in section 26 05 10, “Submittal Process”.

B. Substantiate conformance to this specification by submitting the necessary documents, performance data and wiring diagrams. Any deviations to this specification must be clearly stated by letter and submitted.

C. Submit a lighting plan clearly marked by the manufacturer showing proper product, location and orientation of each sensor.

D. Submit standard catalog literature that includes performance specifications indicating compliance to the specification.

E. Catalog sheets must clearly state any load restrictions when used with electronic ballasts.

1.7 SYSTEM OPERATION

A. Make all proper adjustments to assure owner's satisfaction with the occupancy system.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The Watt Stopper, Leviton, Cooper Industries or Hubbell.

B. The listing of any manufacturer as "acceptable" does not imply automatic approval. It is the sole responsibility of the electrical contractor to ensure that any price quotations received and submittals made are for sensors that meet or exceed the specifications included herein.

2.2 PRODUCTS

A. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion. Passive infrared sensors shall only be used in corridors or hallways. Provide a wall switch infrared sensor with ON/OFF switching in janitor rooms, storage rooms with limited shelving

B. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.

C. Passive infrared sensors shall have a multiple segmented Lodif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

D. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open. Dual technology sensors shall be used in toilets, rooms with partitions, open offices with cubicles, cafeterias and storage rooms or warehouses with shelving.

E. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

1. The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
2. Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic and PIR technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either shall hold lighting on.
3. Sensor shall be capable of corner mounting to a wall or ceiling in order to eliminate detection through open doorways and outside of controlled area. To provide superior small motion detection and immediate activation upon entry, coverage of both technologies must be complete and overlapping throughout the controlled area.
4. To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.

F. Low Voltage Digital Time Switch: The digital time switch shall be programmable to turn loads off after a preset time. Time switch shall be a five terminal, completely self-contained control system that replaces a standard toggle switch. Switching mechanism shall be a 30V @ 1A air gap relay.

1. Time switch shall operate at either 24 VAC/VDC/VAC-half wave rectified. Time switch shall be capable of operating as an ON/OFF switch.
2. Time switch shall have no minimum load requirement. Time-out period shall be adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to12 hours.

G. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.

H. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

I. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

J. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

K. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

L. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

PART 3 - EXECUTION

3. 1 INSTALLATION

A. Locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors as required to properly and completely cover the respective room.

B. Meet with the manufacturer's factory authorized representative, at the owner's facility, to verify placement of sensors and installation criteria.

END OF SECTION

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SECTION 26 21 16 - LOW VOLTAGE UNDERGROUND ELECTRICAL SERVICE ENTRANCE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of electrical service from the utility company transformer location to the main switchboard as shown or indicated on the drawings and/or as specified.

B. Work included:

1. Furnish and install conduits, wires, and metering equipment to provide an additional electrical service entrance as shown on the drawings and/or specified herein. Coordinate work with the electric utility company, verify all requirements, and install service entrance equipment in exact compliance with utility company and local governmental agency requirements.
2. Arrange with the electric utility company to inspect the work and include all utility charges and costs related to the installation of the electric service.

1.3 SYSTEM DESCRIPTION

A. Underground service entrance (from pole mounted transformer).

B. System Voltage: 208/120Y volt, 3 phase, 4 wire, 60 hertz.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

A. All metering shall be furnished and/or installed, as directed by the electric utility company. Install equipment and furnish current transformer cabinet as required at no additional cost to the Owner.

2.2 RACEWAYS AND FITTINGS

A. Provide the excavation and backfill of conduit trench for primary and secondary conduits. Arrange with the electric utility to inspect the conduits before backfilling the trench. Correct all deficiencies

B. Conduit elbows shall be factory manufactured, rigid galvanized steel conduit, 24 inch minimum long radius, sweep bends. Apply corrosion protective tape, half lapped, to elbows.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install service-entrance equipment as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices, to ensure that service-entrance equipment fulfills all requirements. Comply with applicable installation requirements of NEC and NEMA standards.

B. Coordinate with other work, including utility company wiring, as necessary to interface installation of service-entrance equipment work with other work.

END OF SECTION

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SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of electrical panelboards as shown or indicated on the Drawings and/or as specified.

B. Work Included

1. Power distribution panelboards
2. Lighting and branch circuit panelboards

1.3 SUBMITTALS

A. Reference Section 26 00 10 for detailed requirements.

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the manufacturer's certification that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Panelboards shall be manufactured by one of the following:

1. Siemens Energy and Automation
2. General Electric Company
3. Square D Schneider Electric
4. Eaton Corporation

2.2 PANELBOARDS (GENERAL)

A. Panelboards shall be listed by Underwriters Laboratories, Inc. (UL), and shall be so labeled, rated for intended voltage and current characteristics as scheduled. Circuit breakers shall be fully rated.

B. Cabinets for panelboards shall be by NEC gauge sheet steel having steel doors and trim to conform to the cabinet mounting. The trim on cabinets shall be made adjustable with the door. Door shall be mounted with heavy concealed hinges.

C. Cabinets shall have wiring space top, bottom and both sides in accordance with the National Electrical Code, but no less than 4-inches wide, with standard knockouts.

D. Provide a clear, plastic-covered, typed directory card and cardholder on the inside of each door. Key locks alike, and provide Owner with not less than 5 keys. Finish shall be gray enamel over a rust inhibitor, except cans may be galvanized.

E. Multisection panels shall be same height and depth.

F. Interiors shall be completely factory assembled, and shall consist of rigid frame supporting the rectangular bus, mains, neutral and ground bars. Bussing shall be sized in accordance with UL Standards, braced throughout to conform to industry standards governing short circuit stresses in panelboards, and arranged for sequence phasing throughout. Bussing shall be tinned copper.

G. Phase bussing shall be full height without reduction, full size neutral, unless otherwise scheduled, with suitable lug for each outgoing circuit requiring a neutral connection. Provide ground bus with suitable lugs for each branch circuit ground conductor.

H. Terminals for feeder conductors, branch circuit devices and neutrals shall be UL listed as suitable for type of conductors specified.
I. Interiors shall be designed such that circuit protective devices may be changed, replaced, or additional circuits added without disturbing adjacent units and without machining, drilling or tapping. In no case shall the width of panelboard enclosure be less than 20-inches. Branch circuit breakers shall be bolt-in type.
J. Enclosures
    1. Circuit switching/protective devices shall be housed in an enclosure suitable for the environment in which they are located
    2. Normal indoor locations - NEMA 1 general purpose
    3. Outdoor or vault locations - NEMA 3R

2.3 POWER DISTRIBUTION PANELBOARDS
A. Provide dead-front safety type power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown; with anti-turn solderless pressure type main lug connectors approved for copper conductors. Equip with copper bus bars with not less than 98% conductivity, and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections.
B. Provide bolt-in type heavy-duty molded-case branch circuit breaker types for each circuit, with toggle handles that indicate when tripped. Where multiple-pole breakers are indicated, provide with common trip so overload on one pole will trip all poles simultaneously. Provide panelboards with bare un-insulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.
C. On multisection and split-bus panels, the lugs and bus on each and every section shall be of the same current rating as the main overcurrent device protecting the feeder serving the panel and each section shall have a separate neutral, ground bar and conductors. Panel bus shall have double lugs to effect parallel feed of bus bars (rather than series) where scheduled. Feed-thru lugs are not acceptable.

2.4 LIGHTING AND BRANCH CIRCUIT PANELBOARDS
A. Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types, and arrangements shown; with anti-burn solderless pressure type lug connectors approved for copper conductors.
B. Equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit breakers, with toggle handles that indicate when tripped. Interrupting rating shall be in excess of the available fault current at the panel in accordance with UL listings for sizes involved, but no less than 10,000 rms symmetrical amperes. Provide common trip on multi-pole circuit breakers.
C. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate properly with panelboards.
D. On multi-section and split-bus panels, the lugs and bus on each and every section shall be of the same current rating as the main overcurrent device protecting the feeder serving the panel and each section shall have a separate neutral, ground bar and conductors. Panel bus shall have double lugs to effect parallel feed of bus bars (rather than series) where scheduled. Feed-thru lugs are not acceptable.

2.5 INDIVIDUALLY MOUNTED CIRCUIT BREAKERS
A. Individually mounted circuit breakers shall be molded case, capacity as indicated, in a NEMA Type 1 enclosure unless otherwise noted. Breakers shall be quick-make, quick-break thermal magnetic common trip type, ambient compensated with trip-free handle and have interrupting rating in accordance with UL listings for sizes required, but not less than 10,000 amperes rms symmetrical, and conform to requirements of NEMA Standard Publication No. AB1-1969. Each unit shall have insulated neutral and/or ground terminal of proper size, where indicated. Lugs shall be UL listed for copper cables.
B. Enclosures
    1. Circuit switching/protective devices shall be housed in an enclosure suitable for the environment in which they are located. Provide lifting eyes or brackets
    2. Normal indoor locations - NEMA 1 general purpose
    3. Outdoor or vault locations - NEMA 3R
C. Circuit breakers shall be of same manufacturer as panelboards.

2.6 PANELBOARD ACCESSORIES

A. Provide panelboard accessories and devices as recommended by panelboard manufacturer for ratings and applications indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.
C. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure. Provide cross channels at top and bottom in stud walls to support panels.
D. Provide properly wired electrical connections within enclosures.
E. Prepare and affix typewritten directory to inside cover of panelboard indicating loads controlled by each circuit.
F. Install wall-mounted panelboards a maximum of 6 feet 6 inches above finish floor to top of panel.

END OF SECTION

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SECTION 26 27 16 - ELECTRICAL CABINETS AND ENCLOSURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A. Provide all equipment, materials, labor, supervision, and services necessary for or incidental to the installation of electrical cabinets and enclosures as indicated on the Drawings and as specified.

B. Work included:

1. Hinged cover enclosures
2. Cabinets

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide manufacturer's certificates that confirm the materials meet or exceed minimum requirements as specified.

1.4 SUBMITTALS

A. Comply with the requirements specified in 26 00 10.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Type:

1. Indoor locations - NEMA Type 1
2. Outdoor locations - NEMA Type 3R

B. Finish: Manufacturer's standard gray enamel finish.

C. Covers: Continuous hinge, held closed by flush vandal-resistant latch operable by key. Make keys interchangeable with new enclosures of the same voltage and use.

D. Panel for Mounting Terminal Blocks or Electrical Components: 14 gage steel, manufacturer's standard gray enamel.

2.2 CABINETS

A. Cabinet Boxes: Galvanized steel with removable end walls, 24 inches wide 10 inches deep. Provide ¾-inch-thick, plywood backboard painted matte white, for mounting terminal blocks.

B. Cabinet Fronts: Steel, surface type with concealed trim clamps, screw cover front concealed hinge and flush lock keyed to match branch circuit panelboard; finish in gray baked enamel.

C. Provide identification label. Reference Section 26 05 53.

2.3 FABRICATION

A. Shop assembled enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide knockouts on enclosures.

C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets and enclosures plumb, and anchor securely to wall and structural supports at each corner, minimum.
B. Provide accessory feet for free-standing equipment enclosures.
C. Install trim plumb, minimum 6'-6" from finished grade or floor to top of enclosure.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS
- A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SCOPE OF WORK
- A. Provide labor, material, equipment, tools and services, and perform operations required for, and reasonably incidental to, the providing of wiring devices, including related systems and accessories.

1.3 SUBMITTALS
- A. Submit product data and shop drawings in accordance with 26 00 10

1.4 REFERENCE STANDARDS
- A. The wiring devices specified herein shall be designed, manufactured, tested and installed according to the latest version of the following standards:
  1. National Electrical Manufacturers Association (NEMA) WD-1
  2. Federal Specification (FS) WC-596
  3. Federal Specification (FS) WS-896
  4. Underwriters Laboratories (UL)
- B. All wiring devices shall be UL listed.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
- A. Digital switches: Acuity Controls or equal by Lutron, Leviton or Douglas Controls
- B. Conventional wiring devices: Pass & Seymour, Hubbell, Leviton or Cooper.

2.2 RECEPTACLES
- A. General
  1. Receptacles shall be standard style as indicated herein. They shall be constructed of high-impact resistant thermoplastic material with a nylon face and thermoplastic back body, white color. Unless noted otherwise, they shall be 2-pole, 3-wire with a green equipment ground screw or an automatic grounding system attached to the strap.
  2. Receptacle color shall be white unless noted otherwise by architect/owner.
- B. Specification Grade
  1. Specification Grade receptacles shall be standard style. The face shall be constructed of a high-impact resistant thermoplastic. The contacts shall be a triple wipe, T-slot, one-piece copper alloy design. The device shall have a green ground screw or an automatic grounding system attached to the strap. The device shall be 20-ampere, 125-volts, NEMA configuration 5-20R, back and side-wired.
- C. Special purpose receptacles shall be of the specific NEMA configuration indicated on the Drawings.
- D. Ground Fault Circuit Interrupter (GFCI)
  1. GFCI receptacles shall be a feed-through type wired for single receptacle protection thus not affecting receptacles downstream on the same circuit. They shall be UL rated Class 1 with 5-milliampere ground fault trip level and a 20-ampere feed-through rating. GFCI receptacles shall be NEMA configuration 5-20R.
- E. Isolated Ground (IG)
  1. Isolated ground receptacles shall be standard style. The contacts shall be a triple wipe, T-slot, one-piece copper alloy design. The ground contacts shall be isolated from the mounting strap and conduit system. The device shall have a green ground screw that totally isolates the grounding contacts, and it shall require that the insulated ground conductor run uninterrupted to the neutral at the service entrance. The device shall also have an automatic grounding system and center rivet attached to the mounting strap allowing the use of a metal wall plate. The device shall carry an identifying triangle on the face to signify Isolated Ground. The device shall be 20-ampere, 125-volts, NEMA configuration 5-20R, back and side-wired, orange.

2.3 SWITCHES (REFER TO SECTION 26 0923)
- A. Digital Switch
  1. Provide a Rocker Digital Switch by Lighting Control and Design

.

2. Switch shall be 100% digital
3. Switch shall have designer style controls
4. Switch shall be capable of controlling switching, dimming and preset scenes.
5. Switch shall be capable with the digital network lighting control system.

2.4 WALL PLATES

A. Wall plates shall be provided for all switches, receptacles, blanks, telephone and special purpose outlets. The wall plates shall be of suitable configuration for the device for which it is to cover with color matched mounting screws. Color of the wall plates shall match the device (white), unless noted otherwise.

B. Weatherproof: Wiring devices in wet and damp locations shall be installed with a hinged metal outlet cover/enclosure clearly marked “Suitable for Wet Locations While in Use” and “UL Listed”. There shall be a gasket between the cover/enclosure and the mounting surface, and between the hinged cover and mounting plate/base to assure proper seal. The cover/enclosure shall employ stainless steel mounting hardware and be constructed of impact resistant polycarbonate. The cover/enclosure shall be specification grade as manufactured by Pass and Seymour or equal.

PART 3 – EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. Each wiring device shall be mounted in a metallic outlet box. In general, devices in finished spaces shall be flush mounted and devices in unfinished spaces, i.e. mechanical and electrical equipment rooms shall be surface mounted. Verify the requirements of all spaces with the Architect.

B. Wall Plates
   1. Each device shall have a cover plate appropriate for the application.
   2. Cover plates shall be installed true and plumb with building lines, mortar joints and architectural features.
   3. Adjacent devices shall be mounted under a common cover plate suitable for the application.

C. Mount receptacles and special systems outlets above finish floor to the device centerline, unless noted or required otherwise.

D. Place conductor under wiring device screw terminals and draw up snugly.

E. Mount switches above finish floor to the device centerline and 6" from a door strike, unless noted or required otherwise.

F. Grounding continuity shall be maintained between devices and metallic raceway system in addition to the green equipment grounding conductor run with circuit conductors. Care shall be taken when installing receptacles having an isolated ground pole so as to not bond the equipment ground conductor to the conduit system.

G. Wire each receptacle using correct polarity (i.e., neutral to neutral terminal, etc.).

H. Mount receptacles throughout the project with ground pole at the top of the configuration when mounted vertically, on the right when horizontally mounted.

I. All exterior wiring devices shall be provided with a weatherproof cover/enclosure. Exterior receptacles shall be GFCI type.

J. De-rate dimmer capacity as required by the manufacturer if side sections are removed.

K. Run separate neutral wire for each phase of a three phase system when dimmers are installed on multiple phases and for each dimmer when multiple dimmers are installed on the same phase.

L. Receptacles located in secure areas shall be GFCI type.

END OF SECTION

SECTION 26 32 13 - PACKAGED ENGINE GENERATOR SET

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the Contract, including General and Supplementary Conditions, apply to the work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. All other sections of Division 26.

B. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings for all requirements.

1.3 SCOPE

A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of a completed diesel package engine generator set as shown or indicated on the drawings and/or as specified.

B. Work Included:

1. Engine/Alternator
2. Controls
3. Exhaust equipment
4. Sub base fuel tank
5. Equipment concrete pad
6. Level 2 sound attenuation weather enclosure
7. Remote electric fuel gauge
8. Remote monitoring/annunciation panel

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Engineer, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. Provide the Engineer with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

1.5 SYSTEM DESCRIPTION

A. Provide emergency standby power system for supply of power in event of failure of normal supply, consisting of an air cooled, natural gas engine directly coupled to an AC generator complete with fittings, connections, auxiliaries, control panels, safety devices, and meters necessary a for complete operating system.

B. Provide fully automatic operation.

C. System shall be capable of delivering rated kW at sea level and shall be capable of delivering rated kVA at installed location after consideration of applicable de-rating factors. Refer to Drawings for ratings.

1.6 REGULATORY REQUIREMENTS

A. The Engine/Generator set shall conform to the National Electrical Code and the applicable inspection authority.

PART 2 – PRODUCTS

2.1 GENERAL

A. Provide only materials that are new, of the type and quality specified. Where Underwriter’s Laboratories, Inc. has established standards for such materials, provide only materials bearing the

UL label.

B. Provide an emergency generator system that has been prototype tested, factory built, production tested, site tested, of the latest commercial design, together with all accessories necessary for a complete installation as shown on the plans and drawings, and specifications herein.

C. The equipment supplied and installed shall meet the requirements of the National Electrical Code, along with all applicable local codes and regulations.

D. All equipment shall be new, of current production of a national firm that manufactures the generator and controls, and assembles the standby generator sets as a matched unit so that there is one-source responsibility for warranty, parts, and service through a local representative with factory-trained servicemen.

2.2 ACCEPTABLE MANUFACTURERS

A. Cummins

a. Or approved equal by owner, architect & engineer

2.3 SUBMITTALS

A. Submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number, each required interconnection between the generator set, the transfer switch, and the remote annunciation panel.

2.4 TESTING

A. Testing: To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

B. Design Prototype Tests: Components of the emergency system such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests. Similar design prototypes and preproduction models, which will not be sold, shall have been used for the tests. Prototype test programs shall include the requirements of NFPA 110 and the following:

1. Maximum power (kW)
2. Maximum motor starting (kVA) at 10%, 20% and 35% instantaneous voltage dips
3. Alternator temperature rise by embedded thermocouple and by resistance method per NEMA MG1-22.40 and 16.40
4. Governor speed regulation under steady-state and transient conditions
5. Voltage regulation and generator transient response
6. Fuel consumption at 1/4, 1/2, 3/4, and full load
7. Harmonic analysis, voltage waveform deviation, and telephone influence factor
8. Three-phase short circuit tests
9. Alternator cooling air flow
10. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses
11. Endurance testing

C. Final Production Tests: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

1. Single-step load pickup
2. Transient and steady-state governing
3. Safety shutdown device testing
4. Voltage regulation
5. Rated power
6. Maximum power
7. A certified test record will be sent prior to shipment

D. Site Tests: An installation check, start-up test, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected

2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, alternator, generator strip heaters, remote annunciator panels, remote fuel gauge, etc.
3. Start up under test mode to check for exhaust leaks, cooling airflow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage, and phase rotation
4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test. An external load bank shall be connected to the system load where building load is unavailable to load the generator to the nameplate kW rating. The generator shall be operated with the load bank for one (1) hour of continuous operation. The system shall then be tested with building load to include operation of the Smoke Management System
5. Provide a written record of the test, complete with date, time, list of witnesses present, a description of each test and the data taken. The report shall be submitted to the Engineer for review

2.5 WARRANTY & MAINTENANCE

A. The emergency generator system shall be warranted by the manufacturer for 1 year or 2,000 hours, whichever occurs first, from the date of the site start-up. Optional 2-year and 5-year warranties shall be available upon request.

B. Service Contract: The engine-generator distributor shall furnish factory trained personnel and maintain a 24-hour parts and service capability, and show, at time of submittal, that they are regularly engaged in a maintenance contract program to semi-annually inspect and test-run the engine to perform manufacturers recommended preventative maintenance service on the equipment furnished. This service contract shall be provided at no additional charge for a period of two (2) years from date of substantial completion. At the Owner's option, the service contract shall be renewable on a year-to-year basis, thereafter, with costs being paid by the Owner.

2.6 GENERATOR

A. Generator Capacity: as scheduled on the Drawings, 60 Hz 120/208Y Volts, 3-phase, 4 wire.
B. Rotative Speed: 1,800 rpm.
C. Total harmonic distortion – less than 3%.
D. Telephone influence factor – (TIF) less than 50.
E. Insulation – Class H.
F. Exciter: "Brushless" exciter with solid-state revolving SCR Field protected by surge protective devices. Directly coupled with plus or minus 2 percent regulation from no load to full load.
G. Terminal Box: Provide terminal box for generator and exciter leads.
H. Remove neutral point of generator from frame grounding. Grounding provision shall be available for field connection. There shall be separate terminations for both the generator center connection and the generator ground.

2.7 CONTROLLER

A. Set-mounted controller capable of facing right, left, or rear, shall be vibration isolated on the generator enclosure. The controller shall be capable of being remote-mounted. The microprocessor control board shall be moisture proof and capable of operation from -40ºC to 85ºC. Relays will only be acceptable in high-current circuits.

B. Circuitry shall be of plug-in design for quick replacement. Controller shall be equipped to accept a plug-in device capable of allowing maintenance personnel to test controller performance without operating the engine. The controller shall include:
1. Fused DC circuit
2. Complete 2-wire start/stop control, which shall operate on closure of a remote contact
3. Speed sensing system and a second independent starter motor disengagement system shall protect against starter engagement with a moving flywheel. Battery charging alternator voltage will not be acceptable for this purpose

4. The starting system shall be designed for restarting in the event of a false engine start, by permitting the engine to completely stop and then re-engage the starter
5. Cranking cycler with 15-second ON and OFF cranking period.
6. Over crank protection designed to open the cranking circuit after 75 seconds when the engine fails to start
7. Circuitry to shut down the engine when signal for high coolant temperature, low coolant level, low oil pressure, or overspeed is received
8. Engine cool down timer factory set at 5 minutes to permit unloaded running of the standby set after transfer of the load to normal
9. 3-position (AUTOMATIC-OFF-TEST) selector switch. In the TEST position, the engine shall start and run regardless of the position of the remote starting contacts. In the Automatic position, the engine shall start when contacts in the remote control circuit close and stop 5 minutes after those contacts open. In the OFF position, the engine shall not start even though the remote start contacts close. This position shall also provide for immediate shutdown in case of an emergency. Reset of any fault shall also be accomplished by putting the switch to the OFF position.
10. Light emitting diode (LED) indicating lights to signal:
    a. Not-in-Auto (flashing Red)
    b. Over crank (Red)
    c. Emergency Stop (Red)
    d. High engine temperature (Red)
    e. Over speed (Red)
    f. Low oil pressure (Red)
    g. Air damper (Red)
    h. Battery charger malfunction (Red)
    i. Low battery voltage (Red)
    j. Low fuel (Red)
    k. Auxiliary pre-alarm (Yellow)
    l. Auxiliary fault (Red)
    m. System ready (Green)
    n. Pre-alarm high engine temperature (Yellow)
    o. Pre-alarm low oil pressure (Yellow)
    p. Low coolant temperature (Red)
    q. Test button for indicating lights
    r. Alarm horn with silencer switch per NFPA 110
    s. Terminals shall be provided for each signal in a to r above, plus additional terminals for common fault and common pre-alarm

2.8 INSTRUMENT PANEL

A. An instrument panel shall include:
1. Dual range voltmeter 3 1/2-inch, +/- 2% accuracy
2. Dual range ammeter 3 1/2-inch, +/- 2% accuracy
3. Voltmeter-ammeter phase-selector switch
4. Lights to indicate high or low meter scale
5. Direct reading pointer-type frequency meter 3 1/2-inch, 0.5% accuracy, 45 to 65 Hz scale
6. Light emitting diode (panel illuminating lights
7. Battery charging voltmeter
8. Coolant temperature gauge
9. Oil pressure gauge
10. Running time meter
11. Voltage adjust rheostat

2.9 ACCESSORIES

The following accessories shall be installed and wired to a power source:

A. Block heater, (select size as required), 120-Volt AC. Thermostatically controlled and sized to maintain engine coolant at proper temperature to meet requirements of NFPA-110 regulation.
B. Generator strip heater, 120-Volt, single-phase.

C. Overvoltage protection will shut down the unit after 1 second of 15% or more overvoltage. On-line equipment requiring faster shutdown shall have its own overvoltage protection.

D. Weather housings shall be constructed of rugged steel, cleaned, phosphated, and electrocoat painted inside and out with rust inhibiting primer and exterior coat of the manufacturer's standard color. Side panels will be lockable and easily removed for servicing. Top-mounted exhaust silencer with rain shield over the exhaust opening. A battery box heater shall be included.

2.10 ACCESSORIES

The following accessories shall be shipped loose:

A. Battery rack, battery cables, 12-volt lead-antimony batteries capable of delivering the manufacturer's recommended minimum cold-cranking Amps required at 0ºF, per SAE Standard J-537, shall be supplied.

B. 10-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient from -40ºC to +60ºC, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected. Alarm circuit board to meet the requirements of NFPA 110 for low battery voltage, high battery voltage, and battery charger malfunction.

C. Gas-proof, seamless, stainless steel, flexible exhaust bellows with threaded NPT connection. The engine exhaust silencer shall be coated to be temperature and rust resistance with integral condensate drain, rated for critical application. Exhaust noise shall be suitable for a residential environment.

2.11 ADDITONAL FEATURES

A. Provide unit with integral circuit breaker.

B. Generator shall be 2/3 pitch.

C. Provide a failure relay to shutdown the generator set if the alternator field voltage is lost.

D. Provide a resettable exciter field circuit breaker mounted on the AC control panel to protect the alternator from overheating in the event of excessive exciter field current. Provide auxiliary contacts connected in a manner to shutdown the engine in the event that the circuit breaker trips.

E. Provide differential current CT's (current transformers) 3-phase, appropriate for the size of the generator set.

F. Provide a paralleling VAR/PF controller to regulate exciter field current for constant generator set power factor or reactive power.

G. The generator set shall be capable of starting motor loads of 100 kVA inrush, with a maximum voltage dip of 10%.

H. Vibration isolators shall be provided between the engine-generator and heavy-duty steel base, or between the base and the floor.

2.12 ENGINE

A. Capacity: 10 percent overload for one hour operating on natural gas at an ambient temperature of 90 degrees.

B. Governor: Electronic isochronous type governor with a steady-state speed regulation band of less than 1% under constant loading conditions. Speed regulation three cycles maximum from no load to full load with two second maximum recovery to steady state. Governor shall be a Barber Coleman type governor or equal.

C. Immersion Heater: Located in cooling jacket complete with thermostat for 120-volt operation.

D. Accessories: Provide replaceable type oil filters, dry type air cleaners, automatic choke, lubricating oils, greases and coolant.

E. Electric fuel transfer pump capable of lifting fuel 6 feet, fuel filters electric solenoid fuel shut-off valve, and a fuel distribution system.

F. 35-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.

G. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.

H. Dry-type replaceable air cleaner elements for heavy-duty application.
Note: Engines requiring glow plugs will not be acceptable.

2.13 COOLING EQUIPMENT

A. Unit mounted radiator, blower fan, water pump, thermostat, and radiator duct flange shall properly cool the engine in (105°F/125°C) ambient with up to 0.5 inches H_2O static pressure on the fan.
B. Coolant: Glycol base anti-freeze good to -40 ºF (-40 ºC).

2.14 EXHAUST EQUIPMENT
A. Residential and Muffler and Piping: Critical type, completely sealed, metal primed finish. Refer to plans for additional requirements.
B. Connection: Provide flexible connection from manifold to muffler
C. Provide thermal insulation on exposed exhaust piping.
D.

2.15 FUEL TANK
A. Provide a double wall sub-base fuel tank with integral leak detectors.
B. Provide fuel tank capacity to run the generator set for at least 24 hours at full load.

2.16 FABRICATION
A. Mount on common steel rail base.
B. Provide steel spring vibration isolators between rail base and concrete base.
C. Provide semi-flexible couplings between generator and engine and protective guards over moving parts.
D. Machine enamel finish color shall be ANSI 61.

2.17 SOUND ATTENUATING WEATHER ENCLOSURE
A. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing shall have hinged side-access doors and rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two-step electro coating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:
1. Primer thickness, 0.5-2.0 mils. Top coat thickness, 0.8-1.2 mils
2. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall exceed 50%
3. Crosshatch adhesion, per ASTM D3359-93, 4B-5B
4. Impact resistance, per ASTM D2794-93, 120-160 inch-pounds
5. Salt Spray, per ASTM B117-90, 1000+ hours
6. Humidity, per ASTM D2247-92, 1000+ hours
7. Water Soak, per ASTM D2247-92, 1000+ hours
8. Color selected by architect
B. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.
C. The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and pad lockable door latches shall be provided for all doors. Door hinges shall be stainless steel.
D. The enclosure shall be provided with an exhaust silencer that is mounted inside of the enclosure, and allows the generator set package to meet specified sound level requirements. Silencer and exhaust shall include a rain cap and rain shield.
E. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's ANSI 61 color. All surfaces of all metal parts shall be primed and painted.
F. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

2.18 TOOLS
A. Provide tools required for normal maintenance of unit in metal box complete with lock and keys.

PART 3 – EXECUTION

3.1 PREPARATION

A. Provide a concrete base designed for the complete unit including fuel tank and fuel. Coordinate installation with concrete pad, fuel supply and other equipment to provide an efficient and well-coordinated layout.

B. A registered structural engineer licensed to practice in the State of Texas shall design and seal the concrete base shop drawings.

3.2 INSTALLATION

A. Install unit complete and make operational.

3.3 WIRING AND CONNECTIONS

A. Provide conduit, wiring and connections required and recommended by unit supplier.

B. Provide power to control panel, block heaters, and battery charger.

C. Verify that the neutral and ground conductors are bonded together at the generator.

D. Verify that all accessories shipped loose have been properly installed and wired.

E. Verify that the alternator has been connected to the battery.

F.

3.4 FLUIDS

A. Fill the engine crankcase with the type and quantity of oil specified by the manufacturer.

B. Fill the cooling system with coolant as directed by the manufacturer.

C.

3.5 TESTING

A. Perform load tests as specified in Part 2 of this Section.

3.6 GROUNDING

A. If a 4 pole transfer switch is utilized with the generator, provide a ground rod at the generator and bond the neutral to the ground.

B. If a 3 pole transfer switch is utilized with the generator, provide a ground rod at the generator but DO NOT bond the neutral to the ground.

END OF SECTION

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SECTION 26 36 23 - AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SCOPE

A. Provide all equipment, materials, labor, supervision and services necessary for or incidental to the installation of complete automatic transfer switches as shown or indicated on the drawings and/or as specified.

B. Work Included:

1. Automatic transfer switch
2. Equipment concrete pads
3. Conduits to package generator set

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Engineer, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. Provide the Engineer with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

PART 2 - PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCH

A. General Automatic Transfer Switch: Electrically operated, 3 pole with fourth neutral pole, mechanically held and obtaining control and transfer power from the source to which it is being transferred. Switch shall be front accessible.

B. Acceptable manufacturers: Generac HTS or approved equal.

C. Refer to project drawings for specifications on the sizes and types of transfer switch equipment, number of poles and ratings. All transfer switch equipment and accessories shall be UL listed and labeled, tested per UL Standard 1008, and CSA approved.

D. Provide the following features in addition to automatic transfer function:

1. Flush mounted display panel with LED indicators to indicate switch position and source availability
2. 3 position test switch: Fast Test, Auto, and Normal Test
3. Signal before transfer contacts
4. Standby accept voltage: 85-95%
5. Standby accept frequency: 85-95%
6. Nominal voltage: 1 volt increments
7. Allowable deviation of utility: 1-100%
8. Engine warm-up time: 1-300 seconds
9. Minimum run time: 5-60 minutes
10. Return to utility timer: 1-30 minutes
11. Engine cool down timer: 1-30 minutes
12. Signal before transfer timer: 1-30 seconds
13. Transfer type: In phase Time Delay neutral
14. Phase Difference for In Phase monitor: -7 +0 degrees
15. One additional normally open contact on both normal and emergency relays
16. SPDT auxiliary contacts

E. Enclosure: Mounted in separate NEMA 1 enclosure.

PART 3 – EXECUTION

3.1 WARRANTY AND SERVICE

A. The transfer switch manufacturer shall maintain a factory-trained, factory direct, field service organization, available on a 24-hour call basis.

B. Provide 5-year warranty and warranty documentation to owner.

3.2 INSTALLATION

A. All power conductors shall be terminated directly without looping or crossing.

B. All conductors shall be marked with permanent wire markers.

C. The manufacturer's authorized service representative shall provide the following services prior and subsequent to placing the switches in operation:

1. All clearances and contact pressures shall be verified for proper operation prior to testing
2. Adjust all time delay settings and provide verification by test. Provide record of settings to owner or owner's representative subsequent to start up

3.3 WIRING AND CONNECTIONS

A. Provide conduit, wiring and connections required and recommended by unit supplier.

3.4 TESTING

A. Perform load tests as specified.

END OF SECTION

SECTION 26 41 00 - FACILITY LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 CODES AND STANDARDS

A. The following specifications and standards of the latest issue form a part of this specification.
   1. Lightning Protection Institute
   2. Installation Standard, LPI 175
   3. Underwriters Laboratories, Inc.
   4. Installation Requirements, LPI 175
   5. National Electrical Code (NEC)
   6. National Fire Protection Association
   7. Lightning Protection Code, NFPA 780

B. All materials tested by Underwriter's Laboratories shall bear their labels A, B and C for materials and installation.

1.3 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. The lightning protection system shall conform to the requirements and standards for lightning protection systems of the LPI, UL, NFPA, and NEC. Upon completion, application shall be made to the Underwriters Laboratories, Inc. for inspection and certification. In addition, the Lightning Protection Institute certified system shall be delivered to the owner ensuring that the concealed components have also been monitored during job progress.

D. The system to be furnished under this specification shall be the standard product of manufacturers regularly engaged in the production of lightning protection equipment and shall be the manufacturer's latest approved design. The equipment shall be UL listed and properly UL labeled.

1.4 SUBMITTALS

A. Product Data - Submit manufacturer's data on lightning protection systems and components.

B. Shop Drawings - Submit dimensioned layout drawings of lightning protection system equipment and components, including conductor routing and connections.

C. UL Certificate - Provide Owner with UL Master Label for overall system which is suitable for fastening to building for display. Comply with UL 96A, "Master Labeled Lightning Protection Systems."

PART 2 - PRODUCT

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, provide lightning protection components of one of the following (for each type of component):
   1. Advanced Lightning Technology
   2. East Coast Lightning Equipment
   3. Harger Lightning Protection
   4. Robbins Lightning Protection
   5. Thompson Lightning Protection, Inc.
   6. National Lightning Protection Corporation

2.2 LIGHTNING PROTECTION SYSTEM COMPONENTS

A. Standard - All equipment used this installation shall be UL listed and properly labeled. All equipment shall be new, and of a design and construction to suit the application where it is used in accordance with accepted industry standards and LPI, UL, NFPA, and NEC code requirements.

B. Lighting Protection Equipment - All materials shall be copper and bronze and of the size, weight, and construction to suit the application and used in accordance with LPI, UL, and NFPA code requirements. Class 1 components may be utilized on roof levels 75 feet and below in height. Class II size components are required for roof levels over 75 feet in height. Bolt type connectors and splicers shall be utilized on Class I and Class II structures. Pressure squeeze clamps are not acceptable. All mounting hardware shall be stainless steel to prevent corrosion.

C. Aluminum Components - Aluminum materials may not be used except on roof that utilize aluminum roofing components. On aluminum metal roofs or where aluminum parapet caps exist, the entire roof lightning protection equipment shall utilize aluminum components to insure compatibility. However, the downleads and grounding are to utilize copper with the bimetal transition occurring at the through roof assembly with and approved bimetal through roof assembly. Lead coating is not acceptable as a bimetal transition.

D. Materials below grade to 18" above grade: Copper, except ground rods to be stainless steel.

E. Air Terminals:
   1. Point: Solid copper, 12" height x 3/8" diameter

F. Fasteners and Attachments: Same material as air terminals.

G. Main Conductors: Copper cable, minimum weight 187.5 lbs/1,000 ft; minimum wire size No.17 AWAG (Class I)

H. Secondary Conductors: Copper cable; minimum 13 strand No. 17 AWG.

I. Fasteners:
   1. Same material as conductor
   2. Galvanized fasteners not acceptable

J. Connectors and Disconnectors
   1. Compression type designed to withstand 2,000 lbs. pull
   2. Exothermic Welding Type, below grade and in non-accessible areas

K. Ground Electrodes: 10 ft. stainless steel rods 3/4" diameter.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installation shall be accomplished by an experienced installation company that is a UL listed, a member of the Lightning Protection Institute, United Lightning Protection Association qualified and an employer of Certified Master Installers of lightning protection systems. A Certified Master Installer shall directly supervise the work.

B. All equipment shall be installed in a neat, workmanlike manner. The system shall consist of a complete conductor network at the roof and include air terminals, connectors, splicers, bonds, copper downleads, and proper terminals.

C. Air Terminals: Install in plumb position securely fastened to withstand overturning.

D. Conductors:
   1. Fastening:
      a. Fasten conductors to building at 3 feet maximum intervals
      b. On masonry, set fasteners in brick, block or stone, but not in mortar joints

E. Conductor Runs:
   1. Bend to radii greater than 8 inches
   2. Limit angle of turns to 90 degrees
   3. Route horizontal conductors around obstructions in horizontal plane
   4. Route connectors in horizontal or vertical planes only
   5. Install roof conductors concealed under roofing system

F. Connect conductor to metal bodies of inductance located within 6 feet by secondary conductor.

G. Ground: Extend minimum of 10 ft into earth.

H. Install conductors under roof and out of sight.

3.2 COORDINATION

A. The lightning protection installer will work with other trades to insure a correct, neat and unobtrusive installation.

B. It shall be the responsibility of the lightning protection installer to assure a sound bond to the main water service and the main electrical service ground bar and to assure interconnection with other ground systems.
C. Install approved SPD's on power service.

3.3 COMPLETION

A. Upon completion of the installation, the lightning protection installer shall secure and deliver to the Owner the Underwriters Laboratories, Inc. Master Label certification and the Lightning Protection Institute Certified System certification. The system will not be accepted without the UL Master Label plate and the LPI certificate.

3.4 PERSONNEL TRAINING

A. Building Maintenance Personnel Training: Train Owner's building maintenance personnel in procedures for testing and determining resistance-to-ground values of lightning protection system.

END OF SECTION

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SECTION 26 4300 - SURGE PROTECTIVE DEVICES

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SCOPE

A. This section includes Surge Protective Devices (SPD) for low-voltage power equipment (1000Vac and less).
B. Work under this section consists of furnishing all materials necessary for the execution and complete installation of Surge Protective Devices (SPD).

1.3 QUALITY ASSURANCE/REFERENCE STANDARDS

The SPD surge protection system shall be designed and manufactured, and where appropriate, listed to the following standards:

A. Underwriters Laboratory (UL)
   1. UL1449 3rd Edition: Surge Protective Devices (SPD)
   2. UL1283 5th Edition: Electromagnetic Interference Filters
   3. UL796 9th Edition: Printed Wiring Boards
   4. UL67 11th Edition: UL Standard for Safety for Panelboards
B. American National Standards Institute (ANSI)/Institute of Electrical & Electronic Engineers (IEEE)
   1. C62.41.1: 2002 IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits
   2. C62.41.2: 2002 IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and Less) AC Power Circuits
   3. C62.45: 2002 IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits
   4. C62.62: 2000 IEEE Standard Test Specifications for Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits
   5. C62.72: 2007 IEEE Guide for the Application of Surge Protective Devices for Low Voltage (1000V and Less) AC Power Circuits
C. National Electrical Manufacturers Association (NEMA)
D. National Fire Protection Association, NFPA 70 National Electric Code (NEC)
E. Occupational Safety and Health Act (OSHA
F. Federal Information Processing Standards (FIPS)
G. MIL-STD 220A

1.4 PROJECT CONDITIONS

A. Service Conditions: The Surge Protective Device (SPD) shall be rated for continuous operation under the following conditions:
   1. Maximum Continuous Operating Voltage (MCOV): 115% to 125% of the nominal operating voltage
   2. Operating Temperature: 0°C to 60°C
   3. Relative Humidity: 0% to 95%, non-condensing
   4. Operating Altitude: 0 feet to 12,000 feet

1.5 LOCATIONS

A. See the electrical One Line Diagram for Surge Protective Device (SPD) unit locations.

PART 2 – PRODUCTS

2.1 APPROVED MANUFACTURERS

A. The specified equipment is based upon THOR SYSTEMS as supplied by Critical Site Solutions, Irving, Texas. Listed substitutions shall conform to the specifications in its entirety. Complete documentation including literature, drawings and specification review shall be provided.

2.2 GENERAL

A. The following are the general requirements of the SPD products:
   1. Nomenclatures used herein are intended to indicate product type and configuration of equipment required.

2. UL1449 3rd Edition Listed and must bear the 3rd Edition mark.
3. UL1283 5th Edition Listed.
4. The Surge Protective Device (SPD) shall be a stand alone configuration. Systems that must be integral to the switchgear will not be considered.
5. The surge protection system shall provide effective high-energy Transient Voltage Suppression and attenuate high frequency electrical noise.
6. All suppression systems must be permanently connected, parallel designs. Series suppression elements are not acceptable.
7. Short Circuit Current Rating of 100kAIC without the need for fuses or breakers external to the SPD. NEC Article 285.6 requires test data confirming the specified short circuit carrying capability (AIC rating) is provided.
8. All SPD units shall be provided with an auxiliary dry contact (Form C) actuated by any single suppression module including N-G failure for connection to a Building Automation System.
9. All SPD units shall be from the same manufacturer.
10. SPD modules shall be configured to isolate individual suppression component failures without causing total loss of surge protection in that mode.
11. Surge protection or filtering component failures or fuse openings are not permissible during UL1449 3rd Edition Nominal Discharge testing.
12. SPD designs using a single fuse to protect two (2) or more surge paths are not acceptable.
13. Overcurrent protection limiting the 100% rated surge protection is not acceptable.
14. Fuse links or printed circuit board trace fusing are not acceptable.
15. The SPD shall provide redundant parallel copper bus structure and/or low impedance traces, which are 100% surge rated top and bottom of printed circuit board to reduce suppression path impedance.
16. All printed circuit boards are heavy copper double-sided plated through and meet the requirements of UL796 including those for Direct Support applications, as indicated by a Delta symbol on the circuit board.
17. Hybrid three-tier design utilizing:
    a. Thermally Protected Metal Oxide Varistors (TpMOVs) featuring:
        1) "Fail-safe" design technology with integrated thermal apparatus that monitors the status providing local physical indication of the metal oxide disk has built-in dielectric (arc shield) protection and remote indication by an integral N.O micro-switch
        2) The TpMOV eliminates the requirement of internal or external fuses (which would limit surge protection capability) for the surge protection components, while providing a Short Circuit Current Rating (SCCR) of 100,000 Amps
    b. Silicon Avalanche Diodes (SADs) supplying the most ideal suppression element and very fast reaction time; rated 15,000 Watts each and provided L-N and L-G.
    c. Filter capacitors to suppress EMI/RFI electrical noise.
        1) All products shall be provided with high strand count, high frequency/low impedance wire
        2) Products which are encapsulated in an epoxy resin compound or any other compound of similar form are not acceptable

2.3 MODULAR DESIGN (with Individual Replaceable "Per Mode" Modules)

A. The TSri Modular Series is a full three-tier hybrid design featuring Thermally Protected Metal Oxide Varistors (TpMOVs), Silicon Avalanche Diodes (SADs), and Sinewave Tracking Filter Capacitors.
B. The TSri Series has the ability to be upgraded in the field.
C. Configured for the voltage configuration as shown on plans.
D. A modular hybrid design utilizing the following UL Recognized components:
    1. Thermally Protected Metal Oxide Varistors (TpMOVs) utilizing "fail-safe" technology. (Systems using fuse links or printed circuit board trace fusing are not acceptable.)
    2. Silicon Avalanche Diodes (SADs) are provided L-N and L-G mode.
    3. EMI/RFI Filter Capacitors which are UL1283 Listed providing electrical noise attenuation
E. Each module is voltage keyed by color, by numerical identification, and coordinating pin and sleeve to assure correct assembly field replacement.
F. The modular design is available for the complete range of surge ratings (50 through 300), featuring a full complement surge rating on each field replaceable module.
G. Modes of Protection: The SPD system shall provide surge protection in all possible modes (L-N, L-G, L-L, and N-G). Each replaceable module must provide the uncompromising ability to deliver full surge current rating from 50kA to 300kA per mode.
H. The internal SPD/TVSS connection method is an Internal Fused Disconnect or Surge Rated Disconnect or Distribution Block.

I. The replaceable module must be an individual module (one [1] module per mode). Each system must provide a spare module. Modular designs with only a single module or surge brick are not acceptable.

J. Each individual module features a green LED indicating the individual module has all surge protection devices active. If any single component is taken off-line, the green LED will turn off and a red LED will illuminate, providing *individual module* as well as *total system* status indication.

K. Monitoring Options: Select the appropriate monitoring system from the table below:

SPD Monitoring Options *Modular Products*	
Monitoring Type	Feature Descriptions
Type 1	Provides: • Solid State Status Indication Lights • Audible Alarm with Alarm Silence sounds in event of a protection mode failure Form C Contacts for remote monitor
Type 2	Provides: • Surge Counter (microprocessor-based with 8 levels of sensitivity providing programmable adjustment of the Counter trigger level) • Audible Alarm with Silence (*Ack*) button; includes *Enable* button Form C Contacts for remote monitor

L. Provide the SPD in a NEMA 4 enclosure not exceeding 20”H x 16”W x 8”D in size.

M. Each replaceable module shall bolt directly to a low impedance solid copper bus structure. Modular systems with plug-in component modules are not acceptable.

N. Each SPD system shall be supplied with one (1) field replaceable module.

O. The Modular SPD system is supplied with UL1283 Listed EMI/RFI noise filtering having an electrical noise attenuation of 36 to 44dB in the range of 50 kHz to 100MHz as defined by MIL-STD-220A test procedures.

P. The TSri Series SPD system offers an Extended Filter, UL1283 Listed, having an electrical noise attenuation of 45 to 50dB in the range of 50 kHz to 100MHz as defined by MIL-STD-220A test procedures.

Q. The let-through voltage test results used to obtain the UL1449 3rd Edition Voltage Performance Ratings “VPR” (6kV, 3000 Amps, 8/20µs waveform) must not exceed the UL assigned values listed in the following table:

3000A Voltage Let-Through Ratings *Modular Products*				
Voltage Rating	L-N	L-G	N-G	L-L
208/120 Vac	800	700	600	1200
480/277 Vac	1200	1200	1000	1800
Note: Ratings in the above chart were recorded with Fused Disconnects in place.				

R. The let-through voltage test results based on the previous UL1449 2nd Edition (issue date August 1996) Suppression Voltage Rating “SVR” (6kV; 500 Amps; 8/20µs waveform) must not exceed the UL assigned values listed in the following table:

500A Voltage Let-Through Ratings *Modular Products*				
Voltage Rating	L-N	L-G	N-G	L-L
208/120 Vac	400	400	400	700
480/277 Vac	700	800	800	900
Note: Ratings in the above chart were recorded with Fused Disconnects in place.				

S. The Modular systems’ surge current ratings shall be based on the electrical system ampacity listed in the following table. Note: The “per phase” value derived by adding the L-N mode and the L-G mode.

SPD Applications *Modular Systems*		
Electrical System Ampacity @ SPD Install Point	Surge Protection (kA)	
	Per Mode	Per Phase
2500 – 6000A	300	600
1200 – 2000A	250	500
600 – 1000A	200	400
225 – 400A	150	300
125 – 225A	100	200

T. Approved Manufacturer: The following MODULAR SPD models are acceptable, subject to conformance with indicated requirements: THOR SYSTEMS - TSr Product Series.

Example: Model TSri300Fx 3Y4 M202; Replaceable Module; 300kA per Mode (600 per Phase); 480/277Vac, 3 Phase Wye; Fused Disconnect Switch; Type 2 Monitor (LED indication, Audible Alarm, Surge Counter); Form C Contact; Extended EFI/RFI Filter.

2.4 PERFORMANCE

A. Provide a Test Report from a recognized independent testing laboratory (NETA or NRTL) verifying the COMPLETE suppressor (including all necessary fusing, disconnects, monitoring systems, etc.) can survive published current rating on a per mode basis using the IEEE C62.41, 8/20µs waveform. Note that test data on individual module is not acceptable.

B. Provide a COMPLETE documentation package per the requirements of NEMA LS1-1992

C. The SPD shall be capable of surviving the UL 1449 3rd Edition Nominal Discharge Test. The repetitive surge current capacity shall be tested utilizing an 8x20µs, 20kA short circuit test waveform (as defined by ANSI/UL 1449 3rd Edition – 2009, IEEE C62.41.2 – 2002 and IEEE C62.45 – 2002). Surges shall be applied in three (3) groups of five (5) surges. Within one (1) second after the application of each surge, the specified MCOV shall be applied for sixty (60) seconds (±15 seconds). After each group of five (5) surges, the sample shall rest for thirty (30) minutes. After the 15th surge, the MCOV shall be reapplied for at least fifteen (15) minutes. During and following this test there shall be no opening of any supplementary protective devices either internal or external to the device.

D. The SPD must provide superior surge protection performance with the ability to deliver 100% rated surge capacity.

E. The Surge protection system must be rated and marked with a Short Circuit Current Rating (SCCR) of 100kAic without the need for external fuses or breakers. The use of Overcurrent protection that limits the specified surge currents is not acceptable.

2.5 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

B. All surge protective devices, subassemblies, and components are to be 100% tested and certified by the manufacturer to meet their published performance parameters.

2.6 WARRANTY

A. All Surge Protective Devices (SPD), associated hardware, and supporting components shall be warranted to be free from defects in materials and workmanship, under normal use and in accordance with the instructions provided, for a period of five (5) years.

B. Any component or subassembly contained within the surge protection system that shows evidence of failure or incorrect operation during the five (5) year warranty period, shall be replaced by the manufacturer.

PART 3 – EXECUTION

3.1 EXECUTION

A. This section covers the execution and commissioning of the Surge Protective Device/Transient Voltage Surge Suppression (SPD) required on this project.

B. Technical assistance shall be provided by the manufacturer through the efforts of a factory representative or a local distributor and via a factory staffed, THOR SYSTEMS' toll-free technical hotline (1.877.298.1100) and website (www.ThorSystems.us).

C. Verify absence of damage.

D. The unit shall be installed in accordance with the manufacturer's printed instructions. All local and national codes must be observed.

E. The unit shall be installed of the same voltage rating as the intended protected equipment.
F. The location of the field-mounted SPD shall allow adequate clearances for maintenance.
G. Lead Length: The mounting of the SPD shall ensure the connecting leads are as short (recommend one [1] meter or less) and straight (no sharp bends) as reasonably possible.
H. The SPD shall be marked with a Short Circuit Current Rating (SCCR) and shall not be installed at a point on the system where the available fault current is in excess of that rating per the National Electric Code, Article 285, Section 6.
I. Panel Extension Kits shall be factory mounted on the panelboard and tested at the SPD manufacturer's facility and shipped complete to the jobsite. The engineer may allow field mounting of the SPD extension assembly.
J. THOR SYSTEMS' representatives are committed to assuring proper installation guidelines are followed by the commissioning of each individual SPD and verification of proper grounding, including Ground resistance measurement and the recording of the resistance readings, which will be forwarded to the facilities manager with a completed Commissioning Report.
K. System Commissioning. Upon completion of the installation of the Surge Protective Device (SPD) a factory-authorized service representative shall provide product commissioning services. These services shall include but are not limited to the following:
    1. Before energizing the SPD verify the SPD is correct as specified: manufacturer, product series, and model number.

WARNING!
Failure to confirm voltage can result in serious damage, injury, or even death.

        a. All voltage modes including L-L (Line-to-Line), L-G (Line-to-Ground), L-N (Line-to-Neutral), and N-G (Neutral-to-Ground) shall be measured and verified against the unit voltage ratings.
        b. Continuity measurements shall be made between the Neutral and Ground connections to verify the Neutral-to-Ground bond.
        c. Use a calibrated Ground resistance meter to measure the Ground resistance of the Ground wire connected to each individual SPD unit. Record the Ground reading in unit documentation.

        NOTE: The preferred reading is less than 5 Ohms. A Ground system measuring above 10 ohms needs to be evaluated.

    2. Energize the SPD:
        a. All voltage modes including L-L (Line-to-Line), L-G (Line-to-Ground), L-N (Line-to-Neutral), and N-G (Neutral-to-Ground) shall be measured at the unit terminals and again verified against the unit voltage ratings.
        b. All indicating LEDs shall be illuminated Green. The factory shall be contacted in the event of any illuminated Red LEDs.
        c. Monitoring functions shall be checked (if applicable) for correct operation and verification of sensitivity setting. Upon energizing the SPD:
            1) The Yellow *ACTIVE SURGE* LED should turn *On*, then *Off*
            2) The Green *STATUS* and Yellow *ENABLE* LEDs should turn *On*
            3) When the Green and Yellow LEDs turn on, the Counter should display a sensitivity setting of *SEN3*, which is the factory default setting. The display setting should change to *0000*
            4) The Audible Alarm should sound on fault. *ACK* silences alarm. Note: The Alarm should be in the *Enabled* status unless the customer has requested the alarm not sound
        d. Results of the System Commissioning shall be on a standard Commissioning Report which is submitted upon completion to the facilities manager.

END OF SECTION

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SECTION 26 55 00 - LED LIGHTING

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.

B. All other Sections of Division 26.

C. All other Divisions of the Contract Documents. Refer to each Division's specifications and drawings.

1.2 SUMMARY

A. Provided all equipment, materials, labor supervision, and services necessary for or incidental to the installation of all lighting fixtures as indicated on the drawings, and as specified.

B. Work included:

1. This Section includes interior lighting fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, emergency lighting units, and all accessories.
2. Lighting fixtures shall be furnished as scheduled on the drawings and as specified herein.
3. Interior solid-state luminaires that use LED technology.
4. Lighting fixture supports.

C. Provide emergency exit signs at locations shown. Mount signs on ceiling for ceiling heights 10' or less. Mount sign on wall 9" above door where ceiling heights exceed 10'.

D. Related Requirements:

1. Section 26 09 23 "Occupancy Sensors" for automatic control of lighting, including time switches, photoelectric relays, occupancy, vacancy sensors, and multipole lighting relays and contactors.
2. Section 26 09 26 "Lighting & Receptacle Panelboard" for panelboards used for lighting control.
3. Section 26 09 33 "Lighting Control System" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.

1.3 SUBMITTALS

A. Provide submittals as stated in 26 00 10 "Submittal Process".

B. Product Data: Submit manufacturer's catalog cut sheets, data sheets and installation instruction for all light fixtures, lamps and drivers arranged in order of fixture designation.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
   b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.4 MAINTENANCE MATERIAL SUBMITTALS (Spare Parts)

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. LED strips: Ten for every 100 of each type and rating installed. Furnish at least one of each type.

2. Diffusers and Lenses: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: Ten for every 100 of each type and rating installed. Furnish at least one of each type.

1.5 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance with the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents
C. Provide the manufacturer's certificates that confirm that materials meet or exceed minimum requirements as specified.
D. Standards: Comply with applicable NEMA, IEEE, UL and NFPA Standards.
E. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.
F. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
G. Provide luminaires from a single manufacturer for each luminaire type.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
B. Store products in a clean and dry area.
C. Install LED’s wearing white cotton gloves to avoid grease and fingerprints on the fixtures.

1.7 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
B. Warranty Period: Materials, 5 years from date of Substantial Completion.
C. Warranty Period: Labor, 1 Year from date of Substantial Completion

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event.

2.2 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
C. Recessed Fixtures: Comply with NEMA LE 4.
D. Bulb shape complying with ANSI C79.1.
E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
F. Rated lamp life of 35,000-50,000 hours.
G. Lamps dimmable from 100 percent to 10 percent of maximum light output.
H. Integral driver.
I. Nominal Operating Voltage: 120 V ac-277 V ac

J. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.3 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, unless specified on the light fixture schedule.
   1. Lithonia
   2. LSI
   3. HALO
   4. Metalux
   5. Columbia
   6. GE
   7. Portfolio
   8. Prescolite
   9. Elite
   10. Hubble

2.4 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
C. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.
D. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

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.
B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with NECA 1.
B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
C. Install lamps in each luminaire.
D. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and relamping.
   3. Provide support for luminaire without causing deflection of ceiling or wall.
   4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.
E. Flush-Mounted Luminaire Support:
   1. Secured to outlet box.
   2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
   3. Trim ring flush with finished surface.
F. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls.
   2. Do not attach luminaires directly to gypsum board.
G. Ceiling-Mounted Luminaire Support:
   1. Ceiling mount with 2-5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 120 inches in length.
   2. Ceiling mount with pendant mount: With 5/32-inch-diameter aircraft cable supports adjustable to 120 inches.

3. Ceiling mount with hook mount.

H. Suspended Luminaire Support:
   1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
   2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
   3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
   4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

I. Ceiling-Grid-Mounted Luminaires:
   1. Secure to any required outlet box.
   2. Use approved devices and support components to connect luminaire to building structure in a minimum of four locations, spaced near corners of luminaire.

J. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

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

C. Prepare test and inspection reports.

3.5 ADJUSTING & CLEANING

A. Prior to final acceptance, thoroughly clean all fixtures, inside and out, including plastics and glassware. Adjust all trim to properly fit adjacent surface, replace broken or damaged parts and lamps. Test all fixtures for proper operation.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to 2 visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 26 55 64 - TELEPHONE RACEWAY SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this Section.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. All other Sections of Division 26.

B. All other Divisions of the Contract Documents. Refer to each Division's Specifications and Drawings for requirements.

1.3 SCOPE

A. Provide all equipment materials, labor, supervision, and services necessary for or incidental to the installation of a completed telephone raceway system as shown or indicated on the drawings and/or as specified.

B. Provide submittals as stated in 26 00 10 “Submittal Process.”

C. Work Included:

1. Conduit
2. Outlet boxes
3. Pull and junction boxes

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Without additional cost to the Owner, provide such other labor and materials as are required to complete the work of this Section in accordance to the requirements of governmental agencies having jurisdiction, regardless of whether such materials and associated labor are called for elsewhere in these Contract Documents.

C. When requested, provide the Architect with manufacturer's certificate that materials meet or exceed minimum requirements as specified.

1.5 SYSTEM DESCRIPTION

A. Conduit, terminal boards, and outlets to form empty raceway system.

PART 2 - PRODUCTS

2.1 RACEWAYS

A. Where telephone outlets are shown in plan, provide a single gang box with ¾” EMT to the telephone terminal board complete with nylon pull cord.

B. Make conduit provisions for switching of telephone outlets located within the dorm rooms. The switch panel shall be located in the control room.

PART 3 - EXECUTION

A. Place “TELEPHONE” label on pull and junction boxes.

B. Provide a nylon pull cord in each telephone conduit run.

END OF SECTION

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SECTION 28 31 10 - FIRE DETECTION AND ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to the Work in this Section.

1.2 SUMMARY

A This is a performance based specification. The Fire Alarm Contractor will be responsible for the complete system design. The Contractor shall submit shop drawings sealed by a Professional Engineer or a licensed Fire Alarm Planning Superintendent.

B. Design, furnish and install all material and labor necessary to meet or exceed the performance criteria identified in this specification.

C. All fire alarm device locations shall be coordinated with architectural finishes and millwork.

D. Provide all design, equipment, material, labor, supervision and services necessary for or incidental to the installation of a complete and fully operating fire alarm and detection system meeting or exceeding all applicable codes and regulations governing the project and meeting the approval of all authorities having jurisdiction.

E. Drawings are diagrammatic and may not show all required fire alarm devices. Provide devices, wiring, equipment, and accessories necessary to comply with requirements of this Specification and local and state building codes, NFPA, and ADA requirements.

1.3 REFERENCES

A. This building occupancy classification is Group B. Equipment and installation shall comply with current provisions of following standards:

1. International Building Code 2009 Edition
2 Americans with Disabilities Act (ADA)
3 Local and State Building Codes
4. Authorities Having Jurisdiction

National Fire Protection Association (NFPA) Standards:

a. NFPA 70 National Electrical Code
b. NFPA 72 National Fire Alarm Code
c. NFPA 101 Life Safety Code

6. Underwriters Laboratories, Inc., (UL), shall list system and components for use in fire protective signaling system under following standards as applicable:

a.	UL 864/UOJZ, APOU	Control Units for Fire Protective Signaling Systems
b.	UL 268	Smoke Detectors for Fire Protective Signaling Systems
c.	UL 268A	Smoke Detectors for Duct Applications
d.	UL 521	Heat Detectors for Fire Protective Signaling Systems
e.	UL 464	Audible Signaling Appliances
f.	UL 1638	Visual Signaling Appliances
g.	UL 346	Waterflow Indicators for Fire Protective Signaling Systems
h.	UL 1481	Power Supplies for Fire Protective Signaling Systems
i.	UL 1711	Amplifiers for Fire Protective Signaling Systems

1.4 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

B. Provide proof of Factory qualifications and Authorization and Factory Training for the products specified. These qualification credentials shall not be more than 2 years old, to ensure up-to-date product and application knowledge. Shall provide evidence of at least five (5) years experience as a company, in installation and servicing the specified fire alarm system of similar size and scope.

C. Supplier shall have sufficient stock on hand and have fully equipped service organization capable of guaranteeing response time within 8 hours of service calls, 24 hours per day, 7 days per week to service completed systems.

D. Provide a copy of the certificate of successful completion of authorized Training Course given by manufacturer of Fire Alarm Equipment.
E. When requested, provide the manufacturer's certificate that materials meet or exceed minimum requirements as specified.
F. Shall be a licensed fire alarm contractor with the state of Texas.
G. Shall have a permanent full time NICET Level III fire alarm manager on staff.

1.5 SUBMITTALS

A. Submit 8 complete sets of documentation. Document the type, size, rating, style, catalog number, manufacturer name, photographs, and/or catalog data sheets for items proposed to meet these specifications. Proposed equipment shall be subject to approval of Engineer and no equipment shall be ordered or installed without that approval.
B. Submit complete set of Shop Drawings, one for each unit sub-assembly that requires that field wire be connected to it. Shop Drawings shall be reproduced electronically from Master Copy supplied in digital format.
C. Eight copies of the following Manual shall be delivered to the Engineer at time of system acceptance. Close out submittals shall include:
    1. Operating manuals for the fire alarm system.
    2. Point-to-point diagrams of entire system. This shall include connected initiating devices, notification devices, powers supplies and addressable field modules. Drawings shall be provided in standard DXF format. Also provide vellum plots of each sheet. System-generated point-to-point diagrams are required to ensure accuracy.
    3. Equipment cutsheets of all equipment proposed for installation.
    4. Name, address, and telephone number of authorized factory representative and factory authorized servicing agent.
    5. Drawings must reflect device address and programmed characteristics.
    6. Battery calculations for all integral and remote power supplies.
    7. Provide name and telephone number of full time NICET Level III fire alarm manager on duty responsible for this project.
    8. Provide evidence of at least five (5) experience as a company, in installation and servicing the specified fire alarm systems of similar size and scope.
    9. Provide a complete set of fire alarm and detection system design documents indicating all equipment required to meet all applicable codes, regulations, standards and requirements of the authorities having jurisdiction. Provide written certification that whether specifically identified in the shop drawing submittals or not, design, labor and materials shall be furnished and installed meeting or exceeding all applicable codes, regulations, standards and requirements of the authorities having jurisdiction.
    10. Provide proof of training of key individuals installing personnel involved on project.
D. Close out submittal: Provide three (3) copies of all documents as described in the submittal Division 01, in addition to all drawings and backup documentation identifying as built conditions.

1.6 WARRANTY

A. Provided the local IDS installer contact (name, address and phone number). The installer shall respond on-site within eight (8) hours of trouble call after receipt of call to address where warranty is.
B. Guarantee all labor, workmanship, and materials for the new and existing system for a period of one year from date of final acceptance. Should a failure occur within the first year of the system, provide all labor and materials necessary to restore the system to the condition require for testing and acceptance for this contract, at no additional cost.
C. During the warranty period, additional detectors may be connected and their use entered in the database. New devices will be connected in the same manner as shown on the drawings and the existence of the new connections shall not void this warranty.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Life Safety/Fire Alarm System shall be microprocessor-based network system. Control Panel Assemblies and connected Field Appliances shall be both designed and manufactured by same company, and shall be tested and cross-listed as compatible to ensure fully functioning system is designed and installed.
B. Conform to this Specification in its entirety to ensure the installed and programmed Life Safety/Fire Alarm System will accommodate future requirements and operations. Any specified item or operational feature not specifically addressed prior to bid date shall be provided without exception.

2.2 EQUIPMENT AND MATERIAL GENERAL REQUIREMENTS

A. Equipment shall be new and unused. Components and systems shall be designed for uninterrupted duty. Equipment, materials, accessories, devices, and other facilities specified or indicated on Drawings shall be best suited for intended use and shall be provided by a single manufacturer. Where the equipment provided under this Specification interfaces with equipment provided by a different manufacturer, then that equipment shall be recognized as compatible by both manufacturers, and listed by UL.

B. System installation and operations shall be verified by the manufacturer's representative and a verification certificate presented upon completion. The manufacturer's representative shall be responsible for on-site demonstration of operation of system and initial owner's staff training. All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

C. "As-Built" riser and wiring diagrams reflecting T-taps and each programmed device characteristic including detector type, base type, address, sensitivity setting, and wire configurations shall be provided to Engineer.

D. It shall be possible for the contractor, using a Program/Service Tool or laptop PC to change personality/function of Devices to meet changes in building layout or environment.

E. System shall be designed with the capability of expanding the entire system by adding 30% more detection and/or initiating devices without adding any additional equipment to the fire alarm control panel or power supplies. This shall include any additional equipment such as panels, expansion cards, SLC loops, etc. Provide a complete and fully operational system capable of having 30% additional detection and/or initiating devices above what shall be required by applicable codes, regulations, standards and the authority having jurisdiction. Provide written documentation specifically identifying system is designed with these provisions for expansion.

2.3 ACCEPTABLE MANUFACTURERS

A. EST.

B. Notifier.

C. Silent Knight.

D. Other manufacturers must have written approval 21 days before bid time.

2.4 EQUIPMENT

A. Life Safety/Fire Alarm System shall be designed specifically for fire-protection signaling system.

B. Fire Alarm System shall include required hardware and system programming to provide complete and operational system, capable of providing protected premises with following functions and operations:

1. System operational software shall be stored in non-volatile memory. Control panel disassembly and replacement of electronic components of any kind shall not be required in order to upgrade operations of installed system to conform to future application code and operating system changes.
2. System response to any alarm condition must occur within 3 seconds, regardless of size and complexity of installed system.
3. System Common Control Functions shall be automatically routed to any node of system as function of time of day and date.

2.5 MAIN FIRE ALARM CONTROL PANEL

A. The fire alarm control panel (FACP) shall have the following:

1. The FACP shall have a power supply as required and be capable of expansion to a maximum of 4.5 total amps via bus connected expander modules that supervise low battery, loss of AC and loss of communication.
2. The FACP shall have Day/Night sensitivity capabilities on detectors and be capable of supporting 250 analog addressable points and expandable to a maximum of 500 analog addressable points. This shall be accomplished via three signaling line circuits (SLC) capable of supporting a minimum of 125 devices each. The communications protocol on the SLC loop must be digital.
3. The FACP shall have a built in UL approved digital communicator. The communicator must allow local and remote up/downloading of system operating options, event history, and detector sensitivity data.
4. The FACP shall automatically test the smoke detectors in compliance with NFPA standards to ensure that they are within listed sensitivity parameters and be listed with Underwriters Laboratories for this purpose.
5. The FACP shall compensate for the accumulation of contaminants that affect detector sensitivity. The FACP shall have day/night sensitivity adjustments, maintenance alert feature (differentiated from trouble condition), detector sensitivity selections, auto-programming mode (Jumpstart) and the ability to upgrade the core operating software on site or over the telephone.
6. The main communication bus shall be capable of class A or class B configuration with a total Bus length of 3,000 feet between panels.

2.6 SYSTEM WIRING

A. The Signaling Line Circuit and Data Communication Bus shall be wired with standard NEC 760 compliant wiring, no twisted, shielded or mid capacitance wiring is required for standard installations. All FACP screw terminals shall be capable of accepting 14-18 AWG wire. All system wiring shall be in accordance with the requirements of NFPA 70, the National Electrical Code (NEC) and also comply with article 760 of the NEC.

2.7 SLC LOOP DEVICES

A. Devices supported must include intelligent, addressable photoelectric smoke detectors, intelligent addressable heat detectors, intelligent addressable input modules, relay output modules or intelligent addressable notification modules. There is to be no limit to the number of any particular device type up to the maximum of 250 that can be connected to the SLC.

2.8 ANALOG DETECTOR FUNCTIONS

A. The products of combustion detectors must communicate analog values using a digital protocol to the control panel for the following functions:
   1. Automatic compliance with NFPA 72 standards for detector sensitivity testing Drift compensation to assure detector is operating correctly
   2. Maintenance alert when a detector nears the trouble condition Trouble alert when a detector is out of tolerance
   3. Alert control panel of analog values that indicate fire.

2.9 SENSITIVITY FUNCTION

A. The FACP shall have the ability to set three different sensitivity levels. A zone can be programmed to a day and a night sensitivity value. The day/night schedule shall allow for 16 holiday dates that are user programmable to allow the FACP to respond at the night level on those days.

2.10 SERIAL/PARALLEL INTERFACE

A. The fire system shall be capable of supporting up to two serial / parallel interfaces that are capable of driving standard computer style printers. The interface shall be programmable as to what information is sent to it and shall include the ability to print out Detector Status, Event History and System Programming.

2.11 DIGITAL COMMUNICATOR

A. The digital communicator must be an integral part of the control panel and be capable of reporting all zones of alarm, supervisory, and trouble as well as all system status information such as loss of AC, low battery, ground fault, loss of supervision to any remote devices with individual and distinct messages to a central station or remote station. The communicator must be capable of up/downloading of all fire alarm system programming options, Event history and Sensitivity compliance information to a PC on site or at a remote location.

2.12 DRY CONTACTS

A. The FACP shall have two form “C” dry contacts, one will be dedicated to trouble conditions, the other one will be programmable for alarm, trouble, notification, pre-alarm, waterflow, manual pull, aux. 1 or aux. 2. The trouble contact shall be normal in an electrically energized state so that any total power loss (AC and Backup) will cause a trouble condition. In the event that the Microprocessor on the FACP fails the trouble contacts shall also indicate a trouble condition.

2.13 GROUND FAULT DETECTION

A. A ground fault detection circuit, to detect grounds on all field wiring. The ground fault detector shall operate the general trouble devices as specified but shall not cause an alarm to be sounded. Ground fault will not interfere with the normal operation, such as alarm, or other trouble conditions.

2.14 OVERCURRENT PROTECTION

A. All low voltage circuits will be protected by microprocessor controlled circuit breakers or have a self restoring circuit breaker for the following: smoke detector power, main power supply, indicating appliance circuits, battery standby power and auxiliary output.

2.15 TEST FUNCTIONS

A. A “Lamp Test” mode shall be a standard feature of the fire alarm control panel and shall test all LED’s and the LCD display on the main panel and remote annunciators.

B. A “Walk Test” mode shall be a standard feature of the fire alarm control panel. The walk test feature shall function so that each alarm input tested will operate the associated notification appliance for two seconds.

The FACP will then automatically perform a reset and confirm normal device operation. The event memory shall contain the information on the point tested. The zone tripped, the zone restore and the individual points return too normal.

C. A “Fire Drill” mode shall allow the manual testing of the fire alarm system notification circuits. The “Fire Drill” shall be capable of being controlled at the main annunciator, remote annunciators and via a remote contact input.

C. A “Bypass Mode” shall allow for any point or nac circuit to be bypassed without effecting the operation of the total fire system.

2.16 REMOTE INPUT CAPABILITIES

A. The control panel shall have provisions for supervised switch inputs for the purpose of Alarm reset and Alarm and trouble restore.

2.17 MOUNTING

A. The system cabinet shall be grey and flush mounted. The cabinet door shall be easily removable to facilitate installation and service.

2.18 AUDIBLE SYSTEM TROUBLE SOUNDER

A. An audible system trouble sounder shall be an integral part of the control unit. Provisions shall also be provided for an optional supervised remote trouble signal.

2.19 POWER SUPPLY AND CHARGER

A. The entire system shall operate on 24 VDC, filtered switch mode power supply with the rated current available of 5 Amps. The FACP must have a battery charging circuit capable of complying with the following requirements:

B. Twenty Four (24) hours of battery standby with five (5) minutes of alarm signaling at the end of this Twenty Four (24) hour period (as required per NFPA 72 remote station signaling requirements) using rechargeable batteries with automatic charger to maintain standby gel-cell batteries in a fully charged condition.

C. The power supply shall comply with UL Standard 864 for power limiting.

D. The FACP will indicate a trouble condition if there is a loss of AC power or if the batteries are missing or have insufficient capacity to support proper system operation in the event of AC failure. A “Battery Test” will be performed automatically every minute to check the integrity of the batteries. The test must disconnect the batteries from the charging circuit and place a load on the battery to verify the battery condition. In the event that it is necessary to provide additional power one or more 3-BPS Power Supply modules can be provided.

2.20 CONNECTIONS AND CIRCUITS

A. Connections to the light and power service shall be on a dedicated branch circuit in accordance with the National Fire Alarm Code NFPA 72, National Electrical Code (NEC) NFPA 70, and the local authority having jurisdiction (AHJ). The circuit and connections shall be mechanically protected. A circuit disconnecting means shall be accessible only to authorized personnel and shall be clearly marked “FIRE ALARM CIRCUIT CONTROL”.

2.21 NOTIFICATION DEVICES

A. The visible and audible/visible signal be listed by Underwriters Laboratories Inc. per UL.

B. The visible signaling appliance shall maintain a minimum flash rate of 1Hz or greater regardless or power input voltage.

2.22 SMOKE DETECTORS

A. Smoke detectors shall be ceiling mounted, intelligent, addressable photoelectric smoke detectors. The combination detector head and twist lock base shall be UL listed.

B. The base shall permit direct interchange with the ionization smoke detector or the heat detector. The Smoke detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel’s reset switch. The sensitivity of the detector shall be capable of being selected and measured by the control panel without the need for external test equipment.

C. The vandal security-locking feature shall be used in detention areas. The locking feature shall be field selectable when required. It shall be possible to perform a sensitivity test of the detector without the need of generating smoke. The test method shall simulate the effects of products of combustion in the chamber to ensure testing of the detector circuits. Detectors shall have completely closed back to restrict entry of dust and air turbulence and have a 30 mesh insect screen. Electronics of the unit shall be shielded to

protect against false alarms from E.M.I. and R.F.I. The detector shall be a double EE-prom technology and be programmed using the internal programming loop located on the FACP.

2.23 HEAT DETECTORS

A. Furnish and install intelligent, addressable heat detectors where indicated on drawings. The combination heat detector and twist lock base shall be UL listed compatible with the fire alarm control panel. The base shall permit direct interchange with the Ionization smoke detector and the photoelectric smoke detector. The base shall be appropriate twist lock base. The heat detector shall have a flashing status LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady at full brilliance. The detector may be reset by actuating the control panel's reset switch. Electronics of the unit shall be shielded to protect against false alarms from E.M.I. and R.F.I.

2.24 DUCT DETECTORS

A. Duct Detectors shall be provided, installed and powered with remote test switches on the supply and return for each unit 2000CFM or larger. Addressable intelligent modules to monitor the duct detectors for required supervision are to be provided.

2.25 FIRE/SMOKE DAMPERS

A. Fire/Smoke Damper shut down shall be achieved by an intelligent addressable control relay on each electrical circuit serving fire/smoke dampers.

2.26 WATER FLOW TAMPER SWITCHES

A. Water Flow/Tamper switches are to be provided and installed by the sprinkler contractor. Addressable intelligent modules to monitor these switches for required supervision.

2.27 SYSTEM OPERATION

A. When a device indicates any alarm condition the control panel must respond within 3 seconds. The General Alarm or Supervisory Alarm LED on the annunciator(s) should light and the LCD should prompt the user as to the number of current events. The alarm notification must be stored in event memory for later review. Event memory must be available at the main annunciator.

B. When the alarmed device is restored to normal, the control panel shall be required to be manually reset to clear the alarm condition, except that the alarms may be silenced as programmed.

C. An alarm shall be silenced by a code or Firefighter key at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur (subsequent alarm feature). When alarms are silenced the silenced LED on the control panel, and on any remote annunciators shall remain lit, until the alarmed device is returned to normal.

D. When a device indicates a trouble condition, the control panel System Trouble LED should light and the LCD should prompt the user as to the number of current events. The trouble information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators.

E. When the device in trouble is restored to normal, the control panel shall be automatically reset. The trouble restore information must be stored in event memory for later review. Event memory must be available at the main and all remote annunciators. A trouble shall be silenced by a code or Firefighter key at the main or remote annunciators. When silenced, this shall not prevent the resounding of subsequent events if another event should occur.

F. Each SLC loop shall be electrically supervised for opens and ground faults in the circuit wiring, and shall be so arranged that a fault condition on any loop will not cause an alarm to sound. Additionally, every addressable device connected to the SLC will be supervised and individually identified if in a fault condition. The occurrence of any fault will light a trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

G. Each indicating appliance circuit shall be electrically supervised for opens, grounds and short circuit faults, on the circuit wiring, and shall be so arranged that a fault condition on any indicating appliance circuit or group of circuits will not cause an alarm to sound. The occurrence of any fault will light the trouble LED and sound the system trouble sounder, but will not interfere with the proper operation of any circuit which does not have a fault condition.

H. Any alarm, trouble or supervisory signal shall also be communicated to the owner's offsite central monitoring facility.

2.28 SPARE SYSTEM COMPONENTS

A. Provide 10% spare parts for the following components:
   1. Smoke detectors
   2. Duct smoke detectors
   3. Heat Detectors

4. Horn/Strobe notification devices
5. Strobe only notification devices

B. The spare system components shall be delivered to the Owner's attic stock, as directed.

PART 3. - EXECUTION

3.1 INSTALLATION:

A. System components shall be installed in accordance with the latest revisions of the appropriate NFPA pamphlets, the requirements contained herein, National Electrical Code, local and state regulations, the requirements of the fire department and other applicable authorities having jurisdiction (AHJ).

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.

C. All wire on the fire alarm system shall be UL Listed as fire alarm protection signaling circuit cable per National Electrical Code, Articles 760. Wiring shall be installed in a conduit raceway system. Paint junction boxes red. Hand label as "FA" with black permanent marker.

3.2 WIRING METHODS

A. Wiring methods shall be suitable for an inaccessible ceiling space. Reference article 370-29, NEC.

3.3 TEST

A. Before the installation shall be considered completed and acceptable by the code authority, a test of the system shall be performed. Test of system shall require the activation of all detection and initiating devices.

B. Where application of heat would destroy detector, it may be manually activated.

C. The communication loops and the indicating appliance circuits shall be opened in at least two (2) locations per circuit to check for the presence of correct supervision circuitry.

D. Leave the fire alarm system in proper working order, and, without additional expense to the owner, replace any defective materials or equipment provided under this contract within one year from the date of final acceptance by the awarding authority.

E. Prior to final test the fire department and any other authority having jurisdiction must be notified in accordance with local requirements and any testing and/or final inspection shall be performed. Written approval from the authorities having jurisdiction shall be provided prior to final acceptance of system.

F. The service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment shall be provided to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with NFPA 72, Chapter 7.

G. Provide testing and written verification that owner's central monitoring system is fully functional and accurately receiving alarm and status information from the system fire alarm control panel and the intrusion detection system.

3.4 FINAL INSPECTION

A. At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functios properly in every respect.

3.5 OPERATION AND MAINTENANCE MANUALS

A. The intent of this section is to require complete documentation of the FA System for the purpose of system operation and maintenance during and after the warranty period. It is intended that the operation and maintenance manuals be detailed in the coverage of the system to the extent they may be used as the sole guide to the troubleshooting, identification, and repair of defective parts.

B. Provide six complete drawing books and maintenance and operation manuals on the completed system. These manuals shall include basic wiring diagrams, schematics, and functional details such that any component, wire, or piece of equipment in the system may be easily identified by going to the actual equipment and making reference to this manual. It is required that everything in the system be neatly labeled and easily identifiable. Every terminal, wire, component, or piece of equipment, relay, and other such items shall have a number or letter designation. All of these identification characteristics shall be included in the maintenance and operation manuals.

C. Reference Section 26 0500 for additional requirements.

1. The maintenance manual requirement is in addition to shop drawing requirements. Maintenance manuals and drawing sets shall be complied after system fabrication and testing, and shall incorporate any changes made after shop drawing submittal.
2. Provide manufacturer's standard literature, detailing all equipment included in the system. The maintenance manuals shall contain specifications, adjustment procedures, circuit schematics,

component location diagrams, and replacement parts identification. All references to equipment not supplied on this project shall be deleted.

D. All drawings shall be developed specifically for this project and shall be reduced to 11" X 17", folded and bound with hard plastic covers. Provide component identification and cross reference on the drawings for the maintenance department to understand the function of each item (the block diagram), find the room where the FA device is mounted (contract document plans), find its location in the control panel (arrangement drawings), find how it is wired (wiring diagrams), and its detailed specifications (vendor data sheets), and how to repair it (spare part lists). Include the following drawings as a minimum:
   1. Functional Block Diagram: Provide overall block diagrams showing the major interconnections between the new and existing subsystems.
   2. Arrangement Drawings: Provide drawings showing the physical arrangement of all major system components.
   3. Elevation drawings of all equipment panels showing the location of each component in the panel. Components in the racks shall be identified as in the functional block diagrams.
   4. Wiring Diagrams: Provide wiring diagrams showing all new and existing field-installed inter-connecting wiring. Wire identification on the diagrams shall agree with the wire markers installed on the equipment.

3.6 TRAINING AND INSTRUCTION

A. Provide FA system operation and administration/maintenance training for the Owner's personnel. Training materials shall be provided to the Owner 30 days in advance of the training courses. Training sessions and intervals shall be as follows:
   1. Manufacturer's factory certification training shall be provided on site. This training shall be sufficient provision for the Owner's technicians to be permitted to provide service to the system during the warranty period (when required) without voiding the conditions of the warranty.

B. Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components shall be provided.

C. Provide a typewritten "Sequence of Operation."

END OF SECTION

SECTION 310000 - EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes: Excavating, filling, backfilling, grading, and compacting of earth at the site.
B. Related Sections:
   1. Section 003132 - Geotechnical Data
   2. Section 014500 - Quality Control
   3. Section 312513 - Erosion and Sedimentation Controls
   4. Section 311400 - Site Preparation
   5. Section 321823 - Trenching and Backfilling
   6. Section 314133 - Trench Shielding

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM):
   ASTM D 698-78 Tests Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-lb. Rammer and 12-in. Drop.

1.03 SUBMITTALS

A. Samples: Submit in accordance with Section 013323 – Shop Drawings, Product Data, and Samples. Submit material analysis results of existing and imported (if required) topsoil from a testing laboratory indicating compliance with these specifications. Any topsoil delivered to the site which does not comply with the approved sample shall be re-tested at the Contractor's expense and replaced.
B. Test Reports:
   1. Submit copies of test reports in accordance with Section 014500 - Quality Control.
   2. Submit copies of test reports for select fill material. No select fill material, if required, shall be delivered to the site until after the tests have been made and test reports confirmed.
   3. Compaction Tests: Submit copies of compaction test reports.

1.04 QUALITY ASSURANCE

A. Laboratory Control: Select fill material and imported topsoil, if required, shall be inspected and tested by an independent testing laboratory.
   Testing laboratory shall make tests for the soil from the selected source to determine that it meets the specified requirements for select fill and imported topsoil.

1.05 PROJECT CONDITIONS

A. Temporary Sheeting: Shore and sheet excavations to protect utilities and to prevent cave-in. Maintain sheeting secure until permanent construction is in place. Remove sheeting as excavations are backfilled.
B. Drainage: Provide for adequate surface drainage during construction to keep the site free of surface water without creating a nuisance in adjacent areas and in accordance with the erosion control plan.
C. Pumping: Keep the excavations free of water at all times by pumping or other means. This shall be the responsibility of the Contractor regardless of the cause, source, or nature of the water.
D. Protection:
   1. Property: Protect adjoining property, including improvements outside the limits of the work. Protect walks, curbs, and paving from damage by heavy equipment and trucks.
   2. Trees: Protect tops, trunks, and roots of trees on the site which are to remain. Box or fence trees vulnerable to damage during construction. Remove interfering branches with care and cover scars with tree paint. Do not permit fires, storage of materials or excavation within the branch spread of trees to remain.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. Topsoil:

1. Topsoil on the paving site areas shall be stripped, cleaned of grass, roots and debris to a depth of between 6" and stockpiled for later use. Provide soil amendments to existing topsoil per 2.0.1 A.2.B and C or import topsoil. Contractor shall stabilize the top soil mound per the Storm Water Pollution Prevention Plan.
2. Import topsoil, as required.
   a. Contractor shall haul and place imported topsoil obtained from the off-site sources as necessary to construct the topsoil layer and various other details of the construction drawings. All costs related to such imported topsoil fill will be included in the contract price, and no additional or separate payment for imported fill will be due to Contractor.
   b. Topsoil shall be secured from an approved off-site location. It shall be:
      1) Natural, fertile, friable agricultural soil, having characteristics of representative productive soils in the vicinity, and obtained from naturally well-drained areas.
      2) Topsoil shall not be excessively acid or alkaline nor contain toxic substances.
      3) Topsoil shall be without admixture of subsoil and shall be reasonably free from clay lumps, stone, stumps, roots, live plants, or similar substances one inch or more in diameter, debris, or other objects which might be a hindrance to planting operations.
      4) Topsoil shall be free from Johnson grass (Sorgum halepense), nut grass (Cyperus rotundus), and objectionable weeds.
   c. The soil texture shall be classified as loam or sandy loam according to the “soil triangle” published by the United States Agriculture Department and the following Criteria:
      1) Sand (2.0 to 0.05 mm dia.)(No. 10 sieve): Loam 25-50%; Sandy Loam 45-85%.
      2) Silt (0.05 to 0.002 mm dia.)(No. 270 sieve): Loam 30-50%; Sandy Loam less than 50%.
      3) Clay (smaller than 0.002 mm dia.)(Hydrometer Analysis): Sandy Loam less than 50%.
      4) Natural organic content: Not less than 1.5%.
      5) pH of Soil: Not more than 7.6.
      6) Soil texture shall be determined by utilizing processes as prescribed in ASTM D 422 using the No. 10 and No. 270 sieves and a hydrometer analysis.
3. Unsuitable Materials: Topsoil or unclassified fill will be declared as “unsuitable” by the Landscape Architect, Geotechnical Engineer or Civil Engineer if, in his opinion, any of the following conditions or matter and articles are present to a degree that is judged detrimental to the proposed use of the material:
   1) Moisture.
   2) Decayed or un-decayed vegetation.
   3) Hardpan clay, heavy clay, or clay balls.
   4) Rubbish.
   5) Construction rubble.
   6) Sand or gravel.
   7) Rocks, cobbles, or boulders.
   8) Cementitious matter.
   9) Foreign matter of any kind.
   10) Spoils from piers.
4. Unsuitable materials shall be disposed of as “waste” as specified in Section 311400 and 311100.
5. Wet Material: If fill material is unsatisfactory for use as embankment solely because of high moisture content, the Architect may grant the Contractor permission to process the material to reduce the moisture content to a usable optimum condition.

B. Unselected Earth Fill: Clean, sandy soil free of organic matter and refuse, roots, clay lumps and rocks larger than 2".

C. Granular Fill: Clean gravel or crushed rock graded to produce a mixture passing 1-¾" sieve and retained on ¼" sieve. Granular fill for areas to be covered with membrane waterproofing shall be clean pea gravel graded no larger than ¾".

D. Free-Draining Fill: Coarse sand of sand gravel mixture with less than 12% passing a No. 200 sieve, and a Plasticity Index less than 4.

E. Filter Fabric Protective Membrane: The geomembrane filter fabric shall consist of a minimum 4-mils thick polyethylene (impermeable) film with a layer of nonwoven needle-punched polyester or polypropylene fabric bonded to one side. Fabric-film-fabric laminate being furnished shall consist of fabric fused or heat-sealed or otherwise bonded film so as to form an integral geomembrane. Filter fabric shall be able to withstand normal handling and placement at material temperatures from 20ºF. To 145ºF. without endangering the serviceability of the material in the intended application. If the filter fabric evidences delamination, such delamination shall serve as grounds for rejection. Filter fabric shall be mildew, abrasion and puncture resistant and suitable for long term burial in the presence of water or moisture in the intended construction application. Product/manufacturer. Petromat MB: Phillips fibers Corp.

PART 3 - EXECUTION

3.01 PREPARATION

A. Remove grass, weeds, roots and other vegetation from areas to be excavated, filled and graded. Fill stump holes and like small excavations with suitable material placed in lifts and thoroughly tamped.

B. Scarify the subgrade soil in place to a depth of 6 inches and compact to between 95 and 100 percent of Standard Density, at or above optimum moisture content, in accordance with ASTM D 698.

C. Install filter fabric in prepared subgrade soil in strict compliance with manufacturer's instructions and recommendations. Filter fabric joints at the end of each roll and on adjacent rolls shall be overlapped a minimum of 6". Before subsequent rolls of fabric are place, an application of sealant shall be placed along the edge and end of the in-place roll, which is to be overlapped. Sealant shall be applied at the rate of 35-40 linear feet per gallon to develop an approximately 3-inch wide drool centered about 4" from the edge of the in-place fabric. Then within 5-15 minutes, depending upon the ambient temperature, the next roll of moisture barrier fabric shall be placed overlapping the in-place roll by 6". Immediately after placing the overlapping fabric, the overlap seam area shall be rolled with a heavy roller to force the asphalt into the overlapping fabric.

3.02 EXCAVATION

A. General: Excavate to the lines, grades and sections shown on the drawings. Allow space for the construction of forms. Excavate as required regardless of the condition or type of material encountered.

1. Cut areas accurately to the indicated cross-sections and grades. Take care to prevent excavation below the grades indicated. Any bottoms and slopes that are undercut shall be backfilled with earth fill and compacted.
2. Finish the excavating required for graded areas to a tolerance of 0.10 foot above or below the rough grade.
3. Remove underground obstructions except for piping and conduit which shall be handles as specified in Section 311100.

3.03 WASTING

A. Surplus excavated material not suitable or required for embankment fill and backfill shall be wasted off site in a legal matter.

3.04 FILL AND BACKFILL

A. Filling: Construct compacted fills to the lines, grades and sections shown on the drawings.

1. Complete stripping and wasting operations in advance of fill construction.
2. Deposit and mix fill material in horizontal layers not more than 8" deep, loose measurement. Manipulate each layer until the material is uniformly mixed and pulverized.
   a. Fill material layers shall be reduced to not more than 4" deep for structure backfill compactors or small self-propelled compactors.

3. Fill material shall have a moisture content at or slightly above the optimum, to achieve specified compaction. If fill is too wet, dry by aeration to achieve desired moisture content. If fell is too dry, add water and mix in by blading and discing to achieve desired moisture content.
4. Exercise care to prevent movement or breakage or walls, trenches, and pipe during filling and compaction. Place fill near such items by means of light equipment and tamp with pneumatic or hand tampers.

B. Backfilling: Construct compacted fill against and around concrete beams below finish grade.
1. Do not backfill until underground construction has been inspected, tested and approved, forms removed, and the excavations cleaned of trash and debris.
2. Do not backfill against beams until all of the permanent structural concrete supports and bracing members are in place or until adequate shoring has been erected to prevent displacement and deflection of the beams under horizontal load. Exercise care in the placing and compacting of backfill so as not to damage the structure in any way.
3. Bring backfill to required grades by depositing material in horizontal layers not more than 8" deep, loose measurement.
   a. Fill material layers shall be reduced to not more than 4" deep for structure backfill compactors or small self-propelled compactors.

3.05 COMPACTION

A. Compact each layer of earth fill and backfill thoroughly and evenly until there is no evidence of further compaction and a solid and uniform density is secured.
1. Equipment for compacting shall be sheepsfoot and rubber tired rollers or other compactors capable of obtaining the required density. Compact the fill with power tampers and by hand in areas not accessible to rollers.
2. Compact each layer of fill to the density listed below as a function of the location. The required density in each case is indicated as a percentage of the maximum dry unit weight determined using the standard compaction test ASTM D 698.
3. Compact fill to the density listed below at a moisture content per the geotechnical report.
   a. Material under paving _____ 95 to 100%.
   b. Material under lawn areas _____ 85 to 90%.
   c. Material adjacent to retaining walls _____ 93 to 98%.

3.06 FINE GRADING

A. All fine grading and corresponding construction shall be performed as specified herein, and the complete work shall conform to the required lines, grades, and cross sections of the plans.
1. The maximum allowable deviation from the required finished grades of a line or plane shall be a slope (gradient) of plus or minus 0.5% in a horizontal dimension of 8' maximum. This shall be field tested by using an 8' long straight edge. If the surface has a deviation of more than ¼" above or below the midpoint of the straight edge when its ends rest on high or low points, the finished grade will be unsatisfactory and shall be immediately corrected.

B. Road and Parking Lot Subgrade: Fine grading of the concrete road and parking lot subgrade shall be performed after final mixing and compaction of the lime treated is satisfactorily performed. Fine grading may be executed with a combination of a light roller and road grader. See Specification Section 313200.

C. Concrete Walks: Fine grading of concrete walk subgrades shall be scarified to a 6" depth and recompacted to 95% of ASTM D 698 at a moisture content between - 1% and +4%.

D. Athletic Fields (if shown on plans): Fine grading of the athletic fields shall be performed as a final step after placing imported topsoil and mixing of the soil amendments.
1. Topsoil shall first be placed and compacted to normal density, minimum 90% of Tex-113-E Density shall be graded to within 0.02 foot of finished grade.
2. Contractor shall provide to the Engineer a survey for grade verification at the following intervals:
   a. Top of native material.
   b. Top of rough grade.
   c. Finished grade.

   Elevations provided shall have an accuracy of 0.01'.
3. Fine grading shall be executed over all athletic field playing areas by the placement and use of final grade stakes or "blue tops" as directed on the grading plan. Final grade

stakes shall be placed at intervals not to exceed 50' along the exact contour lines as dimensioned on the grading plan. The stakes will be driven to the exact even foot elevation of the contour and will then be painted a bright color on top or be marked with a brightly colored plastic attachment.

4. Fine grading will then be executed with any or all of the following machinery; road grader, tractor box blade, discing machinery, weighted spike harrow, and weighted drags. Bulldozer blades or front end loader buckets are not acceptable devices for fine grading operations.
5. The use of a watering truck to moisten dried and hardened areas may be necessary.
6. It is anticipated that some areas will be loosened and pulverized with discing machinery and will then be recompacted to normal density before fine grading.
7. Satisfactorily fine graded areas shall be true in plane, even in gradient (slope), uniform in surface texture, free of rocks greater than ½" in diameter, and of normal compaction. Areas of loose granular soil pockets interspersed with over-compacted soils are not acceptable. Fine graded areas shall promote complete surface drainage, be ready for turfgrass planting, and assure playability.

E. Timing
1. Fine grading will not begin until all underground utilities are complete, in place, tested to be working properly, and properly backfilled. Fine grading should not be attempted until construction which involves heavy vehicles is complete or nearly complete. Such vehicles cause rutting and over-compaction.
2. After fine grading is accomplished, it shall be the contractor's responsibility to protect all the fine graded areas from vehicular traffic or other disruptive activities. Damages to the fine graded surfaces will be restored to a satisfactory condition as prescribed herein until the job is finished and accepted.

F. Site Grading: Shape and finish earthwork to bring the site to the finish grades and elevations shown on the drawings.
1. Establish grades by means of grade stakes placed at corners of units, at abrupt changes of grade, and elsewhere as may be required.
2. Rough grade for walks, paving, and site improvements to the subgrade elevations required. Soft and unstable material which will not readily compact when rolled or tamped shall be removed and the resulting depressions filled with stable material and re-compacted.
3. Finish grade to the finish contours and spot grades shown. Extend cuts and fills to feather out beyond the last finish contour or spot grade shown. Grade to uniform levels and slopes between points for which elevations are given, round off abrupt changes in elevation, and finish off smoothly. Finish grades shall slope away from the building in all directions to assure proper drainage, minimum of 2%.

G. Grading Around Trees: Where grading is required within the branch spread of trees that are to remain, perform the work as follows:
1. When trenching occurs, the tree roots shall not be cut but the trench shall be tunneled under or around the roots by hand digging.
2. When the existing grade at a tree is below the new finished grade, and fill not exceeding 6" is required, clean washed gravel graded from 1" to 2" size shall be placed directly around the tree trunk. The gravel shall extend out from trunk on all sides a minimum of 18" and finish approximately 2" above the finished grade at the tree. Install gravel before earth fill is placed.
3. Trees in areas where the new finished grade is to be lowered shall have regrading work done by hand to elevation as indicated. Existing grades immediately surrounding the trunk shall not be altered except at the direction of the Architect.

3.07 PLACING TOPSOIL

A. Prior to placing topsoil, scarify subgrade to a depth of 6". Following scarification, topsoil shall be spread in one lift. The in place depth of the topsoil at the pay field shall be 6". Topsoil shall be compacted to the approximate density of undisturbed soil. Provide topsoil to comply with Section 2.01. If there is insufficient stockpiled topsoil from on-site sources to complete the work, bring in topsoil from off-site sources as needed (topsoil for athletic fields shall be imported). After topsoil has been placed, blade, roll lightly, and rake as required to comply with 3.08, B below.

B. After placement of topsoil, Contractor shall eliminate all low or hollow places that would allow water to stand or pond during rainfall or during operation of lawn irrigation systems. The area shall be free of all natural debris and shall also be free of all clods and rocks which are ¾" in size or larger.

3.08 FIELD QUALITY CONTROL

A. Compaction Tests: Field density testing of the select fill material under the paving and at perimeter grade beam shall be performed by an Independent Testing Laboratory.
   1. Testing laboratory shall make one in place density test for each 5,000 sq. ft. of area per lift, but in no case less than two tests, and one test per 100 linear feet of backfill area adjacent to grade beams, to insure that the specified density is obtained.

B. Compaction Tests: Field density testing of fill material shall be performed by an Independent Testing Laboratory.
   1. Testing laboratory shall make one in place density test for each 5,000 sq. ft. of area per lift, but in no case less than two tests, and one test per 100 linear feet of backfill area adjacent to grade beams, to insure that the specified density is obtained.

C. Provide “As Built” survey of all areas for verification of grades and acceptance by Engineer. Contractor shall provide a CAD drawing of the survey by a State of Texas Licensed Surveyor. Survey shots shall include point location, description, elevation, and shall be on the same coordinate plane as the original project.

END OF SECTION 310000

SECTION 310513 - SOILS FOR EARTHWORK

PART 1 -GENERAL

1.01 WORK INCLUDED

This section of the specifications describes the various classes of Earth Fill. All of the classes of Earth Fill contained in this specification may not be used on this project. The classes of Earth Fill used on this project are shown on the drawings or specified in other sections of the specifications. This specification section does not include specifications for placement and compaction of Earth Fill. Specifications for placement and compaction of Earth Fill are included in other sections of the specifications and/or shown on the drawings.

1.02 STANDARDS

Soil materials shall be classified into the appropriate class of Earth Fill shown below according to ASTM D-2487 “Classification of Soils for Engineering Purposes” or other appropriate methods as designated by the Engineer.

PART 2 - PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

A. CLASS 1 EARTH FILL: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60% passing the No. 200 sieve, which are free of organic materials.

B. CLASS 2 EARTH FILL: Limited to clays and sandy clays classified as CH and CL materials with a coefficient of permeability less than or equal to 1.0×10^{-7} cm/sec, a liquid limit greater than or equal to 30, a plasticity index greater than or equal to 15, and more than 50% passing the No. 200 sieve, which are free of organic materials.

C. CLASS 3 EARTH FILL: Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.

D. CLASS 4 EARTH FILL: Consist of materials which are classified as SP, SM, SC, CL, OR dual classifications thereof, which have a liquid limit less than or equal to 30 and a plasticity index of a minimum of 6 and a maximum of 15, which are free of organic materials and have a maximum particle size of 2 inches.

E. CLASS 5 EARTH FILL: Consist of materials classified as SP or SP-SM which have a plasticity index less than or equal to 4 and a maximum of 12% passing the No. 200 sieve, which are free of organic materials. (Class 6 through Class 11 reserved)

F. CLASS 12 EARTH FILL: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.

END OF SECTION 310513

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SECTION 310516 - AGGREGATES FOR EARTHWORK

PART 1 - GENERAL

1.01 WORK INCLUDED

This section of the specifications describes the various classes of Aggregate Fill. All of the classes of Aggregate Fill contained in this specification may not be used on this project. The classes of Aggregate Fill used on this project are shown on the drawings or specified in other sections of the specifications. This specification section does not include installation. Installation of Aggregate Fill is included in other sections of the specifications and/or on the drawings.

1.02 REFERENCES

A. Match material requirements under 033000 Reinforced Cast in Place Concrete for Sidewalks and 032000 Concrete Reinforcement.

1.03 QUALITY ASSURANCE

CLASSIFICATION TESTING

A. CONTRACTOR TESTING
   1. Arrange and pay for the services of an independent testing laboratory to sample and test proposed Aggregate Fill materials.
   2. Submit the test results to the Engineer and obtain approval prior to providing Aggregate Fill.

B. OWNER TESTING
   The Owner shall arrange and pay for additional testing on the Aggregate Fill after delivery to the project site as determined necessary by the Engineer.

C. CONTAMINATION CERTIFICATION
   1. Obtain a written, notarized certification from the Supplier of each proposed Aggregate Fill source stating that to the best of the Supplier's knowledge and belief there has never been contamination of the source with hazardous or toxic materials.
   2. Submit these certifications to the Engineer prior to proceeding to furnish Aggregate Fill to the site. The lack of such certification on a potential Aggregate Fill source shall be cause for rejection of that source

1.04 STANDARDS

Aggregate Fill shall be classified into the appropriate class listed below according to ASTM testing procedures as specified for the various classes.

American Society for Testing Materials standards:

ASTM C33	Specification for Concrete Aggregates
ASTM C88	Test Method for soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C125	Terminology Relating to Concrete and Concrete Aggregates
ASTM C131	Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C535	Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM D448	Classification for Standard sizes of Aggregate for Road and Bridge Construction

PART 2 - PRODUCTS

2.01 MATERIALS; CLASSIFICATIONS

A. Regional Materials: Provide product that meets the definition as of a "regional material," as defined in Section 013520, for 100% of the product by weight.

B. Recycled Content: Provide products with an average recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

C. CLASS I AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 57:

Sieve Size Square Opening	Percent Passing
1-1/2"	100
1"	95 - 100
1/2"	25 - 60
No.4	0 - 10
No. 8	0 - 5

D. CLASS 2 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM Method C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 67:

Sieve Size Square Opening	Percent Passing
1"	100
3/4"	90 - 100
3/8"	20 - 55
No.4	0 - 10
No.8	0 - 5

E. CLASS 3 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 7:

Sieve Size Square Opening	Percent Passing
3/4"	100
1/2"	90 - 100
3/8"	40 - 70
No.4	0 - 15
No.8	0 - 5

F. CLASS 4 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM Method C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 467:

Sieve Size Square Opening	Percent Passing
2"	100
1-1/2"	95 - 100
3/4"	35 - 70
3/8"	10 - 30
No. 4	0 - 5

G. CLASS 5 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 357:

Sieve Size Square Opening	Percent Passing
2-1/2"	100
2"	95 - 100
1"	35 – 70
1/2"	10 - 30
No. 4	0 - 5

H. CLASS 6 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 1:

Sieve Size Square Opening	Percent Passing
4"	100
3 - 1/2"	90 - 100
2 - 1/2"	25 - 60
1 - 1/2"	0 - 15
3/4"	0 - 5

I. CLASS 7 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 6:

Sieve Size Square Opening	Percent Passing
1"	100
3/4"	90 - 100
1/2"	20 - 55
3/8"	0 - 15
No.4	0 - 5

J. CLASS & AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and shall have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D448, size number 56:

Sieve Size Square Opening	Percent Passing
1-1/2"	100
1"	90 - 100
3/4"	40 - 85
1/2"	10 - 40
3/8"	0 - 15
No. 4	0 - 5

K. CLASS 9 AGGREGATE FILL: Consist of washed and screened gravel and natural sands or sands manufactured by crushing stones complying with the requirements of ASTM C33, "Standard Specifications for Concrete Aggregates", except that the gradation shall be as follows:

Sieve Size Square Opening	Percent Passing
1/2"	100
3/8"	95 - 100
No. 4	80 - 95
No. 8	65 – 85
No. 16	50 – 75
No. 30	25 – 60

No. 50	10 – 30
No. 100	0 - 10

Class 9 Aggregate Fill shall have not more than 45% passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

L. CLASS 10 AGGREGATE FILL: Consist of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of "Standard Specifications for Concrete Aggregates", ASTM C33. The gradation as included in ASTM C33 is as follows:

Sieve Size Square Opening	Percent Passing
3/8"	100
No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10

Class 10 Aggregate Fill shall have not more than 45% passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C125, shall be not less than 2.3 nor more than 3.1.

M. CLASS 11 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-3/4"	100
7/8"	65 - 90
3/8"	50 - 70
No.4	35 - 55
No.40	15 - 30
No.100	0 - 12 (Wet Sieve Method)

N. CLASS 12 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-1/2"	100
1"	85 - 100
3/4"	60 - 95
3/8"	50 - 80
No.4	40 - 65
No.16	20 - 40
No.100	0 - 12 (Wet Sieve Method)

O. CLASS 13 AGGREGATE FILL: Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and shall meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-3/4"	100
7/8"	65 - 90
3/8"	50 - 70
No. 4	35 - 55
No. 40	15 - 30
No. 100	0 - 3 (Wet Sieve Method)

P. CLASS 14 AGGREGATE FILL. Consist of durable particles of crushed stone free of silt, clay, or other unsuitable material and have a percentage of wear of not more than 40% when tested in accordance with ASTM C131 or C535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation:

Sieve Size Square Opening	Percent Passing
1-1/2"	100
1"	85 - 100
3/4"	60 - 95
3/8"	50 - 80
No.4	40 - 65
No. 16	20 - 40
No.100	0 - 3 (Wet Sieve Method)

Q. CLASS 15 AGGREGATE FILL. Consist of durable particles of silica sand, washed clean chemically inert, and packaged by the Supplier. The material shall meet applicable regulatory requirements for monitor well filter pack. The source of the material shall be approved by the Engineer and shall meet the following gradation requirements.

Sieve Size Square Opening	Percent Passing
No.20	98 - 100
No.40	0 - 2

END OF SECTION 310516

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SECTION 311100 - CLEARING AND GRUBBING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment and incidentals necessary to perform operations in connection with clearing, grubbing, and disposal of cleared and grubbed materials.

1.02 QUALITY ASSURANCE; DEFINITIONS

A. CLEARING: Clearing is defined as the removal of trees, shrubs, bushes, and other organic matter at or above original ground level.
B. GRUBBING: Grubbing is defined as the removal of stumps, roots, boards, logs, and other organic matter found at or above ground level.

PART 2 - PRODUCTS [Not Used]

PART 3 - EXECUTION

3.01 PREPARATION

A. Mark areas to be cleared and grubbed prior to commencing clearing operations. Engineer shall approve clearing and grubbing limits prior to commencement of clearing operations.
B. Trees and shrubs outside of the clearing limits, which are within 10' of the clearing limits, shall be clearly marked to avoid damage during clearing and grubbing operations.
C. Remove trees and brush outside the clearing limits, but within the immediate vicinity of the work, upon receipt of approval by the Engineer, when the trees or brush interfere with or retard the progress of construction operations.
D. Clearly mark trees and shrubs within the clearing limits, which are to remain, and protect the trees and shrubs from damage during the clearing and grubbing operations.
E. The clearing limits shall not extend beyond the project limits.
F. Establish the clearing limits as follows:
    1. Embankments plus 10' beyond the top of the excavation.
    2. Excavations plus 5' beyond the top of the excavation.
    3. Concrete structures plus 10' beyond the edge of the footing.
    4. New roadways and new parking areas plus 5' beyond the edge of pavement.
    5. Retaining walls plus 10' beyond the edge of the footing unless otherwise shown.
    6. Underground utility trench top width plus 8'.
G. Establish the grubbing as follows:
    1. Embankments plus 2' beyond the toe of the embankment.
    2. Concrete structures plus 2' beyond the edge of the footing.
    3. New roadways and new parking areas plus 1' beyond the edge of pavement.
    4. Retaining walls plus 2' beyond the edge of the footing.

3.02 INSTALLATION

A. CLEARING
Clearing shall consist of the felling, cutting up, and the satisfactory disposal of trees and other vegetation, together with the down timber, snags, brush, rubbish, fences, and debris occurring within the area to be cleared.
B. GRUBBING
    1. Grubbing shall consist of the removal and disposal of stumps and roots larger than 1" in diameter.
    2. Extend grubbing to the depth indicated below: In the case of multiple construction items, the greater depth shall apply.
        a) Footings - 18" below the bottom of the footing.
        b) Walks - 12" below the bottom of the walk.
        c) Roads and Taxiways - 18" below the bottom of the subgrade.
        d) Parking Areas - 12" below the bottom of the subgrade.
        e) Runways - 24" below the bottom of the subgrade.
        f) Embankments - 24" below existing ground.

g) Concrete Structures - 18" below the bottom of the concrete.
h) Retaining Walls - 18" below the bottom of the footing.

3.03 FIELD QUALITY CONTROL

BURNING NOT PERMITTED

Completely remove timber, logs, roots, brush, rotten wood, and other refuse from the Owner's property. Disposal of materials in streams shall not be permitted and no materials shall be piled in stream channels or in areas where it might be washed away by floods. Timber within the area to be cleared shall become the property of the Contractor, and the Contractor may cut, trim, hew, saw, or otherwise dress felled timber within the limits of the Owner's property, provided timber and waster material is disposed of in a satisfactory manner. Materials shall be removed from the site daily, unless permission is granted by the Engineer to store the materials for longer periods.

END OF SECTION 311100

SECTION 311400 - SITE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes: Clearing the site of vegetation, site improvements and obstructions to make way for new work.

1.02 PROJECT CONDITIONS

A. Existing Conditions: Contractor shall visit the site and verify the nature and extent of clearing work required.

B. Protection: Contractor shall be responsible for the protection of adjoining property and improvements outside the limits of the work. Protect paving from damage by heavy equipment and trucks. Take precautions to prevent injury to trees which are to remain.

PART 2 - PRODUCTS [Not used]

PART 3 - EXECUTION

3.01 PERFORMANCE

A. Clearing:
1. Remove trees, shrubs and other vegetation from within the area of the site where shown on the drawings. Grub out roots to a depth of at least 18 inches below natural grade.
2. Dig out and remove buried obstructions to a depth of 24" below natural grade or 24" below the intended excavation elevation, whichever is lower.
3. Unless otherwise specified on the drawings, trees with calipers greater than 3" shall not be cleared (removed).

B. Pavement Removal
Bituminous and concrete pavements shall be removed to neatly sawed edges. Saw cuts shall be made full depth. If a saw cut in concrete pavement falls within 3' of an existing score joint, construction joint, saw joint, cold join, expansion joint, or edge, the concrete shall be removed to that joint or edge. All saw cuts shall be parallel and/or perpendicular to the line of existing pavement. If an edge of a cut is damaged subsequent to saw cutting, the concrete shall again be sawed to a neat, straight line for the purpose of removing the damaged area.

C. Disposal:
1. Clean up and remove from the site existing stumps, logs, broken paving rubble, and trash.
2. Clean up and remove from the site the stumps, logs, broken paving, rubble and debris resulting from the clearing and grubbing operations.
3. Material to be wasted shall be legally disposed of off-site.
4. Burning of combustible materials on the site will not be permitted.
5. Remove and dispose of excess soil off site in a legal manner. No extra pay.

3.02 BACKFILLING

A. All holes, cavities, and depressions in the ground caused by site preparation operations will be backfilled and tamped to normal compaction and will be graded to prevent ponding of water and to promote drainage. In areas that are to be immediately excavated, the Architect/Engineer may permit holes, etc., to remain open.

3.03 STORM WATER MANAGEMENT PRACTICES

A. During the progress of the work, the contractor shall maintain existing storm water erosion and silt control measures in place at the site and shall provide additional erosion control barriers, silt fences, and other techniques in accordance with best management practices. Refer to Section 31 23 00 for additional requirements and land disturbance permit requirements.

END OF SECTION 311400

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SECTION 312333 - TRENCHING AND BACKFILLING

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipments and incidentals necessary to perform operations in trenching, pipe bedding, backfilling, clearing, grubbing and site preparation, handling, storage, transportation and disposal of excavated material; pumping and dewatering, preparation of subgrades, protection of adjacent property; fills, grading; and other appurtenant work. Trenching, backfilling, and pipe embedment procedures shall be in full compliance with Section 31 41 33, Trench Shielding. Earth removed from excavations and which is not required for backfill shall be removed from the site by the Contractor at his own expense, unless arrangements arc made with the Owner through his representative to allow disposal on site. If permitted, the Contractor shall dump and spread excess earth in a manner agreed upon by the Contractor and the Owner Excavation, other than trench excavation and embankment fills are not part of this specification section

1.02 QUALITY ASSURANCE

CLASSIFICATION

A. Excavations shall include material of whatever nature encountered, including but not limited to clays, sands, gravels, conglomeritic boulders, weathered clay shales, rock, debris and abandoned existing structures. Excavation and trenching shall include the removal and subsequent handling of materials excavated or otherwise handled in the performance of the work.
B. Bidders must satisfy themselves as to the actual existing subsurface conditions prior to the submittal of a proposal to complete the proposed work.
C. Trench excavation shall consist of excavation to the lines and grades indicated, required for installation of the pipe, pipe bedding, backfill, and to accommodate trench safety systems

1.03 SUBMITTALS

A. Submittals shall be in accordance with SECTION 013323 – Shop Drawings, Product Data, and Samples and SECTION 012300 – Alternates, Submittals and shall include:
   1. Sieve analysis on embedment materials.
   2. Test results indicating soil resistivity for embedment material used on metal pipe.

1.04 STANDARDS

The following publications, referred to hereafter by basic designation only, form a part of this specification to the extent indicated by the references thereto:

ASTM D-48 “Standard Classification for Sizes of Aggregate for Road and Bridge Construction"
ASTM D-698 "Moisture-Density Relationship of Soils and Soil Aggregate Mixtures, Using 5.5 -Ib Rammer and 12 Inch Drop"
ASTM D-1556 "Density of Soil in Place by the Sand Cone Method"
ASTM D-2487 "Classification of Soils for Engineering Purposes"
ASTM D-2922 "Density of Soil and Soil - Aggregate In-Place by Nuclear Methods"
ASTM D-3017 "Moisture Content of Soil and Soil - Aggregate In-Place by Nuclear Methods"
ASTM D-4253 "Test Methods for Maximum Index Density of Soils Using a Vibratory Table"
ASTM D-4254 "Test Methods for Minimum Index Density of Soils and Calculations of Relative Density"

Any other testing required by these specifications and not specifically referenced to a standard shall be performed under ASTM or other appropriate standards as designated by the Engineer.
Reference herein or on the drawings to soil classifications shall be understood to be according to ASTM D-2487, "Classification of Soils for Engineering Purposes" unless indicated otherwise.

1.05 DELIVERY AND STORAGE

Excavated materials to be used for backfill may be deposited in stockpiles at points convenient for re-handling the material during the backfilling process. The location of stockpiles shall be within the limits of construction easements or public right-of-way. The location of stockpiles is subject to the approval of the Owner or the Owner's representative. Keep drainage channels clear of stockpiled materials.

1.06 JOB CONDITIONS

Place no embedment or backfill material during freezing weather or upon frozen subgrades or previously placed frozen embedment or backfill materials.

PART 2 - PRODUCTS

2.01 MATERIALS

A. CONCRETE FOR BACKFILL, BLOCKING, CRADLING AND ENCASEMENT. Unless other strength requirements arc designated, concrete used shall be 3,500 psi as specified in Section 033000, CAST-IN-PLACE CONCRETE.

B. CLASS 1 EARTH FILL: Limited to clays and sandy clays classified as CH material with a liquid limit greater than or equal to 50, a plasticity index greater than or equal to 25, and a minimum of 60% passing the No. 200 sieve, which arc free of organic materials

C. CLASS 3 EARTH FILL- Consist of any materials classified as CH, CL, SM, SP, SP-SM, SC, and GC, which have a minimum plasticity index of 4, which are free of organic materials.

D. CLASS 12 EARTH FILL: Consist of soils suitable for topsoil which are relatively free of stones or other objectionable debris, which have sufficient humus content to readily support vegetative growth. The suitability of soils for topsoil shall be subject to the approval of the Engineer.

E. CLASS 2 AGGREGATE FILL: [For Reinforced Concrete or Concrete Cylinder Pipe] Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM Method C-13 1 or C-535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C-88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D-448, size number 67:

Sieve Size Square Opening	Percent Passing
1"	100
3/4"	90 - 100
3/8"	20 - 55
No. 4	0 - 10
No. 8	0 - 5

F. CLASS 3 AGGREGATE FILL: [For Iron, Cast Iron, or Corrugated Metal Pipe] Consist of durable particles of crushed stone free of silt, clay, or other unsuitable materials and have a percentage of wear of not more than 40% when tested in accordance with ASTM C-131 or C-535. When material is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with ASTM C-88, Sodium Sulfate Solution, the weighted percentage of loss shall not exceed 12%. The source of the material shall be approved by the Engineer and meet the following gradation in accordance with ASTM D-448, size number 7:

Sieve Size Square Opening	Percent Passing
3/4"	100
½"	90 - 100
3/8"	40 - 70
No. 4	0 - 15
No. 8	0 - 5

G. CLASS 10 AGGREGATE FILL: or Iron-reinforced Concrete, Vitrified Clay, PVC, Fiberglass, or Asbestos Cement Pipe] Consist of washed and screened natural sands or sands manufactured by crushing stones complying with the requirements and tests of "Standard Specifications for Concrete Aggregates", ASTM C-33. The gradation as included in ASTM C-33 is as follows:

Sieve Size Square Opening	Percent Passing
8"	00
No. 4	95 - 100
No .8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10-30
No. 100	2-10

Class 10 Aggregate Fill shall have not more than 45°/O passing any sieve and retained on the next consecutive sieve of those shown above, and its fineness modulus, as defined in ASTM C-125, shall be not less than 2.3 nor more than 3.1.

H. CEMENT: Type I Portland Cement

2.02 MIXES; SAND-CEMENT BACKFILL [OR EMBEDMENT]

A. A minimum sand and cement mixture of 27 parts sand and 2 parts cement will be required.

Fine Sand	1 Cubic Yard
Cement	1 Bag (Minimum)
Water	Optimum Moisture

B. Sand shall be free of any cohesive material and shall meet the following gradation and plasticity index requirements:

Sieve Size	Percent Passing
1"	100
½"	95 - 100
No. 40	80 - 100
Plasticity Index	10 Maximum
Liquid Limit	25 or less

2.03 FABRICATIONS [Not Used]

2.04 MANUFACTURED PRODUCTS [Not Used]

PART 3 - EXECUTION

3.01 PREPARATION

A. SITE

1. Clear sites of logs, trees, roots, brush, tree trimmings and other objectionable materials and debris which are to be occupied by pipe trenches, and grub stumps. Designate material not salvaged for reuse as surface material as spoiled and dispose of material in accordance with Paragraph E - DISPOSAL OF SPOIL MATERIAL, of this section.
2. Do not remove trees outside of the required working area unless their removal is authorized in writing by the Engineer and with the approval of the local governing authority. Adequately protect the trees left standing from permanent damage by construction operations. Standing trees may be trimmed where necessary to facilitate construction, but only with written authorization from the Engineer.

B. DEWATERING

1. Provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering the excavations, trenches, or other parts of the work. Keep each excavation dry during subgrade preparation and continually thereafter until the proposed pipe is installed. Maintain the proper procedures necessary to protect against damage to the proposed work from hydrostatic pressure, flotation, or other water related causes.
2. Dewater excavations which extend down to or below ground water elevation by lowering and keeping the ground water level a minimum of 2-feet below the bottom of the excavation.
3. Divert surface water or otherwise prevent water from entering excavated areas to the fullest extent possible without causing damage to adjacent property.
4. Provide and maintain any piping or conduit necessary to facilitate drainage. Do not alter area drainage patterns to the extent that adjacent property and landowners become threatened with localized flooding and/or water damage. Should such a situation occur, the Contractor shall be responsible for repairing the damage at no additional cost to the Owner.

C. PROTECTION OF EXISTING STRUCTURES AND UTILITIES

1. Prior to the start of construction, communicate with the local representatives of utilities companies, including but limited to oil, gas, telephone, and communications companies, as well as, local water and sewer utilities operating in the location of the proposed construction area. Seek the utility companies assistance in locating existing facilities to avoid conflicts during construction. The location, number, depth, and owner of utilities indicated are for information purposes only, and all utilities and structures may not be shown or may not be in the location shown.

2. Where construction endangers adjacent structures, utilities, embankments and/or roadways, the Contractor shall, at his own expense, carefully support and protect such structures so that no damage occurs throughout the construction process. In case damage should occur, the Contractor shall be responsible for restoring the damaged structure to a condition acceptable to the Owner of that structure and shall bear all cost of such reparations.
3. Repair or replace damaged street surfaces, driveways, sidewalks, curbs, gutters, fences, drainage structures, or other such facilities to the satisfaction of the Owner. Structures shall be returned to a condition equal to or better than the original condition and of same or better material and quality.

D. BLASTING

Blasting shall not be allowed in any instance.

E. DISPOSAL OF SPOIL MATERIAL

1. Suitable material from excavations which meets the requirements for pipe backfill material as indicated, except stripping excavation, may be reused. Designate the remaining excavated materials as spoiled material and dispose of material off the site in accordance with all applicable laws, ordinances, and codes. Contractor shall be responsible for the storage, transportation, and deposition of spoiled material and shall be responsible for acquiring the necessary permits, and the payment of fees and duties at no additional cost to the Owner.
2. No burning of materials shall be permitted on the site.

3.02 TRENCH EXCAVATION

A. GENERAL

The trenches shall be excavated to the alignment and depth indicated or as necessary for the proper installation of the pipe and appurtenances. Brace and dewater the trench if necessary so that the workmen may work therein safely and efficiently. Any specific requirement listed in Part 3.00 EXECUTION may be modified as necessary to meet OSHA requirements. However, if trench widths are wider than indicated, the Contractor shall be responsible for determining the proper class of embedment and piping and the installation.

B. TRENCH WIDTH

The trench widths shall be as shown on the drawings.

C. PIPE FOUNDATION SUBGRADE

1. Excavate the trench to an even grade to permit the installation of the pipe so that the full length of the pipe barrel is supported on the proper depth of bedding material. The entire foundation subgrade area in the bottom of the excavations shall be firm, stable material, and the material shall not be disturbed below required grade except as described in this specification. Where the character of the subgrade material is such that proper subgrade cannot be obtained at the elevation indicated, deepen the excavation to a satisfactory subgrade material
2. Remove the material until a firm, stable, and uniform bearing is reached and the subgrade brought back to the required grade with the specified bedding material compacted in place or with lean concrete material. The expense of replacing any unsatisfactory subgrade shall be borne by the Contractor.

D. CORRECTING FAULTY GRADE

Should any part of the trench be excavated below required grade, correct the trench with bedding material, thoroughly compacted, or with lean concrete, at no additional compensation to the Contractor.

E. CARE OF SURFACE MATERIAL FOR REUSE

If local conditions permit reuse, keep surface material suitable for reuse separate from the general excavation material.

F. TRENCHING METHODS

The use of any suitable trench digging machinery is permitted except in places where such operations may cause damage, above or below ground, in which case, employ hand methods.

G. PIPE CLEARANCE IN ROCK

Remove ledge rock, rock fragments, shale, or other rock to provide proper clearance for bedding materials. Provide adequate clearance for properly jointing pipe laid in rock trenches at bell holes.

3.03 BACKFILL

A. BEDDING WITHING PIPE ZONE

1. CONCRETE CRADLE, ENCASEMENT OR CONCRETE ARCH
   Where indicated, install in the pipe in concrete cradle, encasement, or concrete arch. Take precautions to prevent pipe movement or deflection during construction. Where pipes are placed below structures, completely encase pipes in 1,500 psi concrete, and extend up to bottom of structure.
2. CONCRETE BLOCKING
   Place blocking to rest against firm undisturbed trench walls. The supporting area for each block shall be at least as great as that indicated and shall be sufficient to withstand the thrust, including water hammer, which may develop. Each block shall rest on a firm undisturbed foundation of trench sides and bottom.

B. AGGREGATE FILL BEDDING
1. After the trench has been cut to the depths indicated, bring up the bedding layer to a point slightly above grade in maximum 4" lifts and uniformly compact to the density indicated. Form bell holes and scoop out a trough to grade so that the pipe is uniformly supported by the embedment material. Lay and joint the pipe. Bring up the embedment material in maximum 4" lifts on either side of the pipe to the elevation above the pipe shown on the plans. Uniformly compact the pipe as indicated.
2. After moisture is gone from the embedment material, place and compact the remaining backfill by tampering or other appropriate methods. Water jetting shall not be permitted.

C. COMPACTION REQUIREMENTS
1. Compact earth fill an adhesive aggregate fill in maximum 4" lifts with pneumatic rollers or power hand tampers and make a minimum of eight (8) passes.
2. Compact cohesionless aggregate fill in maximum 4" lifts with vibratory rollers or vibratory plate power hand compactors and make a minimum of eight (8) passes.
3. The acceptability of the compaction equipment shall be based upon the results of a test section.
4. Compact earth fill and cohesive aggregate fill to a minimum of 95% of maximum dry density as determined by ASTM D-698, Standard Proctor.
5. Compact earth fill Class 1 and 2 at a moisture content within minus 0 to plus 5 percentage points of the optimum moisture content. Compact the remaining classes of earth fill and cohesive aggregate fill at a moisture content within minus 2 to plus 5 percentage points of optimum moisture content. The moisture ranges listed above are minimum and maximum limits. A tighter moisture range within these limits may be required to consistently achieve the specified density.
6. Compact cohesionless aggregate fill on which it is not practical to control the density by “Proctor” methods to a minimum of 75% of relative density as determined by ASTM D-4253 and D-4254, or at the discretion of the Engineer, by a field compaction mold method correlated to ASTM D-4253 and D-4254.
7. Compact cohesionless aggregate fill at moisture content within a range that accommodates consistent placement and compaction to the minimum relative density specified above.
8. The Owner will arrange and pay for density and moisture testing. The testing frequency and methods shall be as requested by the Engineer. The Engineer may waive testing requirements on cohesionless bedding where testing is not practical because of limited space between the pipe and trench walls, however, the minimum number of passes of the compaction equipment specified above shall be achieved.

3.04 FINISHING

A. Grade and rake areas smooth and even which do not receive any type of paved surface, to allow drainage to drain away from the structures and toward the roads and streets or the natural drainage course. Break up large clods of earth and remove rocks, trash and debris near the surface.

B. Finish the top portion of backfill beneath established sodded (lawn) areas with not less than 6" of topsoil corresponding to, or better than, that underlying adjoining sodded areas.

3.05 FIELD QUALITY CONTROL

A. Compact backfill and appropriate embedment material to a minimum of 95% of maximum density at a moisture content of 0 to + 5% of optimum for backfill and at optimum for sand-cement embedment as determined by ASTM D-698-78 (Standard Proctor),

B. Make periodic tests of compaction for conformance with this section by an approved testing laboratory selected and paid for by the Owner. Contractor shall pay for re-testing until acceptable

test results are obtained.

3.06 CLEAN AND ADJUST

Remove surplus pipeline materials, tools, rubbish and temporary structures and leave the construction site clean, to the satisfaction of the Engineer.

END OF SECTION 312333

SECTION 313116 - TERMITE CONTROL

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. Soil treatment with termiticide.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of termite control product.
   1. Include the EPA-Registered Label for termiticide products.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For termite control products, from manufacturer.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

B. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.

B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.7 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Corporation, Agricultural Products; Termidor.
      b. Bayer Environmental Science; Premise 75.
      c. FMC Corporation, Agricultural Products Group; .
      d. Syngenta; .
   2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

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

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.

B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT

A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Under ground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.
3. Crawlspaces: Soil under and adjacent to foundations as previously indicated. Treat adjacent areas including around entrance platform, porches, and equipment bases. Apply overall treatment only where attached concrete platform and porches are on fill or ground.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION

SECTION 313200 - SOIL STABILIZATION - (LIME)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.02 SUMMARY

A. Section Includes: In-place lime treatment to stabilize the subgrade under concrete paving. (Base Bid).
B. Related Sections:
   1. Section 014500 - Quality Control
   2. Section 312300 - Earthwork (Site)
   3. Section 321313 - Portland Cement Concrete Paving and Curbs

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
ASTM D 698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
B. TSDHPT - Standard Specifications for Construction of Highways, Streets and Bridges, Texas Dept. of Highways and Public Transportation, as amended.
C. NCTCOG - North Central Texas Council of Governments Standard Specifications for Public Works Construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Lime Stabilization for Concrete Paving (Base Bid):
   1. Hydrated Lime: Type A (dry): Per TSDHPT Item 264-2
   2. Lime should meet the requirements of Items 2.5.2 and 2.5.3 in the North Central Texas Council of Governments Standard Specifications for Public Works Construction.
B. Soil: Upper 6" of the material in-place after the subgrade has been established, compacted, and shaped.
C. Lime: Hydrated lime made from “high-calcium” type limestone with an unhydrated lime content not exceeding 7.0% by weight and a “free” water content not exceeding 4% by weight. Waste lime will not be acceptable.

2.02 EQUIPMENT

A. Distributor truck or tank equipped with agitator to maintain a uniform mixture of lime and water.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The use of lime soil stabilization (BASE BID) or cement soil stabilization (UNIT PRICE) shall be at the direction of the Independent Testing Laboratory engineer in the field.

3.02 PREPARATION

A. Insure that surfaces have been brought to approximate rough grades (plus or minus 0.10 feet). Loosen and pulverize soil to a depth of 6" below bottom of designated paving areas, including a distance of 18-inches outside perimeter of paving.
B. The percentages of lime indicated in this specification section are for bidding purposes only. Prior to beginning any soil stabilization, the contractor shall verify with the Geotech the amount and type of soil stabilization material to be used.

3.03 PERFORMANCE - PAVING SUBGRADE

A. General: It is the primary requirement to secure a completed 8" deep subgrade of treated material containing a uniform lime mixture, free of loose areas, of uniform density and moisture content, well bound for its full depth and with a smooth surface suitable for placing subsequent paving and slabs to achieve a soils Plasticity Index of not greater than 15. Construction methods and equipment shall comply to NCTCOG Items 4.6.

B. Scarification: Excavate and scarify the material to be treated down to the secondary grade (proposed bottom of lime treatment). Wet or unstable material below the secondary grade shall be corrected by scarifying, adding lime and compacting to uniform stability. Then spread the excavated and scarified material to the desired cross section. Full depth of treatment shall be 6" and full width shall be the entire area to be paved between points and lines located one foot beyond pavement edges.

C. Placing Lime: Add lime to the scarified material in an amount equal to 7.0% by dry weight measurement, of 6" depth of compacted subgrade. Apply lime mixed with water to form a slurry. Spread lime only on that area where mixing operations can be completed during the same working day.

D. Mixing: Mix the soil and lime thoroughly with suitable road mixers or other approved equipment until a homogeneous, friable mixture is obtained free from clods and lumps. Aerate or sprinkle the mixture as necessary to secure the optimum moisture content. Necessary optimum moisture content shall be the range of moisture between optimum and 4 percent greater than optimum.

E. Curing: Allow the mixture to cure for a period of from 48 to 72 hours. During the curing period keep the material moist.

F. Final Mixing: After the required curing time, mix the material uniformly with a rotary mixer to reduce the size of the particles so that 100% will pass a 1-3/4' sieve and 60% will pass a No. 4 sieve. Lime-soil mixture pH shall be 12.4 or greater. If not possible to attain 12.4, maximum pH attainable shall be validated by laboratory test for soil being treated.

G. Compacting: Sprinkle the mixture as required and compact by rolling and tamping to a minimum of 95% standard density, ASTM D 698, at -2% to 4% optimum moisture content. Correct irregularities and weak spots by scarifying, adding or removing material, and re-shaping and re-compacting. Maintain the surface of the subgrade smooth, free from undulations and ruts, and to the established lines and grades.

H. Surface Moisture: Keep the surface of the compacted subgrade moist by sprinkling until such time as the paving is placed.

3.04 FIELD QUALITY CONTROL

A. Compaction Tests: Field density of the completed stabilized subgrade under paving shall be performed by an Independent Testing Laboratory.

1. The Laboratory shall make one density test for each 5000 sq. ft. of subgrade to insure that the specified density is obtained.

END OF SECTION 313200

SECTION 313213 - LIME STABILIZED SUBGRADE

PART 1 - GENERAL

1.01 WORK INCLUDED

Furnish labor, materials, equipment and incidental necessary to treat subgrade by pulverization, add lime, mix, and compact the mixed material to the density required, in conformity with the lines, grades, and typical section as indicated

1.02 QUALITY ASSURANCE; AMOUNT OF LIME

The percent of lime to be used shall be as indicated on the plans for the depth of subgrade treatment specified. Tests performed shall be in accordance with Texas Highway Dept. test method No 121-E but in no case less than five (5%) percent by weight applied.

1.03 SUSTAINABLE SUBMITTALS

Regional material data. Provide for each product unless other noted:

A. Product information or statement from manufacturer indicating location of manufacturing and distance from the project site.
B. Product information or statement from manufacturer indicating location of product's raw material extraction or harvesting and distance from the project site.
C. Include statement indicating cost for each regional material and fraction by weight that is considered regional.

1 04 STANDARDS

The applicable provisions of the following standards shall apply as if written here in their entirety

ASTM C-25 "Test Methods for Chemical Analysis of Limestone, Quicklime and Hydrated Lime"
ASTM C-l10 "Methods for Physical Testing of Quicklime, Hydrated Lime, and Limestone"
Texas Highway Department Test Method No 121-E

1.05 DELIVERY AND STORAGE [Not Used]

1.06 JOB CONDITIONS [Not Used]

1.07 OPTIONS [Not Used]

1.08 GUARANTEES [Not Used]

PART 2 - PRODUCTS

2.01 MATERIALS; HYDRATED LIME

A. Provide product that meets the definition as of a “regional material,” as defined in Section 013520.
B. TYPE A, HYDRATED LIME
Hydrated Lime shall consist of a dry powder obtained by treating, quicklime with enough water to satisfy its chemical affinity for water under the conditions of its hydration. This material is to consist essentially of calcium hydroxide or a mixture of calcium hydroxide and a small allowable percentage of calcium oxide, magnesium oxide and magnesium hydroxide (1, 2, and 3 are determined by procedures given in ASTM C-25)

1. Calcium and magnesium oxides — Min. 90%
2. Carbon dioxide:
   - If sampled at place of manufacture — Max. 5%
   - If sampled at any other place — Max. 7%
3. Non-hydrated lime content, per cent by weight:
   - CaO — Max. 5%

The percent by weight of residue retained shall conform to the following requirements, as determined by procedures given in ASTM C-110:

Residue retained on a No. 6 (3360-micron) sieve: None
Residue retained on a No. 10 (2000-micron) sieve: Max 1.0%
Residue retained on a No. 30 (590-micron) sieve: Max 2.5%

Specifications for Type A applies specifically to the normal hydrate of lime made from "high-calcium" type limestone. Hydrated lime for stabilization purposes shall be applied, as provided in the governing specifications, as a dry powder or mixed with water to form a slurry.

C. TYPE B, COMMERCIAL LIME SLURRY

Type B, Commercial Lime Slurry, shall be a pumpable suspension of solids in water. The water or liquid portion of the slurry shall not contain dissolved material in sufficient quantity and/or nature injurious or objectionable for the purpose intended. The solids portion of the mixture, when considered on the basis of "solids content", shall consist principally of hydrated lime of a quality and fineness sufficient to meet the following requirements as to chemical composition and residue.

1. Chemical Composition: The "solids content" of the lime slurry shall consist of a minimum of ninety (90) per cent by weight of calcium and magnesium oxides.
2. Residue: The per cent by weight of residue retained in the "solids content" of lime slurry shall conform to the following requirements:
   Residue retained on No. 6 (3360-micron) sieve: Max. 0.0%
   Residue retained on No. 10 (2000-micron) sieve: Max. 1.0%
   Residue retained on No. 30 (590-micron) sieve: Max. 2.5%

Type B, Commercial Lime Slurry, shall conform to one (1) of the following two (2) grades:
Grade 1: The "Dry Solids Content" shall be at least thirty-one (31) percent by weight of the slurry
Grade 2: The "Dry Solids Content" shall be at least thirty-five (35) per cent by weight of the slurry.
When Type B, Commercial Lime Slurry, is specified, the Contractor shall select, prior to construction, the grade to be used and shall notify the Engineer in writing before changing from one grade to another.

2.02 MIXES; LIME SLURRY

The approximate mix for lime slurry is one (1) ton of lime to 533 gallons of water which gives a 31 percent lime solution, and (1) ton of lime to 445 gallons of water which gives a 35 percent solution.

2.03 FABRICATIONS (Not Used)

2.04 MANUFACTURED PRODUCTS (Not Used)

2.05 EQUIPMENT

A. Machinery, tools, and equipment necessary for proper prosecution of the work shall be on the project prior to the beginning of construction operations.
B. Maintain the machinery, tools, and equipment used in a satisfactory and workmanlike manner.

PART 3 - EXECUTION

3.01 PREPARATION

A. It is a primary requirement of this specification to secure a completed course of treated material containing a uniform lime mixture, free from loose or segregated areas, of uniform density and moisture content, well bound for its full depth, and with a smooth surface suitable for placing subsequent courses. Regulate the sequence of work, use the proper amount of lime, maintain the work, and rework the courses as necessary to meet the above requirements.
B. Prior to beginning any lime treatment, construct and shape the road bed to conform to the typical sections, lines, and grades as indicated on the plans or as established by the Engineer.

3.02 TREATMENT OF SUBGRADE

A. TREATMENT

Excavate material to be treated to the secondary grade (proposed bottom of lime treatment) and remove or windrow to expose the secondary grade. Correct any wet or unstable materials below the secondary grade by scarifying, adding lime, and compacting until it is of uniform stability. Spread the excavated material to the desired cross-section. If the Contractor elects to use a cutting or pulverizing machine that will remove the subgrade material accurately to the secondary

grade, and pulverize the material at the same time, he will not be required to expose the secondary grade or windrow the material. However, the Contractor shall be required to roll the subgrade before using the pulverizing machine and correct any soft areas that this rolling may reveal. This method will be permitted only where a machine is provided which will insure that the material is cut uniformly to the proper depth and which has cutters that will place the secondary grade to a smooth surface over the entire width of the cut. The machine shall be of such design that a visible indication is given at all times that the machine is cutting to the proper depth.

B. APPLICATION

1. Spread lime slurry only on that area on which the mixing operation can be completed the same working day.
2. Accomplish the application and mixing of lime with the materials by the method hereinafter described as “Slurry Placing”, unless otherwise approved by the Engineer.

C. SLURRY PLACING

1. METHOD
   a) Mix lime with water in trucks for approved distributors and apply as a thin water suspension or slurry. Apply Type B, Commercial Lime Slurry, with a lime percentage not less than that applicable for the grade used. The distribution of lime at the rate shown on the plans shall be attained by successive passes over a measured surface of roadway until the proper moisture and lime content have been secured. The distributor truck shall be equipped with an agitator, which keeps the lime and water in a uniform mixture.
   b) It is anticipated that the rate of application of lime shall not be less than four and one-half (4.5) pounds of lime per square yard per inch of depth of compacted subgrade. This is approximately a six (6%) percent mixture of lime by dry weight of the subgrade material, which may vary according to the laboratory tests, but in no case shall be less than five (5%) percent by weight be applied.
2. MIXING
   a) Thoroughly mix material and lime by approved road mixers or other approved equipment, and continue mixing until a homogeneous, friable mixture of material and lime is obtained, free from clods or lumps. Materials containing plastic clay or other materials which will not readily mix with lime shall be mixed as thoroughly as possible at the time of the lime application, brought to the proper moisture content, and left to cure one (1) to four (4) days as directed by the Owner’s Geotechnical Engineer. Keep the material moist during the curing period.
   b) After the required curing time, uniformly mix the material by approved methods. If the soil binder-lime mixture contains clods, reduce the clods in size by raking, blading, discing, harrowing, scarifying, or the use of other approved pulverization methods so that when all non-slaking aggregates obtained on the No.4 sieve are removed, the remainder of the material meets the following requirements when tested dry by laboratory sieves:
      Minimum passing 1" sieve: 100%
      Minimum passing No. 4 sieve: 60%
   c) During the interval of time between application and mixing, hydrated lime that has been exposed to the open air for a period of six (6) hours or more, or to excessive loss due to washing or blowing, will not be accepted for payment.
3. COMPACTION

   The lime stabilized clay should be placed in maximum nine inch loose lifts and compacted at a moisture content not less than optimum, nor more than four percent above the optimum as defined by ASTM D698 (Standard Proctor). Begin compaction of the mixture immediately after final mixing and in no case later than three (3) calendar days after final mixing. Aerate or sprinkle the material as necessary to provide optimum moisture. Begin compaction at the bottom and continue until the entire depth of the mixture is uniformly compacted as indicated or specified by the Engineer. The compacted mixture shall have a uniform density of not less than ninety- eight (98) percent of Standard Proctor Density. After each lift is completed, such tests as are necessary shall be made by the laboratory as required by the Engineer. If any portion fails to meet the density or depth specified, rework the portion as necessary to obtain the specified density and depth of lime treatment required.

D. FINISHING, CURING AND PREPARATION FOR SURFACING

After the mixture has been compacted, shape the surface to the required line, grades, and cross-sections, and then thoroughly roll as directed with a pneumatic or other suitable roller sufficiently

light to prevent hair-cracking. The completed section shall then be moist-cured for a minimum of two (2) to seven (7) days before further courses are added or any traffic permitted, as directed by the Engineer. In cases where subgrade treatment or subbase sets up sufficiently to prevent objectionable damage from traffic, such layers may be opened to light traffic two (2) days after compaction. I the completed section has not been covered by other courses of material or pavement in seven (7) days, seal the completed section by an application of AC-20 asphalt at the rate of one-tenth (0.10) gallon per square yard.

3.03 MAINTENANCE

Maintain the completed soil-lime base within the limits of the contract, in good condition, satisfactory to the Engineer as to grade, crown, and cross-section until such time as the surface course is constructed. Immediately repair irregularities or other defects that may occur at the Contractor's own expense. Repairs are to be made in a manner to insure restoration of a uniform surface and durability of the portion repaired.

3.04 FIELD QUALITY CONTROL (Not Used)

3.05 CLEAN AND ADJUST (Not Used)

3.06 SCHEDULES (Not Used)

END OF SECTION 313213

SECTION 31 41 33 - TRENCH SHIELDING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. This specification consists of the basic requirements which the Contractor must comply with in order to provide for the safety and health of workers in a trench. This specification is for the purpose of providing minimum performance specifications, and the Contractor shall develop, design, and implement the trench safety system. The Contractor shall bear the sole responsibility for the adequacy of the trench safety system and providing "a safe place to work" for the workman.

B. Should the trench safety protection system require wider trenches than specified elsewhere, the Contractor shall be responsible for the costs associated with determining adequacy of pipe bedding and class, as well as, purchase and installation of alternate materials.

1.02 STANDARDS

A. The following standard shall be the minimum governing requirement of this specification and is hereby made a part of this specification as if written in its entirety.
Occupational Safety and Health Standards - Excavations (29CFR Part 1926), U.S. Department of Labor, latest edition.

B. Comply with the applicable Federal, State, and local rules, regulations, and ordinances.

END OF SECTION 314133

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

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 temporary excavation support and protection systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.

1.4 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
   1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
   2. The geotechnical report is included elsewhere in Project Manual.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
   1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
   2. Prevent surface water from entering excavations by grading, dikes, or other means.
   3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
   4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.2 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.
B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of size and strength required for application.
E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
G. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
H. Tiebacks: Steel bars, ASTM A 722/A 722M.

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 that could develop during excavation support and protection system operations.
   1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.2 SOLDIER PILES AND LAGGING

A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than 2 inchesfrom a horizontal line and not more than 1:120 out of vertical alignment.

B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.

C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

3.3 SHEET PILING

A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.

B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to 60 inches. Accurately align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.

C. Cut tops of sheet piling to uniform elevation at top of excavation.

3.4 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
   1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.5 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks regularly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.6 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
   1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
   2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
   3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION

SECTION 316329 - DRILLED CONCRETE PIERS AND SHAFTS

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. Dry-installed drilled piers.

1.3 UNIT PRICES

A. Drilled Piers: Actual net volume of drilled piers in place and approved. Actual length, shaft diameter, may vary, to coincide with elevations where satisfactory bearing strata are encountered. These dimensions may also vary with actual bearing value of bearing strata determined by an independent testing and inspecting agency. Adjustments are made on net variation of total quantities, based on design dimensions for shafts.

1. Base bids on indicated number of drilled piers and, for each pier, the design length from top elevation to bottom of shaft, and the diameter of shaft.
2. Unit prices include labor, materials, tools, equipment, and incidentals required for excavation, trimming, shoring, steel casings, dewatering, reinforcement, concrete fill, testing and inspecting, and other items for complete drilled-pier installation.

B. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed outside dimensions of drilled piers cast against rock. Unit prices for rock excavation include replacement with approved materials.

C. Trial Drilled Pier: Same unit price as indicated for drilled pier, including backfilling.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to drilled piers including, but not limited to, the following:

a. Review geotechnical report.
b. Discuss existing utilities and subsurface conditions.
c. Review coordination with temporary controls and protections.
d. Review measurement and payment of unit prices.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternative 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.

C. Shop Drawings: For concrete reinforcement, detailing fabricating, bending, supporting, and placing.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer land surveyor professional engineer and testing agency.

B. Welding certificates.

C. Material Certificates: From manufacturer, for the following:

1. Cementitious materials.
2. Admixtures.
3. Steel reinforcement and accessories.

D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Record drawings.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in drilled-pier work.

B. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

1.9 FIELD CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating drilled piers. If utilities are to remain in place, provide protection from damage during drilled-pier operations.

1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Architect's and Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for drilled piers.
2. The geotechnical report is included elsewhere in the Project Manual.

D. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for drilled piers. Before excavating, lay out each drilled pier to lines and levels required. Record actual measurements of each drilled pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each drilled pier and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Drilled-Pier Standard: Comply with ACI 336.1 except as modified in this Section.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain. Cut bars true to length with ends square and free of burrs.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150/C 150M, Type I/II . Supplement with the following:

a. Fly Ash: ASTM C 618, Class C or Class F.

B. Normal-Weight Aggregate: ASTM C 33/C 33M, graded, 3/4-inch- nominal maximum coarse-aggregate size. Provide aggregate from a single source.

1. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 STEEL CASINGS

A. Steel Pipe Casings: ASTM A 283/A 283M, Grade C, or ASTM A 36/A 36M, carbon-steel plate, with joints full-penetration welded according to AWS D1.1/D1.1M.

B. Steel casings shall be included in the project base bid.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 limits as if concrete were exposed to deicing chemicals.

C. Proportion normal-weight concrete mixture as follows:

1. Compressive Strength (28 Days): 3000 psi.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Minimum Slump: Capable of maintaining the following slump until completion of placement:
   a. 8 inches.

4. Air Content: Do not air entrain concrete.

2.6 REINFORCEMENT FABRICATION

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

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled-pier operations.

3.2 EXCAVATION

A. Unclassified Excavation: Excavate to bearing elevations regardless of character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions.

1. Obstructions: Unclassified excavation may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. No changes in the Contract Sum or the Contract Time are authorized for removal of obstructions.
2. Obstructions: Unclassified excavated materials may include removal of unanticipated boulders, concrete, masonry, or other subsurface obstructions. Payment for removing obstructions that cannot be removed by conventional augers fitted with soil or rock teeth, drilling buckets, or underreaming tools attached to drilling equipment of size, power, torque, and downthrust necessary for the Work is according to Contract provisions for changes in the Work.

B. Classified Excavation: Excavation is classified as standard excavation, special excavation, and obstruction removal and includes excavation to bearing elevations as follows:

1. Standard excavation includes excavation accomplished with conventional augers fitted with soil or rock teeth, attached to drilling equipment of size, power, torque, and downthrust necessary for the Work.

C. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.

D. Excavate shafts for drilled piers to indicated elevations. Remove loose material from bottom of excavation.

1. Excavate bottom of drilled piers to level plane within 1:12 tolerance.
2. Remove water from excavated shafts before concreting.
3. Excavate rock sockets of dimensions indicated.

E. Notify and allow testing and inspecting agency to test and inspect bottom of excavation. If unsuitable bearing stratum is encountered, make adjustments to drilled piers as determined by Architect.

1. Do not excavate shafts deeper than elevations indicated unless approved by Architect.
2. Payment for additional authorized excavation is according to Contract provisions for changes in the Work.

F. Excavate shafts for closely spaced drilled piers and for drilled piers occurring in fragile or sand strata only after adjacent drilled piers are filled with concrete and allowed to set.

G. Temporary Casings: Install watertight steel casings of sufficient length and thickness to prevent water seepage into shaft; to withstand compressive, displacement, and withdrawal stresses; and to maintain stability of shaft walls.

1. Remove temporary casings, maintained in plumb position, during concrete placement and before initial set of concrete.

H. Tolerances: Construct drilled piers to remain within ACI 336.1 tolerances.

1. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

3.3 TEMPORARY STEEL CASING INSTALLATION

A. Install temporary steel casings of minimum wall thickness required and of diameter not less than diameter of the specified drilled pier.

1. Install casings as excavation proceeds, to maintain sidewall stability.
2. Fabricate bottom edge of lowest casing section with cutting shoe capable of penetrating rock and achieving water seal.
3. Connect casing sections by continuous penetration welds to form watertight, continuous casing.
4. Remove the temporary steel casing gradually while placing concrete in the pier. Contractor shall maintain sufficient head of concrete pressure to ensure water and soil material do not move into the pier excavation as noted below.

3.4 STEEL REINFORCEMENT INSTALLATION

A. Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.

C. Fabricate and install reinforcing cages symmetrically about axis of shafts in a single unit.

D. Accurately position, support, and secure reinforcement against displacement during concreting. Maintain minimum cover over reinforcement.

E. Use templates to set anchor bolts, leveling plates, and other accessories furnished in work of other Sections. Provide blocking and holding devices to maintain required position during final concrete placement.

F. Protect exposed ends of extended reinforcement, dowels, or anchor bolts from mechanical damage and exposure to weather.

3.5 CONCRETE PLACEMENT

A. Place concrete in continuous operation and without segregation immediately after inspection and approval of shaft by a qualified Special Inspector and testing agency.

B. Dry Method: Place concrete to fall vertically down the center of drilled pier without striking sides of shaft or steel reinforcement.

1. Where concrete cannot be directed down shaft without striking reinforcement, place concrete with chutes, tremies, or pumps.
2. Vibrate top 60 inches of concrete.

C. Coordinate withdrawal of temporary casings with concrete placement to maintain at least a 60-inch head of concrete above bottom of casing.

1. Vibrate top 60 inches of concrete after withdrawal of temporary casing.

D. Screed concrete at cutoff elevation level and apply scoured, rough finish. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation.

E. Protect concrete work, according to ACI 301, from frost, freezing, or low temperatures that could cause physical damage or reduced strength.

1. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
2. Do not use calcium chloride, salt, or other mineral-containing antifreeze agents or chemical accelerators.

F. If hot-weather conditions exist that would seriously impair quality and strength of concrete, place concrete according to ACI 301 to maintain delivered temperature of concrete at no more than 90 deg F.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Drilled piers.
2. Excavation.
3. Concrete.
4. Steel reinforcement welding.

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

C. Drilled-Pier Tests and Inspections: For each drilled pier, before concrete placement.

1. Soil Testing: Bottom elevations, bearing capacities, and lengths of drilled piers indicated have been estimated from available soil data. Actual elevations and drilled-pier lengths and bearing capacities are determined by testing and inspecting agency. Final evaluations and approval of data are determined by Architect.

D. Concrete Tests and Inspections: ASTM C 172/C 172M except modified for slump to comply with ASTM C 94/C 94M.

1. Slump: ASTM C 143/C 143M; one test at point of placement for each compressive-strength test but no fewer than one test for each concrete load.
2. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and 80 deg F and above, and one test for each set of compressive-strength specimens.
3. Compression Test Specimens: ASTM C 31/C 31M; one set of four standard cylinders for each compressive-strength test unless otherwise indicated. Mold and store cylinders for laboratory-cured test specimens unless field-cured test specimens are required.
4. Compressive-Strength Tests: ASTM C 39/C 39M; one set for each drilled pier but not more than one set for each truck load. Test one specimen at seven days, test two specimens at 28 days(for 6”x12” cylinders) and 3 at 28 days (for 4”x8” cylinders), and retain one specimen in reserve for later testing if required.
5. If frequency of testing provides fewer than five strength tests for a given class of concrete, conduct tests from at least five randomly selected batches or from each batch if fewer than five are used.
6. If 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.
7. Strength of each concrete mixture is 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.
8. Report test results in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. List 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 in reports of compressive-strength tests.
9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency to make additional tests of concrete if test results indicate that slump, compressive strengths, or other requirements have not been met, as directed by Architect.

a. Continuous coring of drilled piers may be required, at Contractor's expense, if temporary casings have not been withdrawn within specified time limits or if observations of placement operations indicate deficient concrete quality, presence of voids, segregation, or other possible defects.

11. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

E. An excavation, concrete, or a drilled pier will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports for each drilled pier as follows:

1. Actual top and bottom elevations.
2. Actual drilled-pier diameter at top, bottom, and bell.
3. Top of rock elevation.
4. Description of soil materials.
5. Description, location, and dimensions of obstructions.
6. Final top centerline location and deviations from requirements.
7. Variation of shaft from plumb.
8. Shaft excavating method.
9. Design and tested bearing capacity of bottom.
10. Depth of rock socket.
11. Levelness of bottom and adequacy of cleanout.
12. Ground-water conditions and water-infiltration rate, depth, and pumping.
13. Description, purpose, length, wall thickness, diameter, tip, and top and bottom elevations of temporary or permanent casings. Include anchorage and sealing methods used and condition and weather tightness of splices if any.
14. Description of soil or water movement, sidewall stability, loss of ground, and means of control.
15. Date and time of starting and completing excavation.
16. Inspection report.
17. Condition of reinforcing steel and splices.
18. Position of reinforcing steel.
19. Concrete placing method, including elevation of consolidation and delays.
20. Elevation of concrete during removal of casings.
21. Locations of construction joints.
22. Concrete volume.
23. Concrete testing results.

3.7 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 316329

SECTION 321313 - CONCRETE PAVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.02 SUMMARY

A. Section Includes: New concrete walks, curbs and gutters, paving, approaches, and other concrete flatwork outside the building.
B. Related Sections:
   1. Section 310000 - Earthwork
   2. Section 033000 - Cast-in-Place Concrete
   3. Section 321373 - Sealants and Caulkings

1.03 REFERENCES

A. American Concrete Institute (ACI):
   1. ACI 301 - Specifications for Structural Concrete for Buildings.
   2. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete.
   3. ACI 305 - Recommended Practices for Hot Weather Concreting.
   4. ACI 306 - Recommended Practices for Cold Weather Concreting.
B. American National Standards Institute/American Society for Testing and Materials (ANSI/ASTM):
   1. ANSI/ASTM D1752-84 - Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
C. NCTOG - Standard Specifications for Public Works Construction.

1.04 QUALITY ASSURANCE

A. Codes and Standards: Comply with the applicable provisions of the following codes, specifications, and standards:
   ACI 301 "Specifications for Structural Concrete for Buildings."
   ACI 304 "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete."
   ACI 311 "Recommended Practice for Concrete Inspection."
   ACI 318 "Building Code Requirements for Reinforced Concrete."
   ACI 347 "Recommended Practice for Concrete Formwork."
   Concrete Reinforcing Steel Institute, "Manual for Standard Practice."
B. Workmanship: Contractor is responsible for correction of concrete work which does not conform to the specified requirements, including strength, tolerance, and finishes. Correct deficient unsatisfactory concrete as directed by the Engineer. All pavement replacement shall be a minimum of ½ panel.
C. Perform work in accordance with ACI 301.
D. Obtain materials from same source throughout.
E. City Standards: Street sidewalks, curbs and gutters, and approaches shall be constructed to meet or exceed the requirements of the city standard specifications (or NCTCOG) where the city standards are applicable.

1.05 SUBMITTALS

A. Submit product data under provisions of SECTION 013323 – Shop Drawings, Product Data, and Samples. And SECTION 012300 – Alternates.
B. Include data on joint filler, admixtures and curing compounds.
C. Submit manufacturer's instructions under provisions of SECTION 013323 – Shop Drawings, Product Data, and Samples and SECTION 012300 - Alternates
D. Provide field samples of surface textures specified for Engineer approval prior to beginning work.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not place pavement when base surface or ambient temperature is less than 40°F, or if base surface is wet or frozen.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Formwork shall meet the requirements specified in SECTION 031100 - CONCRETE FORMING.
B. Reinforcement shall meet the requirements specified in SECTION 032000 - CONCRETE REINFORCING. ASTM A 615, Grade 60.
C. Concrete shall meet the requirements specified in SECTION 033000 - CAST-IN-PLACE CONCRETE. Portland Cement: ASTM C 150 Type I Domestic manufacturer. Use only one brand of cement throughout the project. Minimum compressive strength shall be 3,500 psi at 28 days. Provide entrained air of 5% (±1%) ASTM C260 with a maximum water cement ratio of 0.50.
D. Expansion Joints:
    1. Redwood expansion for joints to be caulked with sealant and joints in architectural concrete flatwork.
E. Normal Weight Aggregates: ASTM C 33
    1. Fine Aggregate: Clean, sharp, natural sand free from loam, clay, lumps, or other deleterious substances.
    2. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay, mud, loam or foreign matter, as follows:
        a. Crushed stone, processed from natural rock or stone.
        b. Washed gravel, either natural or crushed. Use of pit or bankrun gravel is not permitted.
        c. Maximum Aggregate Size: 1½".
F. Water: Clean, fresh, free from oil, acid, organic matter or other deleterious substances.
G. Air-Entraining Admixture: ASTM C 260.
H. Fly ash and calcium chloride or admixture containing more than 0.1% chloride ions are not permitted.
I. Supports for reinforcement: Provide supports for reinforcement-plastic chairs and fastening reinforcing in place. Wood, brick and other devices will not be acceptable.

2.02 RELATED MATERIAL

A. Membrane-Forming Curing Compound: ASTM C309, Type I.
B. Bonding Compound: Polyvinyl acetate or acrylic base, rewettable type.
Product/manufacturer; one of the following:
Weldcrete; Larsen Products
EucoWeld; Euclid Chemical Co.
Sonocrete; Sonneborn-Contech
Acrylic Bondcrete; The Burke Co.

2.03 PROPORTIONING AND DESIGN OF MIXES

A. Prepare design mix for concrete, to produce a minimum 28 day compressive strength of 3,500 psi, as indicated on Contract Documents. Use an independent testing facility acceptable to the Architect for preparing and reporting proposed mix designs.
B. Proportion mixes by laboratory trial batch, using materials to be employed on the project for each class of concrete required, complying with ACI 211.1.
C. Submit written reports to the Architect of each proposed mix for each class concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by the Architect/Engineer.
D. Admixtures:
    1. Use air-entraining admixture in exterior exposed concrete. Add air-entraining admixture at the manufacturer's prescribed rate to result in concrete at the point of placement having air content of 5% (±1%) with a maximum water cement ratio of 0.50.
E. Slump Limits: Proportion and design mixes to result in concrete slump at the point of placement of not less than 3" and not more than 5".

2.04 CONCRETE MIXING

A. Ready-Mix Concrete: Comply with the requirements of ASTM C94, and as herein specified. No additional water to be added to the batch for material with insufficient slump with approval of Architect/Engineer.
   1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. When the air temperature is between 85° F and 90° F, reduce the mixing and delivery time from 1-2 hours to 75 minutes, and when the air temperature is above 90° F, reduce the mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify compacted subgrade is ready to support paving and imposed loads, free of frost, smooth and properly compacted.
B. Verify gradients and elevations of base are correct, and proper drainage has been provided so that water does not stand in the area to receive paving.
C. Beginning of installation means acceptance of existing conditions.

3.02 PREPARATION

A. Verify subgrade meets specified moisture, density and composition specified no longer than two days before concrete placement.
B. Moisten base to minimize absorption of water from fresh concrete.
C. Notify Architect, Owner, and testing laboratory, minimum 24 hours prior to commencement of concreting operations.
D. Grade Control: Establish and maintain the lines and grades for concrete site work items by means of lines and grade stakes. Complete any fine grading required to prepare the subgrade. Maintain the finished subgrade cushions in a satisfactory condition.
E. Ensure all irrigation and electrical sleeves are installed prior to concrete placement.

3.03 INSERTS AND ACCESSORIES

A. Make provisions for installation of inserts, accessories, anchors, and sleeves.

3.04 INSTALLATION

A. Forming: Set forms to lines and grades, and brace and secure to withstand wet concrete without deflection or leakage. Stake forms securely in position with joints keyed to prevent relative displacement. Clean and oil forms each time they are used. Refer to SECTION 031100 - CONCRETE FORMING for additional installation requirements. Place concrete in thicknesses scheduled below:
   1. Walks: As shown on paving plan; as detailed.
   2. Curbs and Gutters: As detailed.
   3. Drive Approaches and Drive Pavement as detailed.
   4. Miscellaneous: Catch basins and other miscellaneous items of concrete shall be constructed to detail.
B. Reinforcing: Install reinforcing to meet the requirements of SECTION 032000 - CONCRETE REINFORCING. Where reinforcement is not specifically detailed, reinforce paving and walks with #4 rebar at 12" o.c. each way.
   1. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports.
   2. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
   3. Accurately position, support, and secure reinforcement against displacement by formwork, construction, or concrete-placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers.

4. Place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

C. Concrete: Place concrete to meet the requirements of SECTION 033000 - CAST-IN-PLACE CONCRETE.
1. Place concrete in accordance with ACI 301 and 304. Deposit concrete so that specified slab thickness will be obtained after vibrating and finishing operations. Minimize handling to prevent honeycombs. Exercise care to prevent disturbance of forms and reinforcing and damage to vapor retarder. Place concrete to lines and levels shown, properly sloped to drain into adjacent yard areas or drainage structures.
2. Hot Weather Placement: ACI 305.
3. Cold Weather Placement: ACI 306.
4. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed during concrete placement.
5. Place concrete continuously between predetermined construction joints. Do not break or interrupt successive pours such that cold joints occur.

D. Expansion Joints: Locate expansion joints around fixed objects within or abutting concrete, and at intervals of not more than 30 ft. o.c. along walks and curbs and max of 90 ft. o.c. along all other paving.
1. Install preformed filler with the top edge approximately 1/4" below the finished concrete surface to leave a neat, straight joint.
2. Joint edges shall be rounded with an edging tool.
3. There shall be no connection by reinforcement or keyway across expansion joints. Joints shall be held in alignment with sleeved, smooth dowels.
4. Install expansion joints at all point of curvatures, point of tangency, structuring and point of inflections.

E. Scoring: Provide all tooled joints on all sidewalks and flatwork.
1. Saw cut, approaches, and paving using an abrasive or diamond blade. Cut joint width shall be 1/8" and depth shall be 1/4" deep at walks and 1/4 slab thickness at approaches and paving. Cutting of joints must be done as soon as concrete surface is firm enough not to be torn or damaged by the blade (within 4 to 12 hours), and before random shrinkage cracks can form in the concrete slab.
   a. Tool joint walks at max 5 foot intervals each way.
   b. Score curbs and gutters at approximately 5 foot intervals.
   c. Score approaches and paving at max 12 foot intervals each way or as shown.

F. Standard Finishing: Strike slabs off true by double screeding to the required level at or below the elevations and grades shown on the drawings. Set edge forms and screed strips accurately to produce the designated elevations and contours.
1. Standard Walks: Float with wood floats to true planes with no coarse aggregate visible. Hand trowel to produce smooth surfaces. Brush surfaces with a soft fiber brush to produce a uniformly striated finish. Edge concrete surfaces with a rounded edging tool.
2. Curbs and gutters: Finish the curb and flow lines of gutters with a steel “S” shaped trowel to the contour of the curb and gutter and then cross brush surfaces with a soft fiber brush to produce a fine brush finish.
3. Approaches: Screed and float to a monolithic medium float finish and belt with a canvas belt to produce a herringbone texture finish.
4. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps. Immediately after trowel finishing, slightly roughen surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

G. Curing:
1. Cure concrete 7 days as specified in SECTION 033000 - CAST-IN-PLACE CONCRETE. Coat exposed surfaces with curing compound and protect surfaces from pedestrian and vehicular traffic during the curing period. Damaged areas shall be re-sprayed.
2. Concrete surfaces designated to receive chemical stain must be free of curing compound. Accordingly, finished concrete shall be “water-cured” or shall be completely sandblasted if cured with a curing compound membrane.
3. Concrete surfaces shall be cured by application of curing compound. Provide membrane curing by applying membrane-forming curing compound to damp concrete surfaces as soon as water film has disappeared. Apply uniformly in 2-coat continuous operation by power-spray equipment in accordance with manufacturer’s directions. Apply second coat

at right angle to first coat.

H. Removing Forms: Forms shall remain in place for a least 12 hours after concrete has been placed and finished. Remove forms without damaging the concrete. Bars and heavy tools shall not be used to pry against the concrete in removing the forms.

3.05 FIELD QUALITY CONTROL

A. Grade and Smoothness Tests:
   1. Plan Grade: Finished surface of the flatwork shall not vary more than 0.02 ft. above or below the plan grade or elevation. Finished surfaces of abutting pavement and walks shall coincide at their juncture. Where a new pavement or walk abuts an existing surface, transition pavement or walk strip shall be installed.
   2. Surface Smoothness: Finished surface of the flatwork shall have no abrupt changes or more than 1/8" and shall not deviate from the testing edge of a 12 ft. straight edge more than 1/4" plus or minus tolerance. Flow line of gutters shall not deviate from the testing edge of a 10 ft. straight edge more than 1/8" plus or minus tolerance.
   3. Concrete shall be sampled and tested for quality control during the placement of concrete, as follows:
      a. Slump: ASTM C 143: One test for each concrete load at point of discharge; and one for each set of compressive strength test specimens.
      b. Compression Test Specimens: ASTM C 31; one set of 4 standard cylinders for each compressive strength test. Mold and store cylinders for laboratory cured test specimens.
      c. Compressive Strength Tests: ASTM C 39; one set for each 100 cu. Yds. or fraction thereof, of each concrete class placed in any day or for each 5,000 sq. Ft. of surface area placed; 1 specimen tested at 7 days, 2 specimens tested at 28 days and the remaining specimen held for future testing, if required. Report test results in writing to the Architect and the Contractor on the same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of contractor, name of concrete type and class, location of concrete batch in the structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day test and 28-day tests.

B. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained. Test to determine adequacy of concrete will be by cored cylinders complying with ASTM C 42. Contractor shall pay for such test conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

C. Concrete shall meet the compressive strength as shown on the plans and specifications regardless of ACI 318. ACI 318 shall have no bearing on pass/fail of all site concrete.

3.06 CLEANING

A. Remove debris, scraps, surplus materials, tools and equipment from the premises upon completion of the work. Clean concrete droppings from walks and curbs. Leave the graded areas free of debris and rubble.

3.07 PROTECTION

A. Immediately after placement, protect concrete under provisions of SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS from premature drying, excessive hot or cold temperatures, and mechanical injury.

3.08 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, but only when acceptable to the Architect/Engineer. Remove and replace damaged concrete as directed by Engineer.

B. Cut out honeycomb, rock pockets, voids over ½” diameter, and holes left by tie rods and bolts, down to solid concrete, but in no case to a depth of less than 1". Make edge of cuts perpendicular to the concrete surface. Before placing cement mortar, thoroughly clean, dampen with water and

brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Architect/Engineer.

END OF SECTION 321313

SECTION 32 13 73 - SEALANTS AND CAULKINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.02 SUMMARY

A. Section Includes: Sealing and caulking of joints.
B. Related Sections:
   1. Section 321313 - Concrete Paving
   2. Section 033000 - Cast-In-Place Concrete

1.03 REFERENCES

A. American National Standards Institute/American Society for Testing and Materials (ANSI/ASTM):
   1. ANSI/ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
   2. ANSI/ASTM D 1565 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam).
   3. ASTM C790 - Use of Latex Sealing Compounds.
   4. ASTM C804 - Use of Solvent - Release Type Sealants.
   5. ASTM C834 - Latex Sealing compounds.
   6. ASTM C920 - Elastomeric Joint Sealants.
   7. ASTM C962 - Use of Elastomeric Joint Sealers.
B. Federal Specification (FS):
   1. FS TT-C-00598 - Caulking Compound, Oil and Resin Base Type.
   2. FS TT-S-001657 - Sealing Compound, Single Component, Butyl Rubber Based, solvent Release Type.
   3. FS TT-S-00227 - Sealing Compound: Elastomeric Type, Multi-Component.
   4. FS TT-S-00230 - Sealing Compound: Elastomeric Type, Single Component.
   5. FS TT-S-001543 - Sealing Compound, Silicone Rubber Base.
C. SWI (Sealing and Waterproofers Institute) - Sealant and Caulking Guide Specification.

1.04 SUBMITTALS

A. Submit under provisions of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples.
B. Submit product data indicating sealant chemical characteristics, performance criteria, limitations, color availability and application instructions.
C. Submit two samples 1/4 inch diameter x 4 inches in size illustrating color selections available.
D. Submit manufacturer's certificate under provisions of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years documented experience.
B. Applicator: Company specializing in applying the work of this Section with minimum 3 years documented experience and approved by sealant manufacturer.
C. Conform to Sealant and Waterproofers Institute requirements for materials and installation.

1.06 FIELD SAMPLES

A. Provide samples under provisions of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples.
B. Construct one field sample joint, 5 feet long, illustrating sealant type, color, and tooled surface.
C. Locate where directed.
D. Accepted sample may remain as part of the Work.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: No caulking shall be done at temperatures below 40°F.

1.08 WARRANTY

A. Furnish to the Owner a written warranty that the caulking shall remain watertight for a period of 2 years from the date of acceptance of the project. Joints which prove defective by leaking, cracking, melting or shrinking of the sealant shall be re-sealed without additional expense to the Owner.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Polyurethane (Type 2 Sealant):
   1. Two-part conforming to FS TT-S-00227E, Class A, Type I (self-leveling) and ASTM-920.
   2. Color: Custom color as selected by Architect.
   3. Acceptable products
      a. Urexpan NR-00, Pecora Corp.
      b. Sonolastic Paving Joint Sealant, Sonneborn-Contech.
      c. THC 900 (Self leveling) or 901 (low sag), Tremco.
      NO SUBSTITUTIONS

2.02 ACCESSORIES

A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
C. Joint Backing: Refer to Section 321313 Concrete Paving for expansion joint filler.
D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and joint openings are ready to receive work and field measurements are as shown on Drawings and recommended by the manufacturer.
B. Beginning of installation means installer accepts existing substrate.

3.02 PREPARATION

A. Joint surfaces shall be clean and dry. Remove loose mortar and other material completely with compressed air or by brushing.
   1. Joints to be caulked shall be at least 1/4" wide. At any point where the width of the joint is appreciably less, cut or grind out the joint to that width to assure an adequate volume of sealant along the length of the joint.
   2. Pack with backing material the voids and recesses around metal frames which are deeper than the depth required for caulking. Leave the proper depth for the sealant.
   3. Particular attention shall be paid to the preparation of horizontal joints in war surfaces to be filled with sealant. Adjust joint depth to comply with sealant manufacturer's recommendations by malleting down the joint filler or filling in with rod stock as may be required.
   4. Perform preparation in accordance with ASTM C804 for solvent release sealants, C790 for latex base sealants, and C962 for elastomeric sealants

3.03 APPLICATION

A. Priming: prime porous joint surfaces, particularly concrete. Test the primer to make sure it causes no staining of the material on which it is applied.
B. Depth of sealant: Seal joints to a depth of approximately 2" the joint width, but never less than 1/4" deep. Follow the sealant manufacturer's recommendations where possible.

C. Apply the sealant in accordance with the manufacturer's instructions.
   1. Force the sealant into joints with enough pressure to expel all air and provide a solid filling. Correct any flowing or sagging before final inspection is made.
   2. Where adjacent surfaces permit, use masking tape to obtain straight, even lines. Remove tape immediately after the joints have been sealed.
   3. Fill joints flush with adjacent surfaces except where a recessed joint is specifically detailed. Tool beads with a sled runner or similar tool to insure full contact with joint faces.
   4. For caulking horizontal joints in wear surfaces, use a gun with a narrow nozzle. Apple the flow type sealant with the nozzle riding along the bottoms so that the sealant is forced up to completely fill the slot without cavities. Provide and use a portable vacuum cleaner to remove loose dirt from the joints just ahead of the caulking gun.

D. Install sealant free of air pockets, foreign embedded matter, ridges, and sage.

E. Tool joins concave. Sealant shall achieve a firm skin before surface coating is applied.

3.04 CLEANING/REPAIRING

A. Clean adjacent surfaces of soiling due to caulking operations. This applicator shall be responsible for and shall bear the cost of replacing any material damaged or discolored due to caulking operations.

B. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.05 SEALANT SCHEDULE

A. Locations specified below for sealant required under this section are general and shall not be considered as affecting the required use of sealing compounds specified under other sections of the specifications.

3.06 SEALANT TYPE APPLICATION

A. Horizontal control and expansion joints in concrete paving and at junctures between this material and other adjacent materials.

END OF SECTION 321373

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 wheel stops.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 4-1/2 incheshigh 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. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
2. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inchdiameter, 10-inch minimum length.
3. Provide 15 bumpers as indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

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

3.2 INSTALLATION

A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Securely anchor wheel stops to pavement 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

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.01 SCOPE

Provide all labor, materials and equipment necessary to paint all parking stripes as indicated on the Drawings and as specified herein on concrete or asphalt paving.

1.02 PROTECTION

The Contractor shall protect his own work and adjacent surfaces from damage or splatters with suitable coverings. Take every precaution to avoid danger of fire. Remove oily rags, waste, and empty cans from site every night.

1.03 DELIVERY AND STORAGE

A. Deliver materials in original containers with seals unbroken and labels intact.
B. Store materials and equipment in an approved area. Store rags, paint, and solvents in closed metal containers located in designated area. Use adequate means and precautions to prevent fire, explosions and other damage caused by paint materials.

1.04 RELATED DOCUMENTS

A. Provisions established within the General and Supplementary General Conditions of the Contract, Division 1 - General Requirements, and the Drawings are collectively applicable to this Section.

1.05 SUMMARY

A. Section Includes: Pavement marking on concrete paving.

1.06 REFERENCES

A. Federal Specification (Fed. Spec.)
Fed Spec. TT-P-115E Paint, Traffic, Highway, White, and per City requirements, color for fire lanes.

1.07 PROJECT CONDITIONS

A. Environmental Requirements: Apply paint when ambient temperature is 50°F or above, and relative humidity is below 85%.

1.08 QUALITY ASSURANCE

A. Installer: Shall have a minimum of 2 years experience in the layout and striping of parking lots.
B. Job Conditions: Do not apply marking paint when weather is foggy or rainy, or ambient or pavement temperatures are below 40°F, nor when such conditions are anticipated during eight hours after application.

1.09 SUBMITTALS

A. Submit manufacturer's product data and installation instructions.
B. Substitutions: Submit in accordance with of Section 012300 Alternates and 013323 Shop Drawings, Product Data, and Samples.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Traffic Paint: Fed. Spec. TT-P-115E, Type III alkyd-chlorinated rubber-chlorinated paraffin marking paint. Fire lane stripes shall be per City requirements. Provide Premium Chlorinated Rubber Base Paint as manufactured by Highway Signs & Paint, Inc. Phone (214) 878-9505.

B. Paint Schedule is as follows, see plans for locations and if required:

Parking Stall Stripes:	ACR-Stripe (White)
Handicap Parking Stripes and Crosswalks:	ACR-Stripe (White)
Fire Lane Striping:	ACR-Stripe (Red)
Lettering on yellow or white stripes:	ACR-Stripe (Black)
Lettering on red or blue	ACR-Stripe (White)

C. Cleaning Solvent: VM & P Naphtha.
D. When striping must be removed from existing concrete paving (see Site Plan for possible locations), striping shall be water or sandblasted to expose the concrete beneath.

2.02 EQUIPMENT

A. Applicators: Hand-operated push type marking machine or conventional airless spray equipment with guide lines and templates.

2.03 WORKMANSHIP

A. All work shall be done by experienced, skilled craftsmen. All finishes shall be applied in accordance with manufacturer's printed directions. All finishes shall be applied evenly and be free from runs, skips or other defects.
B. Do not apply paint during extremely hot weather or when air and/or surface temperature is below 50 degrees Fahrenheit or if rain is imminent.

PART 3 - EXECUTION

3.01 PREPARATION

A. Surface Conditions: Clean and dry free from dirt, loose paint, oil, grease, wax, and other contaminants.
B. Concrete Surfaces: Allow concrete to cure a minimum of 90 days prior to application of marking paint.
C. Existing Concrete and Asphalt Surfaces: Shall be swept clean of all debris, including grease.
D. Equipment Condition: Clean previously used paint and solvent from application equipment, using VM & P Naphtha.
E. Paint: Stir contents thoroughly from bottom of container. Do not thin paint.
F. Locate markings as indicated on Drawings. Provide qualified technician to supervise equipment and application of markings. Lay out markings using guide lines, templates and forms.
G. Allow paving to cure before painting as required by manufacturer of traffic paint.
H. Apply primer for all locations to receive paint.

3.02 APPLICATION

A. Three (3) coats minimum at the rate of 8.0 mils dry film thickness.
B. Fire Lane Striping: Stripe fire lanes as shown on the plans and as required to meet City requirements.
C. Directional Striping and Painting: Stripe and paint all directional stripes pavement markings.
D. Stripes shall be 4" wide unless shown otherwise.
E. Apply striping as shown on the drawings by power spray or other approved method.

3.03 CLEANING

A. Upon completion of the work, remove all spatterings, spots and blemishes caused by this work. Remove all extra materials from the job site and leave buildings and grounds in neat, clean and finished condition.

END OF SECTION 321723

SECTION 323100 - VEHICULAR SLIDE GATE OPERATOR

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Furnish and install a complete microprocessor based vehicular slide gate operator system, with a solid-state board to control all functions of the slide gate operator, as described herein and shown on the plans. Include all necessary control boards, power supplies, loop detectors, connectors, and accessories for a complete operational system.

1.2 CONTRACT DOCUMENTS

A. All equipment and work specified in this section shall comply, with all the General Conditions of the specifications, contract documents, and drawings as indicated.

1.3 RELATED WORK

A. Parking control / gate operator systems contractor shall coordinate all work with other contractors and trades where necessary.
B. All necessary conduit, raceways and pull boxes shall be installed by the electrical contractor.
C. Installation of the vehicular slide gate operator system shall be coordinated with the installation of other parking control related systems.

1.4 QUALITY ASSURANCE

A. Installation shall comply with all applicable codes.
B. All equipment shall be new, in current production, and the standard products of a manufacturer of vehicular gate operator equipment.
C. Manufacturer shall guarantee availability of parts, for a minimum of seven (7) years from date of shipment.
D. If required, manufacturer shall be able to demonstrate features, functions and operating characteristics to the Owner.
E. System shall be installed by a factory authorized contractor, with technicians specifically trained in this system.
F. On-site maintenance and repair service shall be available locally and within four (4) hours of notification for emergency condition.

1.5 REFERENCE STANDARDS

A. Vehicular Slide Gate Operator shall be in compliance with Underwriter Laboratories Inc. (UL) Standard for Safety - Door, Drapery, Gate, Louver and Window Operators and Systems, UL 325 Fourth Edition; and Underwriters Laboratories Inc. (UL) Standard for Safety - Tests for Safety-Related Controls Employing Solid-State Devices, UL 991 Second Edition.
B. Vehicular Slide Gate Operator shall be tested for compliance to UL 325 and UL 991 and shall be LISTED by a Nationally Recognized Testing Laboratory (NRTL).
C. Vehicular slide gate fabrication, construction and installation shall conform to ASTM F2200; Standard Specification for Automated Vehicular Gate Construction.

1.6 SUBMITTALS

A. Provisions: Comply with Section 013300.
B. Shall include an equipment list, data sheet(s), system description, block diagrams on equipment to be furnished and electrical wiring diagrams for installation.
C. Shall include all data necessary to evaluate design, quality and configuration of proposed equipment and system(s).

1.7 WARRANTY

A. Products shall include a factory warranty that equipment is free from defects in design, material, manufacturing and operation. Factory warranty period shall be for five (5) years parts and workmanship; 60-months from date of shipment.
B. Manufacturer shall not be responsible for improper use, handling, or installation of the product.
C. Installing contractor shall guarantee the equipment, wire and installation for 12-months from date of acceptance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. The system as described herein is based on the 9150 series vehicular slide gate operator system, manufactured by DoorKing, Inc., Inglewood, California. The vehicular slide gate system specified meets requirements of the specifications and shall be considered as the acceptable Base Bid.

B. Substitutions must meet requirements of Prior Approval, as outlined in the contract documents. Substitutions that meet Prior Approval requirements must be listed as alternates by addendum, and shall be shown separately on the bid forms. Consideration will be based on ability to comply with all aspects of the specifications, the desired functional operation, quality, reliability, design, size, and appearance of the equipment, and the support capabilities of the manufacturer.

2.2 SYSTEM DESCRIPTION

A. Slide Gate Operator:

1. The slide gate operator shall use a microprocessor based solid-state control board that controls all functions of the slide gate operator. Operator shall be rated for continuous duty for use in residential, commercial and industrial applications.
    a. Configure operator to interface with emergency vehicle Opticom IR platform .
2. Primary reduction system shall employ an adjustable clutch and power transfer shall be provided by single cog belt drive train.
3. Operator shall employ magnetic sensing to set open and close limit adjustment. Mechanical type limit switches shall not be allowed.
4. Operator shall automatically set both open and close limit adjustments upon power-up and activation in the open direction. Operator shall automatically sense for any gate coasting to insure true limit settings.
5. Pulling medium shall provide a positive mechanical connection to the gate system. Friction driven rail type pulling mediums shall not be allowed. Roller chain pulling medium shall be minimum size #40.
6. A positive dead bolt shall activate only when the gate is forced open, to reduce solenoid lock wear and failure.
7. Operator shall be capable of being mounted at the front, center or rear of the gate system, shall be designed for either left or right hand mount and shall be designed for pad or post mounting.
8. Operator frame shall use 12-gauge G90 galvanized steel to avoid rusting and shall be painted charcoal gray.
9. Operator shall have two 115 VAC convenience outlets available for accessory transformer power and shall have a built-in lockable power disconnect and reset switch.

B. Control Circuit:

1. Control board shall have connections for optional Gate Tracker board. Gate tracker shall record operator cycles (x100), input errors, loop detector errors, obstruction hits, and power up events. Record shall be time and date stamped.
2. Control board shall allow a stop or a stop and reverse function (settable) from a safety related input.
3. Control board shall have two ports for plug in of vehicular loop detectors, (DoorKing, Models 9409 or 9410).
4. A dry set of relay contacts shall be available for external use, and shall have four programmable functions.
5. A special input shall allow the gate to be partially opened.
6. A timer override function shall cause an opening gate to stop and then reverse direction when the reverse loop(s) or reverse input is clear even if the gate has not reached the full open position, to help reduce tailgating.
7. Control board shall have separate inputs for external contact and non-contact entrapment protection devices.
8. Functions will be user programmable by DIP-switches located on the control board.

C. Fail-Safe Operation

1. To prioritize safety over security, operator shall assume a fail-safe mode in the event of a power loss or if an entrapment is sensed (entrapment alarm activated).
    a. Operator shall revert to a fail-safe mode allowing the gate to be pushed open without any special knowledge or use of any special cranks, keys or other devices.

D. Entrapment Prevention

1. Non-contact sensors, or contact sensors, or combination thereof, shall be utilized to prevent persons from becoming entrapped in the gate system.

2. Warning signs shall be installed in accordance with manufacturer's installation instructions and UL 325 guidelines.

E. Convenience Open Drive System:
   1. A battery powered convenience open DC drive system shall be available as a factory installed option.
   2. The DC drive system shall monitor the primary power source and shall power the gate open upon command, or automatically, if power to the operator is interrupted.
   3. When power is restored, the DC drive system shall automatically set the operator to return to normal operation and disengage.
   4. The system shall provide a trickle charge to the batteries to maintain nominal battery power levels.
      a. LIMITATIONS: This convenience open DC drive system is not intended to operate the vehicular gate operator continuously during a power interruption. Its sole purpose is to provide a convenient method to open the gate should a power interruption occur. For applications that require continuous back-up power, refer to the DoorKing Model 2000 Power Inverter System.

F. Electronic Reverse
   1. The vehicular gate operator shall be equipped with an inherent electronic obstruction sensing system. The electronic sensing system shall automatically cause the gate operator to stop and reverse if an obstruction is sensed during the open or close cycle.
   2. For enhanced safety, the control circuit shall check the obstruction sensing system circuit prior to the start of each cycle of operation. Should the control circuit detect a fault in the obstruction sensing system, the motor shall not be allowed to start.

G. A complete operational system shall be provided.

2.3 EQUIPMENT

A. Model 9150 Vehicular Slide Gate Operator
   1. Single cog belt drive train with adjustable clutch.
   2. Automatic limit / coast magnetic adjustment system.
   3. Solid-state control circuit and motor control.
   5. Partial open limit feature.
   6. UL Class of Operation: I, II, III and IV.
   7. #40 roller chain.
   8. 1/2 HP
      a. 1000 Lb maximum gate weight, 800 Lb if convenience open option is installed.
      b. 30-ft maximum gate length, approximately 1-ft/sec gate speed.
      c. Operates at 115 VAC; 230 or 460 volt operation is available utilizing factory installed step down transformer.
      d. Typical current draw is 5.4 amps at 115 V; 2.7 amps at 230 V; 1.35 amps at 460 V.
      e. Dimensions: 24 inches high, 15 inches wide, 16.5 inches deep.

B. Entrapment Prevention
   1. Non-contact sensors (photo-cells).
      a. P/N 8080-010 Infrared thru-beam, 165 foot sensing distance.
      b. P/N 8080-011 Photo-reflective beam, 30 foot sensing distance.
   2. Contact sensors
      a. P/N 8080-015 Single-sided sensitivity with mounting channel.
      b. P/N 8080-020 Three-sided sensitivity with mounting channel.
      c. P/N 8080-021 Sensor designed to mount on 2 inch round post.
      d. P/N 8080-022 Sensor designed to mount on 2 inch square post.

C. Options
   1. Vehicle Loop Detectors
      a. P/N 9410-010 Single channel detector.
      b. P/N 9409-010 Two channel detector.
   2. Environmental Control
      a. P/N 1601-154 Heater kit.
   3. Drive Chain
      a. P/N 2600-444 Nickel plated drive chain, #40.
   4. Post Mount Base Plate
      a. P/N 2600-495 Use to post mount the 9150 operator (mounting post are not included).

5. Gate Tracker: The vehicular slide gate operator shall have output for connection to Gate Tracker control board (P/N 2351-010). Gate Tracker shall maintain a detailed electronic record of cycles, input errors, loop detector errors, obstruction hits, and each time power is applied to the operator. This record shall be time and date stamped and shall be analyzed using the DoorKing Remote Account Manager for Windows software.
    a. DoorKing 1830 series telephone entry or access control system is required for Gate Tracker operations.
6. Convenience open (battery backup) drive system.
7. Opticom Gate Opener
    a. Model 500632 Gate Opener Panel (powered off the gate operator and mounted within the enclosure)
    b. Model 762 Phase Selector (plugs into 500632 Gate Opener Panel)
    c. Model 138 cable
    d. Model 721 optical detector

D. A complete operational system shall be provided.
E. Provide four (4) remote gate operators.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Shall be installed by qualified technicians who have been factory trained and certified.
B. Model 9150 shall be post or pad mounted, as required.
    1. Post mount (Requires DoorKing P/N 2600-495 base plate).
        a. Mounting posts shall be welded to base plate and mounted in concrete, firmly secured, plumb and level.
    2. Pad mount.
        a. Mounted directly to a concrete pad, firmly secured, plumb and level.
C. Wiring shall be uniform and in accordance with national electric codes and manufacturers instructions.
D. All splices shall be in easily accessible junction boxes or on terminal boards.
E. All cable runs in all junction boxes shall be tagged and identified.
F. Coordinate all work with other effected trades and contractors.

3.2 SYSTEM INITIALIZING AND PROGRAMMING

A. System shall be turned on and adjustment made to meet requirements of specifications and on-site conditions.
B. System shall function as specified.

3.3 SYSTEM TEST PROCEDURES

A. System shall be completely tested to assure that all components and accessories are hooked-up and in working order.
B. System shall be pre-tested by contractor and certified to function in accordance with plans and specifications.
C. System shall be tested in presence of owner's representative.

3.4 OWNER INSTRUCTIONS

A. Installation contractor shall conduct up to (1) hour of instruction in use and operation of the system to designated owner representatives, within (30) days of acceptance.
B. Installation contractor shall conduct up to (1) hour of technical training, in troubleshooting and service of the system, to designated owner representatives within (90) days of system acceptance.

3.5 MANUALS AND DRAWINGS

A. Contractor shall provide owner with (2) copies of standard factory prepared operation, installation and maintenance manuals. Manuals shall include typical wiring diagrams.
B. Contractor shall provide owner with (2) copies of any risers, layouts, and special wiring diagrams showing any changes to standard drawings, if required on project.

3.6 MAINTENANCE

A. The manufacturer recommends periodic maintenance at three month intervals as described in the installation and maintenance manual.
B. External reversing devices should be checked at least once a month.

SECTION 323101 - CANTILEVER GATE SYSTEM

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall provide all labor, materials, and appurtenances necessary for installation of the industrial cantilever gate system defined herein at (City of Denton Fire Station).

1.2 SYSTEM DESCRIPTION

A. The manufacturer shall supply a total industrial ornamental aluminum cantilever gate system of the Ameristar® TransPort II design, (Genesis) style. The system shall include all components (i.e., tracks, uprights, bracing, pickets, hardware, fittings and fasteners) required.

1.3 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.4 SUBMITTAL

A. The manufacturer's submittal package consisting of gate elevations, hardware details, and installation details, shall be submitted prior to installation.

1.5 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism, and theft.

PART 2 - MATERIALS

2.1 MANUFACTURER

A. All industrial ornamental aluminum cantilever gates shall conform to the Ameristar® TransPort II gate system, (Genesis) style, manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma. The project gate schedule shall include the following additional information for each cantilever gate included in the project scope: 25 feet clear opening, and 4 inch gate posts. For questions, please contact Emily Sullivan at 888-333-3422.

B. Substitutions: Submit in accordance with Section 012500.

2.2 MATERIAL

A. The materials used for cantilever gate framing (i.e., uprights, diagonal braces and pickets or pales) shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with a yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish. The TransPort® Fast-Trak™ rails shall be manufactured from ASTM B221 aluminum (designation 6063-T-6) with minimum yield strength of 25,000 PSI, a tensile strength of 30,000 PSI and a standard mill finish.

B. Material for diagonal bracing and uprights shall be 2" sq. x ¼" aluminum. The design of the top and bottom enclosed track shall conform to the manufacturers 5" x 2" Fast-Trak system. Material for pickets shall be 1" x 1/8" wall aluminum.

C. Internal roller truck assembly shall be self-aligning swivel ball-and-socket type running on four bearing wheels. Internal roller truck assembly shall be affixed to the hanger bracket by means of a 5/8" diameter industrial-grade rod end/center bolt, with a minimum static load rating of 10,000 pounds. Attachment of the center bolt to the truck body shall be by means of a swivel joint to ensure equivalent and consistent loading on all bearing wheels and internal track surfaces throughout the travel of the gate.

D. Provide "Emergency Release Lever" in padlocked box, accessible from outside the gate.

2.3 FABRICATION

A. Pickets, enclosed track, uprights and diagonal bracing shall be pre-drilled and labeled for easy assembly. All components shall be precut to specified lengths.

B. Top and bottom rail extrusions shall be mechanically fastened to vertical uprights and reinforced with diagonal braces, as required by drawing.

C. The manufactured components shall be subjected to the Ameristar thermal stratification coating process (high-temperature, in-line, multi-stage, and multi-layer) including, as a minimum, a six-stage pretreatment/wash and an electrostatic spray application of a polyester finish. The topcoat shall be a "no-mar" TGIC polyester powder coat finish with a minimum thickness of 2 mils (0.0508mm). The color shall be (Black). The stratification-coated framework shall be capable of meeting the performance requirements for each quality characteristic shown in Table 1.

Table 1 – Coating Performance Requirements

Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 3,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

D. Provide nominal gate opening of 25 feet.

PART 3 - EXECUTION

3.1 PREPARATION

A. All new gate installations shall be laid out by the contractor in accordance with the construction plans.

B. All hardware shall be installed in accordance with the Transport installation instructions. Transport cantilever gates shall be installed so they comply with current ASTM F2200 & UL325 standards.

C. Gate stops shall be installed on each track in a way that conforms to current ASTM F2200 standards.

3.2 GATE INSTALLATION

A. Gate post shall be spaced according to specified gate elevation. Posts shall be set in concrete footers having a minimum depth of 48" with a minimum diameter of 12" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.3 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

END OF SECTION

SECTION 323120 - METAL FENCES AND GATES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. The contractor shall provide all labor, materials and appurtenances necessary for installation of the welded ornamental steel fence system defined herein at City of Denton Fire Station.

1.2 SYSTEM DESCRIPTION

A. The manufacturer shall supply a total fence system of Montage Industrial® *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel Genesis design. The system shall include all components (i.e., panels, posts, gates and hardware) required.

1.3 QUALITY ASSURANCE

A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

1.4 SUBMITTAL

A. The manufacturer's literature shall be submitted prior to installation.

1.5 PRODUCT HANDLING AND STORAGE

A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

1.6 PRODUCT WARRANTY

A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufactures warranty shall be guaranteed for five (5) years from date of original purchase.

PART 2 - MATERIALS

2.1 MANUFACTURER

A. The fence system shall conform to Montage Industrial *Welded and Rackable* (ATF – All Terrain Flexibility) Ornamental Steel, (Genesis) design, (extended picket) bottom rail treatment, (2-Rail) style manufactured by Ameristar Fence Products, Inc., in Tulsa, Oklahoma. For questions, please contact Emily Sullivan at 888-333-3422.

B. Substitutions: Submit in accordance with Section 012500.

2.2 MATERIAL

A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653/A653M, with a minimum yield strength of 45,000 psi (344 MPa) and a minimum zinc (hot-dip galvanized) coating weight of 0.60 oz/ft2 (184 g/m2), Coating Designation G-60. A minimum of 62% of the steel material shall be derived from recycled scrap metal.

B. Material for pickets shall be 1" square x 16 Ga. tubing. The rails shall be steel channel, 1.75" x 1. 75" x 105". Picket holes in the rail shall be spaced 4.715" o.c. For fence systems up to and including 6 feet tall, posts shall be a minimum of 2-1/2" square x 14 Ga. For fence systems 7 feet tall and 8' tall, posts shall be a minimum of 2-1/2" square x 12 Ga. Gate posts shall meet the minimum requirements of Table 1.

C. Provide "Emergency Release Lever" in padlocked box, accessible from outside the gate.

2.3 FABRICATION

A. Pickets, rails and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.

B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by Ameristar's proprietary fusion welding process, thus completing the rigid panel assembly (Note: The process produces a virtually seamless, spatter-free good-neighbor appearance, equally attractive from either side of the panel).

C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be (Black). The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 2 meet or exceed the coating performance criteria of ASTM F2408).

D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6' in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

PART 3 - EXECUTION

3.1 PREPARATION

A. All new installation shall be laid out by the contractor in accordance with the construction plans.

3.2 FENCE INSTALLATION

A. Fence post shall be spaced according to Table 3, plus or minus ½". For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36" (Note: In some cases, local restrictions of freezing weather conditions may require a greater depth). The "Earthwork" and "Concrete" sections of this specification shall govern material requirements for the concrete footer. Posts setting by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application.

3.3 FENCE INSTALLATION MAINTENANCE

A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces; 1) Remove all metal shavings from cut area. 2) Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry. 3) Apply 2 coats of custom finish paint matching fence color. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Ameristar spray cans or paint pens shall be used to prime and finish exposed surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-Ameristar parts or components will negate the manufactures' warranty.

3.4 GATE INSTALLATION

A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application; weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

3.5 CLEANING

A. The contractor shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

Table 1 – Minimum Sizes for Montage Industrial Posts

Fence Posts	Panel Height
2-1/2" x 14 Ga.	Up to & Including 6' Height
2-1/2" x 12 Ga.	Over 6' Up to & Including 8' Height

Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4'1" to 6'	3" x 12Ga.	4" x 11 Ga.	4" x 11 Ga.
6'1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8'1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10'1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12'1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"

14’1” to 16’	6” x 3/16”	6” x 3/16”	6” x 3/16”

Table 2 – Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8” coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625” ball).
Weathering Resistance	D822 D2244, D523 (60˚ Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

	Table 3 – Montage Industrial – Post Spacing By Bracket Type									
Span	For INVINCIBLE® 8’ Nominal (91-1/2” Rail)				For CLASSIC, GENESIS, & MAJESTIC 8’ Nominal (92-5/8” Rail)					
Post Size	2-1/2”	3”	2-1/2”	3”	2-1/2”	3”	2-1/2”	3”	2-1/2”	3”
Bracket Type	Industrial Flat Mount (BB301)*		Industrial Line 2-1/2” (BB319) 3” (BB320)		Industrial Universal 2.5” (BB302) 3” (BB303)		Industrial Flat Mount (BB301)		Industrial Swivel (BB304)*	
Post Settings ± ½” O.C.	94-1/2”	95”	94-1/2”	95”	96”	96-1/2”	96”	96-1/2”	*96”	*96-1/2”
*Note: When using BB304 swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the BB301 flat mount bracket for Invincible style, rail may need to be drilled to accommodate rail to bracket attachment.										

END OF SECTION

SECTION 32 84 00

LANDSCAPE IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

Applicable requirements of the General Conditions and other sections of the Project Manual apply to this section.

1.2 SCOPE OF WORK

A. Provide a complete and operable landscape irrigation system including all equipment not specifically specified herein or on drawings to meet requirements of all governing authorities.

B. Provide a complete and operating lawn sprinkler installation as shown on the plans, including, but not limited to, the following items:

1. Tap, water meter, and double check valve.

2. Pipe and fittings.

3. Sprinkler heads.

4. Control system and connection to electrical supply.

5. Trenching, installation of system, connection to water source, testing, and backfilling.

6. Permits and Impact Fees (if required).

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 32 92 00 - Turf Establishment (Hydromulch)

B. Section 32 93 00 - Landscaping

C. Perform work in accordance with requirements of conditions of the contract and Division 01 - General Requirements as well as provisions of all applicable laws, codes, ordinances, rules, and regulations.

D. Conform to requirements of reference information listed below except where more stringent requirements are shown or specified in Contract Documents.

1. American Society for Testing and Materials (ASTM) - Specifications and Test Methods specifically referenced in this Section.

2. Underwriters Laboratories (UL) - UL Wires and Cables.

1.4 APPLICABLE STANDARDS

ASTM Sections:

D2241 - Poly Vinyl Chloride (PVC) Plastic Pipe (SDR-PR)
D2464 - Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Threaded, Schedule 40
D2466 - Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Socket Type, Schedule 40
D2564 - Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

STANDARD RECOMMENDED PRACTICE FOR:

D2855 - Making Solvent-Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

1.5 GENERAL CONDITIONS SPECIFICALLY FOR LANDSCAPE IRRIGATION

A. The Contractor will flag the location of all heads, electric valves, quick coupler valves, gate valves, automatic controllers, backflow preventors, etc., prior to construction for the Landscape Architect or Owner's approval. The Contractor shall report to the Landscape Architect any deviations between the irrigation plan, specifications, and the site. Failure to do so prior to the installation of the equipment (which subsequently requires replacement or relocation of the equipment) will result in the work being done at the Contractor's expense.

B. All local, municipal, and state laws, ordinances, codes and regulations relating to, or governing of, any portion of this work are hereby incorporated into and made a part of these specifications and will be carried out by the Contractor. The Contractor must carry sufficient insurance coverage, and must be active in irrigation installation for a minimum of 5 years.

C. Any permits needed for construction of the work included in this contract, which is required by any legally constituted authority having jurisdiction, shall be obtained by the Contractor. The Contractor shall pay for all costs in connection with any inspections or examinations required by these authorities. The Landscape Architect or Owner's Representative will be notified when these inspections are required. Any necessary work needed to be done by the Contractor as a result of these inspections will be performed at the Contractor's expense. Copies of all permits and inspection reports shall be forwarded to the Owner's Representative.

1.6 GUARANTEE AND MAINTENANCE

A. Material and workmanship shall be fully guaranteed for one year after the Date of Substantial Completion; replacement of defective material or repair of work shall be done at no expense to the Owner during the first year, except for repairs or replacements necessitated by damage of any kind not of the Contractor's making. Any reimbursement for repairs must have prior approval of the Owner's Representative.

B. Raising and lowering heads to proper height, adjusting arc and radius, filling trenches that have settled, packing the earth firmly around the heads and quick couplers will all be considered part of warranty work and done at no charge to the Owner for one year after acceptance of system.

C. The Contractor will extend to the Owner all of the warranties and guarantees provided by the manufacturer on all equipment used. Printed copies of such warranties and guarantees will be provided the Owner with final payment.

D. Contractor will provide four (4) copies of service and maintenance manuals on all major items in the installation along with the request for final payment.

E. The Contractor shall provide a minimum of three (3) hours of operating instructions to the Owner's designated representative. The Owner's representative will be notified at least one week in advance with a date for such instruction. Demonstrate the proper operation of each and every head, each electric valve, and each controller.

F. Maintenance and guarantee as stated above does not include alterations necessitated by relandscaping, addition of trees, regrading, or the addition and changes in walks, walls, driveways, or the like. Further, maintenance does not include trimming grass around heads or any service required due to lack of the Owner's maintenance of lawns and plants. It is also expressly understood that the guarantee and maintenance, after final acceptance, does not cover any mechanical damage (breakage) or any repairs or service needed for causes beyond the control of this Contractor.

G. Provide schedule indicating length of time each valve is required to be open to provide determined amount of water.

H. Expenses due to vandalism or damage before substantial completion shall be borne by the Contractor.

1.7 SUBSTITUTIONS

Sprinkler material shall be as specified. The sprinkler system has been designed according to the operating characteristics of the specified equipment. Therefore, no substitutions of equipment will be allowed except under provisions of Section 01630.

1.8 RECORD DRAWINGS

The Contractor is to provide record drawings on reproducible mylars as provided by the Owner. Information to be included will be the dimensional location of major components from permanent fixed points, such as buildings, walls, corners, sidewalks, curbs, etc. At least two actual measurement dimensions will be shown with a minimum of 75 degrees between the lines of measurement to each major item of the system, such as electric valves, quick couplers, main line shut-off valves, or wire splice boxes, etc. Single dimensions will be shown at appropriate intervals from permanent features to the main line piping and to the wire routing. Dimensions are to be recorded on the drawings so that maintenance personnel can locate and service these items. Since pipe routing shown on the plan is schematic by nature, actual routing shall be clearly indicated on the record drawing.

1.9 DEVIATION FROM PLANS

The Irrigation Contractor is cautioned to defend the hydraulics of this system by following the plans and specifications carefully. Particular attention should be given to operating controllers in alternate sequence, by not operating the system until flow controls or section valves have been adjusted to proper operating pressure, by not installing additional tees or elbows unless approved by the Landscape Architect or Owner's representative by following the manufacturer's recommendations for installation of all items, etc. Prior to start of construction, the Contractor will confirm the static water pressure in writing to the Owner's representative.

1.10 SUBMITTALS

A. Submit shop drawings and product data under provisions stated elsewhere.

B. Include piping layout to water source, list of fittings to be used, control system, and wiring diagrams and data.

C. Provide one sprinkler head of each type, complete with housing. Accepted samples may be used in work.

D. Controller charts - Do not prepare charts until record (as-built) drawings have been approved by Landscape Architect.

1. Provide one controller chart for each automatic controller installed.

a. Chart may be same size reproduction of record drawing, if scale permits fitting inside controller door without folding drawing. If photo reduction prints are required keep reduction to maximum size possible to retain full legibility.

b. Chart shall be blueline print of actual "as-built" system, showing area covered by that controller valve, using a distinctly different pastel color for each zone. Highlight heads, lateral piping, and control valve.

2. Identify area of coverage of each remote control valve, using a distinctly different pastel color for each zone. Highlight heads, lateral piping, and control valves.

3. Following review of charts by Landscape Architect, hermetically seal each chart between two layers of 20 mm thick clear plastic.

4. Charts shall be completed and approved by Landscape Architect prior to final completion walk-through of irrigation system.

5. Attach approved chart to inside of each controller door.

E. Operation Manual: Submit 3 sets of operation manuals to Consultant for approval prior to scheduling final completion walk-through. Manual to include the following in 1"-3" ring binder:

1. Index sheet stating project name, and listing company, address, phone number and contact person of Owner, Consultant and Contractor, including Primary Sub-Contractors.

2. Written instructions for operation and maintenance of pumping equipment, fertilizer/chemical injectors (if applicable).

3. Manufacturer Technical Manual for controllers.

4. Manufacturer cut sheets for all heads, control valves, quick coupling valves, gate valves, controllers, drip irrigation components, and valve boxes.

1.11 QUALIFICATIONS AND REQUIREMENTS

A. Installer Qualifications - Installer shall have had considerable experience and demonstrate ability in the installation of irrigation system(s) of specific type(s) in a neat, orderly, and responsible manner in accordance with recognized standards of workmanship. To demonstrate ability and experience necessary for this project, and financial stability, submit, prior to contract award the following:

1. List of 3 projects completed in the last 2 years of similar complexity to this project. Description of projects shall include:

a. Name of project

b. Location
c. Owner
d. Brief description of work and project budget

B. Special Requirements:

1. Work involving substantial plumbing for installation of copper piping, backflow preventer(s), and related Work shall be executed by licensed and bonded plumber(s). Secure a permit at least 48 hours prior to start of installation.

2. Tolerances - Specified depths of mains and laterals and pitch of pipes are minimums. Settlement of trenches is cause for removal of finish grade treatment, refilling, recompaction, and repair of finish grade treatment.

3. Coordination with Other Contracts - Protect, maintain, and coordinate Work with Work under other Section.

4. Damage to Other Improvements - Contractor shall replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Sections during Work associated with installation of irrigation system at no additional cost to Owner.

C. Pre-Construction Conference - Contractor shall schedule and conduct a conference to review in detail quality control and construction requirements for equipment, materials, and systems used to perform the Work. Conference shall be scheduled not less than 10 days prior to commencement of Work. All parties required to be in attendance shall be notified no later than 7 days prior to date of conference. Contractor shall notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to Landscape Architect, Contractor's superintendent, and installer.

1. Minutes of conference shall be recorded and distributed by Contractor to all parties in attendance within five days of conference.

1.12 DELIVERY, STORAGE, AND HANDLING - Deliver, unload, store, and handle materials, packaging, bundling, products in dry, weatherproof, waterproof condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism. Deliver in original unopened packaging containers prominently displaying manufacturer name, volume, quantity, contents, instructions, and conformance to local, state, and federal law. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.

A. Handling of PVC Pipe - Exercise care in handling, loading and storing of PVC pipe. All PVC pipe shall be transported in a vehicle which allows length of pipe

to lie flat so as not to subject it to undue bending or concentrated external loads. All sections of pipe that have been dented or damaged shall be discarded, and if installed, shall be removed and replaced with new piping.

1.13 JOBSITE CONDITIONS:

A. Protection of Property:

1. Preserve and protect all trees, plants, monuments, structures, and paved areas from damage due to Work of this Section. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to satisfaction of Owner. All injury to living plants shall be repaired by Owner, and all costs of such repairs shall be charged to and paid by Contractor.

2. Protect buildings, walks, walls, and other property from damage. Flag and barricade open ditches. Damage caused to asphalt, concrete, or other building material surfaces shall be repaired or replaced at no cost to Owner. Restore disturbed areas to original condition.

B. Existing Trees (if required):

1. All trenching or other Work under limb spread of any and all evergreens or low branching deciduous materials shall be done by hand or by other methods so as to prevent damage to limbs or branches.

2. Where it is necessary to excavate adjacent to existing trees, use all possible care to avoid injury to trees and tree roots. Excavation, in areas where 2 inch and larger roots occur, shall be done by hand. Roots 2 inches or larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be heavily wrapped with burlap to prevent scarring or excessive drying. Where a trenching machine is operated close to trees having roots smaller than 2 inches in diameter, wall of trench adjacent to tree shall be hand trimmed, making clean cuts through roots. Roots 2 inches and larger in diameter shall be painted with two coats of "Tree Seal." Trenches adjacent to trees shall be closed within 24 hours, and when this is not possible, side of trench adjacent to tree shall be kept shaded with moistened burlap or canvas.

C. Protection and Repair of Underground Lines:

1. Request proper utility company to stake exact location (including depth) of all underground electric, gas, or telephone lines. Take whatever precautions are necessary to protect these underground lines from damage. If damage does occur, all damage shall be repaired by Contractor, and all

costs of such repairs shall be paid by Contractor unless other arrangements have been made.

D. Replacement of Paving and Curb - Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and shall be restored to original condition.

PART 2 - PRODUCTS

2.1 GENERAL

A. "Sprinkler Mains" are that portion of piping from water source to operating valves. This portion of the piping is under constant pressure.

B. "Lateral Piping" is that portion of the piping from operating valves to the sprinkler heads. This portion of the piping is under pressure during operation of the system.

C. "Quick Coupling Valve Lines" are considered a part of the sprinkler main.

2.2 GENERAL PIPING

A. Pressure Supply Line (from point of connection through backflow prevention unit) - Type 'K' Hard Copper.

B. Pressure Supply Lines (downstream of backflow prevention units) - Schedule 40 PVC (1" - 2-1/2").

C. Non-Pressure Lines - Class 200 PVC BE.

D. Drip Tubing - Agriculture Products, Inc. - Standard IPS flexible vinyl pipe.

E. Emitter Tubing - by emitter manufacturer.

2.3 COPPER PIPE AND FITTINGS

A. Copper Pipe - Type K, hard tempered.

B. Fittings - Wrought copper, solder joint type.

C. Joints - Soldered with solder, 45% silver, 15% copper, 16% zinc, and 24% cadmium and solidus at 1125□F and liquids at 1145□F.

2.4 BRASS PIPE AND FITTINGS

A. Brass Pipe - 85% red brass, ANSI Schedule 40 screwed pipe.

B. Fittings - Medium brass, screwed 125-pound class.

2.5 POLYVINYL CHLORIDE PIPE

Polyvinyl chloride pipe (hereinafter referred to as PVC pipe) shall have been manufactured in accordance with the Product Standards as follows:

A. Product Standard PS-22-70 shall apply and be the governing authority as applicable to main line piping and shall be SDR-21 (Class 200) specification.

B. Product Standard PS 22-70 shall apply and be the governing authority, as applicable to PVC lateral piping, shall be per SDR-21 (Class 200) specification. 2 1/2" and smaller main line and lateral line piping will be solvent-weld joints.

C. Marking and Identification: All PVC pipe shall be continuously and permanently marked with the following information: manufacturer's name, pipe size, type of pipe and material, SDR number, Commercial Standard Number and NSF (National Sanitation Foundation) Seal.

2.6 PIPE FITTINGS

A. 2 1/2" and smaller pipefittings shall be PVC Schedule 40, as manufactured by the LASCO COMPANY, or equal.

B. All PVC fittings shall be of the same material as the PVC pipe specified and shall be compatible with the PVC pipe furnished.

C. Only solvent recommended by the manufacturer of the PVC pipe and the manufacturer of the PVC fittings shall be used.

2.7 LOW PRESSURE/VOLUME SYSTEMS

A. Drip Tubing - Manufactured of flexible vinyl chloride compound conforming to ASTM D1248, Type 1, Class C, Category 4, P14 and ASTM D3350 for PE 122111C.

B. Fittings - Type and make recommended by tubing manufacturer.

C. Drip Valve Assembly - Type and size shown on Drawings.

1. Wye Stainer - Plastic construction with 120 mesh nylon screen and 1/2 inch blowout assembly. Pepco "Y" Filter.

2. Control Valve - 2 way, solenoid pilot operated type made of synthetic, non-corrosive material; diaphragm activated and slow closing. Include freely pivoted seat seal; retained (mounted) without attachment to diaphragm.

3. Emitters - O1-PC series, single port, pressure compensating, press on type.

2.8 QUICK COUPLING VALVES

Brass two-piece body designed for working pressure of 150 psi; operable with quick coupler. Equip coupler with locking rubber cover. #44 LVC manufactured by Rainbird or approved equal.

2.9 VALVE BOXES

A. Gate Valves, Drip Line Blowout Stubs, Quick Coupling Valves, and Wire Stubs - Carson #910-12 or approved equal.

B. 3/4 inch through 2 inch Control Valves - Carson #1419B-13B or approved equal.

C. Drip Valve Assemblies - Carson #1419B-13B or approved equal.

D. Control Wiring Splices - Carson #910-12 or approved equal.

2.10 ELECTRICAL CONTROL WIRING

A. Low Voltage:

1. Electrical Control Wire - AWG UF UL approved No. direct burial copper wire for control wire and No. 12 for common wire - or larger if required to operate system as designed.

2. Wire Colors:

    a. Control Wires - Red
    b. Common Wires - White
    c. Spare Wires - Black (labeled at terminators)

3. If multiple controllers are utilized, and wire paths of different controllers cross each other, both common and control wires from each controller shall be different colors approved by Landscape Architect.

4. Control wire connections and splices shall be made with 3M direct bury slice, Rainbird Pentite connectors, or similar dry splice method.

B. High Voltage - Type required by local codes and ordinances, of proper size to accommodate needs of equipment serviced.

ALL WIRE SPLICES SHALL BE IN VALVE BOXES, AND NO DIRECTLY BURIED OR UNDERGROUND SPLICES WILL BE ACCEPTED.

2.11 EXPANSION COILS

Expansion coils, which are to consist of approximately 10 wraps of wire around 1" pipe, will be provided on each wire approximately every 100 feet. Wires are to be bundled and taped together every 10 feet. Provide expansion coil at each electric valve inside the valve box.

2.12 MAIN LINE SHUT-OFF VALVES

All main line shut-off valves 2 1/2" and smaller shall be bronze bodied, bronze fitted gate valves with threaded connections and a 150# W.O.G. rating. Valve stems shall be equipped with a heavy cast bronze wheel handle. NIBCO #T113 or approved equal.

2.13 DRAIN VALVES (if applicable)

A. All mainline drain shall be installed as per the detail on the plan using a bronze bodied globe valve with a wheel handle. NIBCO #T211 or approved equal.

B. Automatic drains shall be brass bodied, spring-loaded valves that open with less than 3PSI. Automatic drains shall be located after the manual drain valves.

2.14 SPRINKLER HEADS

As indicated on Drawings. Fabricated riser units in accordance with details on Drawings - with riser nipples of same size as riser opening in sprinkler body.

2.15 SLEEVES

A. All sleeve piping shall be Class 200 PVC with solvent weld joints. Sleeves shall extend at least 2'-0" past the edge of pavement.

B. Bores, if necessary, shall be completed by a commercial boring company approved by the Landscape Architect and/or Owner's representative.

C. Bore holes, if necessary, are to be made with a minimum 12" clearance between the top of the sleeve piping and the bottom of the concrete paving.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Before installation is started, the Contractor shall place a stake where each sprinkler head, quick coupler valve, and electric valves are to be located in accordance with the plans. The staking shall be approved by the Landscape Architect or Owner's representative before the installation is started. Should a discrepancy in the plans become apparent at this time, such discrepancy shall be pointed out to the Landscape Architect or Owner's representative. Work must not proceed until the Owner's representative approves any design changes made necessary by such discrepancy. Should such changes create extra cost to the Contractor, approval for extra compensation shall be obtained in writing from the Owner's representative before commencing work. Should such changes create a savings in cost to the Contractor, a written reduction in the contract price shall be approved by the Owner's representative in writing before commencing work.

B. The Contractor is cautioned to provide adequate protection to those using the site. Provide barricades as necessary.

C. All material shall be installed in strict accordance to the manufacturer's installation specifications which shall be considered a supplement to these specifications.

D. Piping layout indicated is diagrammatic only. Route piping to avoid plants and structures. Provide full and complete coverage.

E. Review layout requirements with other effected work. Coordinate locations of sleeves (under paving) to accommodate system.

3.2 EXCAVATION, BACKFILL, AND PROTECTION OF SHRUBBERY, GENERAL

A. All excavation in this contract shall be unclassified and is to include earth, loose rock, rock, or any combination thereof, in wet or dry state.

B. All trenches shall be backfilled with the material removed, except that no rock or debris, which can damage the pipe, shall be used as backfill. In this case, the special backfill specifications shall take precedence over this general specification. (See 3.7)

C. All trench backfill shall be water settled and compacted in order to prevent after-settling. Use only the minimum amount of water necessary to settle ditches. Flooding of ditches without compaction will not be permitted.

D. All trenches and adjoining areas shall be hand-raked to finish grade. Remove rocks, excess dirt, and debris from the site.

E. Install sleeving under asphalt paving and concrete walks, prior to concreting and paving operations, to accommodate piping and wiring. Compact backfill around sleeves to 95% Modified Proctor Density within 2% of optimum moisture content in accordance with ASTM D1557.

F. Boring will be permitted only where pipe must pass under obstruction(s) which cannot be removed. In backfilling bore, final density of backfill shall match that of surrounding soil. It is acceptable to use sleeves of suitable diameter installed first by jacking or boring, and pipe laid through sleeves. Observe same precautions as though pipe were installed in open trench.

3.3 PIPE INSTALLATION

Note: All pipe is to be inspected prior to the installation. Pay particular attention to mechanical damage resulting from shipment and storage and to defects that occur during extrusion. Such defective pipe shall be removed from the site at the end of each workday. The Owner's representative shall have the option to accept or reject pipe that does not appear to be of good and uniform quality.

A. Main Line Piping:

Pipe shall be installed in a 4" wide (minimum) trench with a minimum of 18" of cover.

B. Lateral Piping:

All PVC lateral line piping shall be solvent-weld type. Install in 4-inch wide (minimum) trench deep enough to allow for installation of sprinkler heads and valves, but in no case with less than 12 inches of cover for rotary and/or spray zone laterals.

C. PVC Pipe Installation:

1. All lumber, rubbish and large rocks (over 2" diameter) shall be removed from the trenches. Pipe shall have a firm, uniform bearing for the entire length of each pipeline to prevent uneven settlement. Wedging or blocking of pipe will not be permitted. Pad the trenches with sand if the trench is rocky. See 3.7

2. Never lay PVC pipe when there is water in the trench. Never lay PVC pipe when the temperature is 32 degrees F. or below. Pipe shall be snaked from side to side of trench bottom to allow for expansion and contraction.

3. All foreign matter or dirt shall be removed from inside of the pipe before welding and piping and shall be kept clean by approved means during and after laying of pipe.

4. Backfilling of Trenches: Because of the expansion and contraction of PVC pipe, backfilling shall be done in the cool part of the day. If this is not possible or practical, water settling of trenches is necessary before and during backfill. Selected fill dirt or sand shall be used if soil condition is rocky or contains large clods.

5. After pipe installation is completed, flush system completely to remove any and all debris from piping prior to installation of adapters and sprinkler heads.

6. Replace and/or repair plant material, structures, and installations by others, damaged by work of this Section.

D. PVC Pipe and Fitting Assembly:

Contractor shall use only the solvent supplied and recommended by the manufacturer of the PVC pipe to be installed on this project site to make any solvent-welded joints. The pipe and fittings shall be thoroughly cleaned of dirt, dust and moisture before applying solvent. PVC pipe and fittings shall be cleaned with PVC primer or sanded with plumber's cloth before solvent welding. The Contractor shall make solvent welds with a non-synthetic bristly brush in the following sequence:

1. Apply an even coat of solvent to the outside of the pipe. Then, apply solvent to the inside of the pipe, making sure that coated area on the pipe is equal to the depth of the fitting socket.

2. Insert pipe quickly into the fitting and turn the pipe approximately 1/4 turn to distribute the solvent and remove air bubbles. Check all tees and ells for correct position; then hold joint for approximately 15 seconds so that pipe does not push out from the fitting. Wipe off any excess solvent with a clean rag.

3. Allow at least fifteen (15) minutes set-up time for each welded joint before moving.

4. On PVC to metal connection, the Contractor shall work the metal connections first. A non-hardening pipe dope such as Permatex #2, or equal, shall be used on all threaded PVC to metal joints, and light wrench pressure is all that should be used. Teflon tape or a liquid Teflon paste can also be used on all threaded PVC to metal joints, and light wrench pressure is all that should be used.

5. Where threaded PVC connections are required, use threaded PVC adapters into which the pipe may be welded. Teflon tape will be used on threads.

E. Drip Tubing:

1. Make all fitting connections per manufacturer recommendations.

2. Use only manufacturer provided or recommended hole punch when making penetrations in drip tubing for insert fittings. Use of any other hole punch shall be cause for immediate removal and replacement of all installed drip tubing.

3. Install drip line blowout stubs at all dead ends of drip tubing.

3.4 AUTOMATIC CONTROLLERS/PEDESTALS

A. Automatic controllers shall be supplied in accordance with the materials list and shall be located as shown on the plan.

B. Owner will provide 120 volt, 20-amp service to within 5 ft. of controller location(s). Contractor shall provide service into the controllers as part of this contract.

C. All electric work shall conform to local codes, ordinance, and authorities having jurisdiction. All high voltage electrical work shall be performed by a licensed electrician.

3.5 ELECTRIC VALVES

A. Electric remote valves shall be supplied in accordance with the specifications and sized according to the plan.

1. Valves shall be installed in a level position. Valves shall be installed deep enough so that there will be at least 10" of cover over the valve.

2. Manufacturer's specifications and installation instructions for the valve supplied shall become a part of these specifications.

3. A plastic valve box (with extension if necessary) shall be installed over the valve with the stem centered in the box to enable flow adjustment to be easily operated. A green plastic top shall be installed on the valve box flush with the final grade.

3.6 QUICK VALVE ASSEMBLIES

Install quick couplers on double swing-joint assemblies of Schedule 80 PVC pipe; flush to grade. Angled nipple relative to pressure supply line shall be no more than 45□ and no less than 10□. Install quick coupling valves as detailed.

3.7 DRIP VALVE ASSEMBLIES

Install drip valve assembly as detailed.

3.8 DRIP EMITTERS

Stake all surface emitters as detailed and staked with acceptable tubing stakes.

3.9 HEAD INSTALLATION

A. IMPORTANT: Backfill shall be specially tamped under the head flange and around the head for a distance of one foot by a suitable means, after trench backfill has dried from water settling.

The purpose is to eliminate loose heads in the ground that would move when run over with mowers thereby creating a possible source of damage.

B. CAUTION: Refer to Guarantee and Maintenance (1.6) regarding importance of backfill.

C. ALL SPRINKLERS

1. All sprinklers shall be located 4" from back of curb and checked for proper operation and proper alignment for direction of throw.

2. After system is thoroughly flushed and ready for operation, each section of sprinklers must be adjusted to control pressure at heads. Use the following method, one section per time: Remove last head on section and install a temporary riser above grade. Install tee with pressure gauge attached on top and reinstall head with nipple onto tee. Correct operating pressure at last head of each section - 40 lbs. for rotary heads and 20 to 25 lbs. for spray heads.

3. The system shall be flushed free of all dirt and debris prior to the installation of the heads.

D. ROTARY HEADS

1. All rotary heads shall be installed 4" from back of vehicular curb using a full swing joint with schedule 40 PVC threaded fittings and Schedule 80 PVC nipples. The top of the head shall be no more than 1/4" above finished grade. Adjust part-circle arcs as required to complete coverage.

E. SECTION VALVE WIRING

1. Section valve wiring shall be supplied in accordance with the specifications. Valve wires shall be bundled with plastic electrical tape every 10 feet. Wiring shall be inspected during installation to avoid any wiring with faulty insulation. All wire splices shall be made with mechanical connectors, which are then waterproofed, and a 10" valve box is to be installed over all splices.

F. QUICK COUPLER VALVES

1. Provide quick coupler valves (whether shown on plans or not) so that no limit of proposed landscaping cannot be reached with a maximum 100' long hose.

3.10 SPECIAL BACKFILL SPECIFICATIONS

A. If rock in encountered, the Contractor will remove the rock to a depth 2" below the bottom of the pipe. A minimum of 2" of sand bedding will then be installed completely around the pipe.

The next 4" of trench will then be backfilled with a select backfill free from rocks and debris and water settled. The remaining backfill will then be completed with the material remaining on site. No rocks larger than 2" in diameter will be allowed in this remaining backfill material.

3.11 FIELD QUALITY CONTROL

A. Flushing - After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves, thoroughly flush piping system under full head of water pressure from dead end fittings. Maintain flushing for 5 minutes through furthermost valves. Cap risers after flushing.

B. Testing - Conduct tests in presence of Owner. Arrange for presence of Owner 48 hours in advance of testing. Supply force pump and all other test equipment.

1. After backfilling, and installation of all control valves, fill pressure supply line with water, and pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater, for a period of 2 hours.

2. Leakage, Pressure Loss - Test is acceptable if no leakage or loss of pressure is evident during test period.

3. Leaks - Detect and repair leaks.

4. Retest system until test pressure can be maintained for duration of tests.

5. Before final acceptance, pressure supply line shall remain under pressure for a period of 48 hours.

C. Walk Through for Substantial Completion:

1. Arrange for Owner's presence 48 hours in advance of walk-through.

2. Entire system shall be completely installed and operational prior to scheduling of walk-through.

3. Operate each zone in its entirety for Owner at time of walk-through and open all valve boxes if directed.

4. Generate a list of items to be corrected prior to Final Completion.

5. Furnish all materials and perform all Work required to correct all inadequacies of coverage due to deviations from Contract Documents.

6. During walk-through, expose all drip emitters under operations for observation by Owner to demonstrate that they are performing and installed as designed; prior to placing of all mulch material. Schedule separate walk-through if necessary.

D. Walk-Through for Final Completion:

1. Arrange for Owner's presence 48 hours in advance of walk-through.

2. Show evidence to Owner that Owner has received all accessories, charts, record drawings, and equipment as required before Final Completion walk-through is scheduled.

3. Operate each zone, in its entirety for Owner at time of walk-through to ensure correction of all incomplete items.

4. Items deemed not acceptable by Owner shall be reworked to complete satisfaction of Owner.

5. If after request to Owner for walk-through for Final Completion of irrigation system, Owner finds items during walk-through which have not been properly adjusted, reworked, or replaced as indicated on list of uncompleted items from previous walk-through, Contractor shall be charged for all subsequent walk-throughs. Funds will be withheld from final payment and/or retainage to Contractor, in amount equal to additional time and expenses required by Owner to conduct and document further

walk-throughs as deemed necessary to ensure compliance with Contract Documents.

3.12 ADJUSTING

Upon completion of installation, "fine-tune" entire system by regulating valves, adjusting patterns and break-up arms, and setting pressure reducing valves at proper pressure to provide optimum and efficient coverage. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible. Heads of same type shall be operating at same pressure ±7%.

A. If it is determined that irrigation adjustments will provide proper and more adequate coverage, make such adjustments prior to Final Acceptance, as directed, at no additional cost to Owner. Adjustments may also include changes in nozzle sizes, degrees of arc, and control valve throttling.

B. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated.

C. Areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at no additional cost to the Owner.

3.13 CLEANING

Maintain continuous cleaning operation throughout duration of Work. Dispose of, off-site at no additional cost to Owner, all trash or debris generated by installation of irrigation system.

3.14 FINAL CLEAN-UP

Upon completion of the work and before acceptance and final payment will be made, the Contractor shall clean and remove from the site of the work, his surplus and discarded materials, temporary structures and discarded materials and debris of every kind. He shall leave the site of the work in a neat and orderly condition equal to that which originally existed. Surplus and waste materials removed from the site of the work shall be disposed of at locations satisfactory to the Owner's representative.

3.15 SYSTEM DEMONSTRATION

A. Instruct Owner's personnel in operation and maintenance of system, including adjusting of sprinkler heads. Use operation and maintenance material as basis for demonstration. (See 1.6/Guarantee and Maintenance)

END OF SECTION

SECTION 32 91 19

FINISH GRADING FOR LANDSCAPE AREAS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Perform topsoil grading work as shown and specified. The work includes:

1. Topsoil Placement:
2. Site fine grading (raking and bed preparation of new shrub, groundcover, and grass areas) of topsoil.
3. Removing debris and waste materials.

B. Related Work.

1. Section 32 93 00 - Landscaping

1.2 QUALITY ASSURANCE

Comply with applicable city, state and federal requirements regarding materials and methods of work and disposal of waste materials.

1.3 SUBMITTALS

A. Submit topsoil material sample (on-site stockpile and/or imported topsoil) for Landscape Architect's approval.

B. Provide and pay for material testing. Testing agency shall be acceptable by the Owner. Provide the following data:

1. Test representative material sample proposed for use.

a. pH factor (range of 6 to 8).
b. Mechanical analysis (Plastic Index of 7 to 20. Minimum laboratory dry weight at optimum moisture content of 110 lbs./cu. ft.).
c. Percentage of organic content.
d. Recommendation on type and quantity of additives required to establish satisfactory pH factor and supply of nutrients to bring nutrients to satisfactory level for planting.

1.4 WORK SCHEDULE

A. General: Work continuously on the site with the exception of bad weather delays until the work is complete.

B. The Contractor shall be ready to tentatively begin work within seven (7) working days of notice to proceed from Owner.

1.5 JOB CONDITIONS

A. Protect existing utilities, pavement and other facilities from damage caused by earthwork operations. Verify utility locations prior to start up of project.

B. Locate, protect, and maintain benchmarks, monuments, control points and project engineering reference points.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Topsoil (on-site stockpile and/or imported): Fertile, friable, natural topsoil of sandy loam character, without admixture of subsoil material, obtained from a well-drained, arable site, reasonably free from clay clods, stones, plants, roots and other foreign materials.

1. Provide imported topsoil free of substances harmful to the plants which will be grown in the soil.

PART 3 – EXECUTION

3.1 PREPARATION

A. Contractor to rough grade site prior to landscaping with ±1" tolerance according to the following as applicable:

- Hydromulched Grassed areas = 1/10" of finished grade
- Solid Sod Grassed areas = 1" of finished grade
- Shrub and groundcover beds = -6" of finished grade (6” topsoil to be placed 6” below finished grade)

B. Examine proposed rough grading area and conditions of installation prior to landscape construction. Do not start grading work until unsatisfactory conditions are corrected.

C. Notify the Owner of unexpected subsurface conditions.

D. Establish extent of grading by area and elevation.

3.2 FINE GRADING

A. Fine grade topsoil eliminating rough and low areas to ensure positive drainage.

B. Remove stones, roots, weeds, and debris while spreading topsoil materials. Rake surface clean of stones 1" or larger in any dimension and all debris. Provide surfaces suitable for soil preparation provided under lawn and planting work.

C. Leave all graded areas approximately 1/2" below finished paved surfaces at edges only.

3.3 MAINTENANCE

A. Protect graded areas from traffic and erosion. Keep free of trash and debris. Repair and re-establish grades in settled, eroded and damaged areas.

B. Where completed areas are disturbed by construction operations or adverse weather, scarify surface, reshape and compact to required density.

3.4 WASTE MATERIALS

Haul from site and legally dispose of waste materials, including excess topsoil used for this project, rock, trash and debris.

3.5 CLEAN UP

Upon completion of filling and grading work, remove equipment and tools. Leave site clear, clean, free of debris and ready for landscaping work.

END OF SECTION

SECTION 32 92 00

TURF ESTABLISHMENT (HYDROMULCH)

PART 1 - GENERAL

1.1 DESCRIPTION

Work Included - This work involves various operations necessary to provide and establish a turf-bed in accordance with the plans and specification contained herein.

1.2 RELATED WORK

A. Section 32 91 19: Finish Grading for Landscape Areas

B. Section 32 93 00: Landscaping

1.3 QUALITY ASSURANCE

A. Qualifications of Workmen - Provide at least one person who shall be present at all times during execution of this portion of the work, who shall be thoroughly familiar with the type of materials being installed and the proper materials and methods for their installation, and who shall direct all work performed under this section.

B. Equipment - Hydromulching equipment shall be suitable for the project and in good repair.

C. Inspection - Provide for inspection by Landscape Architect of materials used. Materials shall be delivered to project in standard sealed container. Keep empty packages to verify quantities used, then dispose as directed.

D. Standards - All plants and planting material shall meet or exceed the specifications of Federal, State and County laws requiring inspection for plant disease and insect control.

E. Materials Lists - Within 10 days after award of the Contract, submit a complete list of all materials proposed to be furnished and installed under this section, demonstrating complete conformance with the requirements specified.

F. Certificates - Deliver all certificates to the Landscape Architect.

G. Deliver Receipts and Invoices - All delivery receipts and copies of invoices for materials used for this work shall be subject to checking by the Owner or his representative and shall be subsequently delivered to the office of the Owner.

H. Samples and Producers' Specifications - Various samples, certificates, and specifications of seed, fertilizer, sand, compost, other soil amendments, and other materials shall be submitted for approval as required by subsequent sections of this specification.

1.4 PRODUCT HANDLING

A. Deliver and Storage

1. Deliver all items to the job site in their original containers with all labels intact and legible at time of Landscape Architect's inspection.

2. Use all means necessary to protect materials before, during, and after installation and to protect the work and materials of all other trades.

3. Immediately remove from the site all materials that do not comply with the specified requirements.

B. Replacements - In the event of damage, immediately make all repairs and replacements necessary to the approval of the Landscape Architect and at no additional cost to the Owner.

1.5 JOB CONDITIONS

A. Bermudagrass hydromulch shall not be applied prior to May 15 nor after August 15 nor at any time the soil temperature is less than 70EF. Contractor shall guarantee a full stand of grass.

B. Contractor shall initially provide a grassing of perennial Ryegrass as Base Bid.

C. As an alternate, Contractor shall provide a bid price to return Spring 1998, scalp the Ryegrass, and overseed with Bermuda to establish a permanent turfgrass.

1.6 GUARANTEE

A. Coverage will be complete; areas of ungerminated seed 12" square and larger will be rehydromulched.

B. Repair any damage made during reshooting immediately.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Ryegrass Seed - “SOUTHWEST EAGLE BLEND” as supplied by Lesco Industries (phone:972-424-8007) composed of 34% “Legacy II” 34% “Linedrive”, and 29% “Buccaneer” or approved equal.

B. Bermudagrass Seed - Turfgrass seed shall be "Cynodon dactylon" (Common Bermudagrass). The seed shall be harvested within one (1) year prior to planting, free of Johnsongrass, field bind weed, dodder seed, and free of other weed seed to the limits allowable under the Federal Seed Act and applicable seed laws. The seed shall not be a mixture. The seed shall be hulled, extra fancy grade, treated with fungicide, and have a germination and purity that will produce, after allowance for Federal Seed Act tolerances, a pure live seed content not less than 85%. Seed shall be labeled in accordance with U.S. Department of Agriculture rules and regulations.

1. Certificate Submittal - Prior to planting, provide the Landscape Architect with the State Certificate stating analysis of purity and germination of seed.

2.2 MULCH

Conwed Regular wood fiber mulch, or approved equal.

2.3 FERTILIZER

Mississippi Chemical 18-18-5, water soluble, or an approved equal. Delivered to the site in bags labeled with the manufacturer's guaranteed analysis. If stored at the site, protect fertilizer from the elements at all times.

2.4 HERBICIDE

Monsanto Roundup applied at 3 ounces active ingredient per 1,000 square feet or other approved post-emergent herbicide.

2.5 Apply Fiber Tack with hydromulch on all slopes and berms at the rate of one and one-half (1-1/2) pounds of Fiber Tack per one thousand (1,000) square feet.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to the proper and timely completion of the work. Do not proceed until unsatisfactory conditions have been corrected.

B. Contractor shall inspect existing automatic irrigation systems with Owner prior to commencing the work. Any problems with the system shall be noted by the Landscape Architect and repaired by Contractor prior to proceeding with the turfgrass operations.

C. After soil preparation and prior to planting, Contractor shall re-inspect irrigation system to ensure system is operating properly in every respect. Contractor shall raise, lower and make all head adjustments as necessary prior to planting.

3.2 PREPARATION

A. Herbicide - Two weeks prior to planting, the area to be hydromulched is to be treated with post-emergent herbicide at a rate of 3 ounces active ingredient per 1,000 square feet of planted area.

B. Contractor shall inspect treated areas with Landscape Architect for approval prior to tillage and planting.

C. Any treated areas which are deemed unacceptable shall be re-treated by Contractor at no additional expense to Owner.

D. Tillage - Tillage shall be accomplished to loosen the soil, destroy existing vegetation, and prepare an acceptable seed bed. All areas shall be tilled to a depth of two inches.

E. Cleaning - Soil shall be further prepared by the removal of debris, building materials, rubbish, weeds, and stones larger than one and one-half (1-1/2") inches in diameter.

F. Fine Grading - After tillage and cleaning, all areas to be planted shall be leveled, fine graded, and drug with a weighted spike harrow or float drag. The required result shall be the elimination of ruts, depressions, humps, and objectionable soil clods. This shall be the final soil preparation step to be completed before the commencement of fertilizing and planting.

G. Rock Removal - During the soil preparation process, a "Rock Pick" or "Rock Rake" shall be used to gather surface stones as small as one and one-half (1-1/2) inch in diameter. The Contractor shall be responsible for the disposal of collected materials.

3.3 HYDROMULCHING

A. Application

1. Typical mix for 800-gallon tank with coverage not to exceed 6,000 s.f. shall consist of 15 lbs. of grass seed, 360 lbs. of Conwed mulch, and 150 lbs. of 18-18-5 fertilizer. Add tackifier at manufacturer's recommended rate.

2. Apply in a uniform manner over all areas to be hydromulched.

B. Protection

1. No heavy equipment shall be moved over the planted lawn areas unless the soil is again prepared, graded, leveled, and replanted. It will be the responsibility of this Contractor to protect all paving surfaces, curbs, utilities, plant materials, and any other existing improvements from damage. Any damages shall be repaired or replaced at no cost to the Owner. Contractor will also locate and stake all irrigation heads, valve risers, etc., prior to beginning any soil preparation work.

C. Establishment and Acceptance

1. Regardless of unseasonable climatic conditions and other adverse conditions affecting planting operations and the growth of the turfgrass, it shall be the sole responsibility of the Contractor to establish a uniform stand of turfgrass as herein specified. When adverse conditions such as drought, cold weather, high winds, excessive precipitation, or other factors prevail to such an extent that satisfactory results are unlikely, the Owner may, at his own discretion, stop any phase of work until conditions change to favor the establishment of turfgrass.

2. Uniform Stand of Turfgrass - A uniform stand with complete coverage of the specified grass shall be defined as not less than one hundred fifty (150) growing plants per square foot for seeded areas. Growing plants shall be defined as healthy grass plants of two blades or more at least 1-1/2 inches tall.

3. Block Sodding (if applicable) - At locations shown on plans or where directed, soft blocks shall be carefully placed on the prepared areas. When sufficiently dry, the sodded area shall be rolled or tamped to form a thoroughly compacted, solid mat. Any voids left in the block sodding shall be filled with additional sod and tamped. Surfaces of block sod, which in the opinion of the Landscape Architect, may slide due to the height and slope of the surface or nature of the soil, shall upon direction of the Landscape Architect driven through the sod blocks into firm earth sufficiently close to hold the block sod firmly in place.

3.4 POST-PLANTING MAINTENANCE

A. Maintenance shall begin immediately after each portion of grass area is planted. All planted areas will be protected and maintained by watering, weed control, and replanting as necessary after initial planting and for as much longer as necessary to establish a UNIFORM STAND WITH COMPLETE COVERAGE. Upon receipt of Substantial Completion from the Landscape Architect, the Contractor shall maintain the turf (including regular mowing and edging) for a period of 90 days.

B. Watering - Use the automatic irrigation system to apply at least one-half (1/2") inch of water over the entire planted area every three days. If necessary, watering equipment

(other than the automatic irrigation system) required to establish and maintain a uniform stand of grass will be furnished by the Contractor. Contractor shall water thoroughly and infrequently once grass is established to encourage deep root growth.

C. Mowing of Grass:

1. It is anticipated that a minimum of one (1) mowing will occur before the grass areas are accepted by the Owner.

2. Once grass is established the planted area shall be mowed at least once a week during the growing season. Grass shall be mowed to a height of one (1") inch. Mowing during dormant season will be done as necessary (if Contractor has not received Final Acceptance).

D. Weed Control - Keep seeded areas free of weeds by "pulling" weeds until grass has been established.

3.7 EROSION CONTROL

A. Throughout the project and the maintenance period for turfgrass, it is the Contractor's responsibility to maintain the topsoil in place at specified grades. Topsoil and turfgrass losses due to erosion will be replaced by the Contractor until establishment and acceptance is achieved.

3.8 CLEANUP

A. Contractor shall remove any excess material or debris brought onto the site or unearthed as a result of his turfgrass operations.

3.9 GUARANTEE

A. Contractor shall guarantee all materials used for this work to be the type, quality, and quantity specified.

END OF SECTION

SECTION 32 93 00

LANDSCAPING

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

The requirements of the "General Conditions of the Agreement" shall apply to all work of this Section with the same force and effect as though repeated in full herein.

1.2 WORK INCLUDED

Furnish all labor, material, equipment and services necessary to provide all landscape planting, and related items complete in place, as shown on the Drawings and specified, herein.

A. Work Specified in this Section: Rock excavation (for tree planting) if required, topsoil placement (if required), fine grading, soil preparation, planting, clean-up, and all other miscellaneous items related to landscaping as shown on the drawings.

B. Rock excavation for trees is included as part of work. Contractor shall examine Geotechnical Report to determine what, if any, trees may need rock excavation. If rock is encountered, Contractor to follow procedure for “Tree Hole Water Retention” as outlined under Planting Installation in this section.

1.3 RELATED WORK

A. Section 32 91 19: Finish Grading for Landscape Areas

B. Section 32 84 00: Landscape Irrigation System

1.4 QUALITY ASSURANCE

A. Standards:

1. “Grades and Standards” latest edition. Texas Association of Nurserymen Specifications. Austin, Texas 78704.

2. Standardized Plant Names, 1942 Edition, American Joint Committee on Horticulture Nomenclature.

3. American Standards for Nursery Stock, Latest Edition, American Association of Nurserymen.

B. Source Quality Control:

1. Submit documentation to Landscape Architect within ten (10) days after award of Contract that all plant material to be supplied by Landscape Contractor is available. Landscape Contractor to submit pay application for stored materials confirming plant materials are being held at the grower’s. Any and all substitutions due to unavailability must be requested in writing prior to confirmation of ordering. All materials shall be subject to inspection by Landscape Architect at any time after confirmation of ordering.

2. Plants to be supplied by Landscape Contractor shall be subject to inspection and approval of Landscape Architect at place of growth or upon delivery for conformity

to Specifications. Such approval shall not impair the right of inspection and rejection during progress of the work. Inspection and tagging of plant material by the Landscape Architect is for design intent only and does not constitute the Landscape Architect's approval of the plant materials in regards to their health and vigor. The health and vigor of the plant material is the sole responsibility of the Contractor. Submit written request for inspection of plant material at place of growth to Landscape Architect. Written request shall state the place of growth and quantity of plants to be inspected. Landscape Architect reserves the right to refuse inspection at this time if, in their judgment, a sufficient quantity of plants is not available for inspection.

3. All plants approved at the nursery by the Landscape Architect shall be tagged with numbered self-locking tags approved by the Landscape Architect and furnished by the contractor. Trees delivered to the site without these tags or with broken tags shall be rejected.

4. Substitutions of plant materials will not be permitted unless authorized in writing by Landscape Architect. If proof is submitted that any plant specified is not obtainable, a proposal will be considered for use of the nearest equivalent size or variety with corresponding adjustment of Contract Price. Such proof shall be substantiated and submitted in writing to Owner at least twenty (20) days prior to start of Work under this Section. These provisions shall not relieve Contractor of the responsibility of obtaining specified materials in advance if special growing conditions or other arrangements must be made in order to supply specified materials.

5. Plants identified as “specimen” shall be approved and tagged at place of growth by Landscape Architect. Photographs shall be submitted for preliminary approval.

6. The Contractor shall submit specifications of any item being used on site upon the request of the Landscape Architect.

7. The Contractor shall submit a minimum of three (3) photographs of each tree species specified on drawings if Landscape Architect does not tag trees at nursery. Each of the three photographs should be of a different tree within that species. Photographs should be representative of remainder of trees in that species to be planted. Approval of photographs does not constitute approval of all trees to be planted.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. Deliver packaged materials to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trademark, and conformance to State Law.

2. Deliver all plants with legible identification labels.

   a. Label trees, evergreens, bundles of containers of like shrubs, or groundcover plants.
   b. State correct plant name and size indicated on plant list.
   c. Use durable waterproof labels with water-resistant ink, which will remain legible for at least 60 days.

3. Protect plant material during and after delivery to prevent damage to root ball or desiccation of leaves.

B. Storage:

1. Store plant material in shade and protect from weather.

2. Storage at the site is allowed, however, Contractor accepts full responsibility for damage, theft, or vandalism.

3. Any plant material balled or burlapped, not installed within 24 hours of delivery shall be healed in until such time as it is installed.

4. Maintain and protect plant material not to be planted within four (4) hours in a healthy, vigorous condition.

C. Handling: The Contractor is cautioned to exercise care in handling, loading, unloading and storing of plant materials. Plant materials that have been damaged in any way will be discarded and if installed, shall be replaced with undamaged materials at the Contractor's expense.

1.6 JOB CONDITIONS

A. Perform actual planting only when weather and soil conditions are suitable in accordance with locally accepted practice.

B. Scheduling: Install trees, shrubs, and liner stock plant material before grassing is commenced.

C. Landscape Contractor shall note that rock may be encountered on some areas of the site. Rock excavation shall be included as part of bid.

1.7 QUALIFICATIONS OF WORKMEN

Provide at least one person who shall be present at all times during execution of this portion of the Work, who shall be thoroughly familiar with the type of materials being installed and the proper materials and methods for their installation, and who shall direct all work performed under this Section.

1.8 SAMPLES AND TESTS

Landscape Architect reserves the right to take and analyze samples of materials for conformity to specifications at any time. Contractor shall furnish samples upon request by Landscape Architect. Rejected materials shall be immediately removed from the site at Contractor's expense. Cost of testing of materials not meeting Specifications shall be paid by Contractor.

1.9 PLANT GUARANTEE

A. All trees, shrubs, vines, and groundcovers will be guaranteed for a twelve (12) month period after Final Acceptance (including trees supplied by Owner). The Contractor will replace all dead or defective materials upon notification (weather permitting) with plants of the same kind and size as those originally planted. Plants, including trees, which have partially died so that shape, size, or symmetry has been damaged, shall be considered subject to replacement, and the opinion of the Landscape Architect will be final. At the direction of the Landscape Architect, plants may be replaced at the start of the next planting or digging season, but in such cases, Contractor will remove dead plants within two (2) working days.

B. Contractor to make monthly visits to the site and submit a written statement as to his opinion of maintenance and items in need of correction that the contractor, in his opinion, feels if uncorrected would void warranty conditions. Reports shall be submitted to the Landscape Architect by the last working day of the month.

C. All replacement work (including materials, labor and equipment) will be done at no cost to the Owner. Any damage, such as ruts in lawn or bed areas, that occurs when Contractor makes replacements, will be repaired immediately by the Contractor.

D. The guarantee will not apply where plants die after Final Acceptance because of injury by storms, drowning, drought, hail, freeze, insects, disease, mechanical injury by humans or machines, and theft.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All materials shall be of standard, approved and first-grade quality and shall be in prime condition when installed and accepted. Any commercially processed or packaged material shall be delivered to the site in the original unopened container bearing the manufacturer's guaranteed analysis. Contractor shall supply Landscape Architect with a sample of all supplied materials accompanied by analytical data from an approved laboratory source illustrating compliance or bearing the manufacturer's guaranteed analysis.

B. Product Manufacturer's name(s) and/or model numbers are used herein to set a standard of quality and are not intended to be a restraint of trade or prevent submittals of other manufacturer's products of equal quality.

C. Soil Amendment:

1. Compost Mix: "A Professional Bedding Soil" as produced by Living Earth Technologies, Inc., 1808 W. Northwest Highway, Dallas, Texas (phone: 214/869-4332) or “Natural T. L. Compost” as produced by Soil Building Systems, Inc. 1770 “Y” Street, Dallas, Texas (phone: 972-831-8181), or approved equal.

D. Tree Backfill Fertilizer:

13.13.13 analysis bulk fertilizer.

E. Shrub, Groundcover, and Seasonal Color Fertilizer:

Provide commercial balanced slow release fertilizer, delivered to the site in bags labeled with the manufacturer's guaranteed analysis. If stored on the site, protect fertilizer from the elements at all times. Osmocote or approved equal.

F. Tree, Shrub, and Groundcover Planting Tablets:

a. Shall be slow-released type (such as Agriform or approved equal) with potential acidity of not more than 5% by weight containing the following percentages of nutrients by weight:

20% nitrogen
10% phosphoric acid
5% potash

G. Plant Material:

1. Plant names indicated, comply with "Standardized Plant Names" as adopted by the latest edition of the American Joint Committee of Horticultural Nomenclature. Names of varieties not listed conform generally with names accepted by the nursery trade. Provide stock true to botanical name and legibly tagged.

2. Plant material shall meet and/or exceed grades and standards set forth by the Texas Association of Nurserymen. All plants shall have a normal habit of growth and shall be sound, healthy, vigorous and free of insect infestations, plant diseases, sunscalds, fresh abrasions of the bark, excessive abrasions, or other objectionable disfigurements. Tree trunks shall be sturdy and have well "hardened" systems and vigorous and fibrous root systems which are not root or pot-bound. In the event of disagreement as to condition of root system, the root conditions of the plants furnished by the Contractor in containers will be determined by removal of earth from the roots of not less than two plants or more than two percent of the total number of plants of each species or variety where container-grown plants are from several sources, the roots of not less than two plants of each species or the variety from each source will be inspected. In case the sample plants inspected are found to be defective, the Landscape Architect reserves the right to reject the entire lot or lots of plants represented by the defective samples. Any plants rendered unsuitable for planting because of this inspection will be considered as samples and will be provided at the expense of the Contractor.

3. Trees, which have damaged or crooked leaders, or multiple leaders, unless specified, will be rejected. Trees with abrasions of the bark, sun scalds, disfiguring knots will be rejected. Trees with low forking will be rejected unless specifically approved by Landscape Architect.

4. Plants shall be measured when branches are in their normal position. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Caliper measurement shall be taken at a point on the trunk six (6”) inches above the crown at natural grade of trees up to four (4”) inches in caliper and at a point twelve (12”) inches above the crown at natural grade for trees over four (4”) inches in caliper. The measurements specified are the measurements specified and possess a normal balance between height and spread.

5. The size of the plants will correspond with that normally expected for species and variety of commercially available nursery stock or as specified on Drawings. The minimum acceptable size of all plants measured before pruning with the branches in normal position, shall conform with the measurements, if any, specified on the drawings in the list of plants to be furnished. Plants larger in size than specified may be used with the approval of the Landscape Architect, but the use of larger plants will make no change in Contract price. If the use of larger plants is approved, the ball of earth, container size, or spread of roots for each plant will be increased proportionately.

6. Provide "specimen" plants with a special height, shape, or character of growth. Tag specimen trees or shrubs at the source of supply. Plants may be inspected by the Landscape Architect and reviewed at the place of growth, for compliance with specification requirement for quality, size, and variety. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of the work.

7. Field-selected or Nursery Grown Balled and Burlapped Tree Stock (B&B): Dig balled and burlapped plants with, natural balls of earth of sufficient diameter and depth to encompass the fibrous and feeding root system necessary for full recovery of the plant. Balled and Burlapped trees shall have a root ball size of ten (10) times the caliper up to 4" caliper and eight (8) times the caliper above 4" caliper. If a tree is of multi-trunk variety, the caliper of the tree is the size of the largest trunk plus 1/2 of all the other trunks combined. Cracked or mushroomed balls are not acceptable. Selectively remove 1/2 to 2/3 of twig growth.

8. Container-grown Stock (General): Grown in a container for sufficient length of time for the root system to have developed to hold the soil together, firm and whole.

   a. Container stock shall have been grown continuously in the containers, and in the container in which delivered, for at least six (6) months, but not over two (2) years. Container stock shall not be pruned before delivery.
   b. No plants shall be loose in the container.
   c. Container stock shall not be pot bound.
   d. Stock shall not have cracked or broken balls when removed from the container.

9. Container-grown Tree Stock: Grown in a container from seedling stage and complies with Paragraph 2.1 - G-6, Container-grown Stock requirements.

10. Containerized Tree Stock: Grown in a container for not less than one (1) year and complies with Paragraph 2.1 - G-6, Container-grown Stock requirements.

11. Plants planted in rows shall be matched in form, height and overall character.

12. Shrubs and small plants shall meet the requirements for spread and height indicated in the plant list.

    a. The measurements for height shall be taken from the ground level to the average height of the top of the plant and not the longest branch.

    b. Single stemmed or thin plants will not be accepted.

       (1) Side branches shall be generous, well-twigged, and the plant as a whole well-bushed to the ground.

    c. Plants shall be in a moist, vigorous condition, free from dead wood, bruises, or other root or branch injuries.

13. Pruning: At no time shall trees or plant materials be pruned, trimmed or topped prior to delivery and any alteration of their shape shall be conducted only with the approval and when in the presence of the Landscape Architect.

14. All plants not conforming to the requirements herein specified, shall be considered defective and such plants, whether in place or not, shall be marked as rejected and immediately removed from the site of the work and replaced with new plants at the Contractor's expense. The plants shall be of the species, variety, size and conditions specified herein or as shown on the Drawings. Under no conditions will there be any substitutions of plants or sizes listed on the accompanying plans, except with the express consent of the Landscape Architect.

H. Tree Paint: Morrison Tree Seal, Cabort Tree Paint, or equal.

I. Water: Furnished by Landscape Contractor; transport as required.

J. Mulch Topdressing: Shall be shredded, fine textured, pinebark mulch. Minimum 2" layer spread uniformly.

K. Steel Edging and Stakes: 1/8" x 4" Ryerson 'Estate' edging, as manufactured by Joseph Ryerson Co., Inc., Houston, Texas (phone 713-675-6111), or approved equal. Used as designated on drawings only.

L. Soil Saver/Jute Mesh (if required): Heavy weight (green) jute mesh as manufactured by Jim Walls Company, 12820 Hillcrest Road, Dallas, Texas 75230, or approved equal. Install on all slopes, groundcover or shrub bed slopes greater than 3:1 slope.

M. Guying and Staking Materials:

1. Metal "T" Posts: 6' length minimum metal stakes used for fencing. Painted green. Minimum two per tree in north/south axis.

2. Guying Hardware:

a. Wire: Pliable and galvanized at the following sizes:

Ornamental Trees	16 gauge
Shade Trees	14 gauge

b. Hose: 1/2" new rubber hose (black).

c. Turnbuckles: Galvanized or dip-painted, size as required. Turnbuckle openings shall be at least 3".

N. Soil Separator: “Trivera Spunbound” as manufactured by Contech Construction Products or approved equal.

O. Gravel Mulch (if applicable): 3/4" - 1-1/2" crushed granite (gray / pink color). Install 3" layer over layer of polypropylene filter fabric. Provide sample of gravel mulch and filter fabric for Landscape Architect's approval.

P. Other Materials: All other materials, not specifically described but required for a complete and proper installation, shall be as selected by the Contractor subject to the approval of the Landscape Architect.

PART 3 - EXECUTION

3.1 INSPECTION

A. Obtain Landscape Architect's certification that final grades to ±0.10' have been established prior to commencing planting operations. Provide for inclusion of all amendments, settling, etc. Landscape Contractor shall be responsible for shaping all planting areas as indicated on Plans or as directed by Landscape Architect.

B. Inspect trees, shrubs and groundcover plant material for injury, insect infestation and trees and shrubs for improper pruning.

C. Do not begin planting of trees until deficiencies are corrected or plants replaced.

3.2 PLANTING PREPARATION

A. Soil Preparation for Groundcover, Shrub, and Seasonal Color Beds:

1. Excavate existing soil, if necessary, and add to shrub, groundcover, and seasonal color areas the following:

4” layer of Compost Mix

14-14-14 slow release fertilizer (Osmacote)
at a rate of 5 lbs. / 100 s.f.

2. Spread materials uniformly and cultivate thoroughly by means of a mechanical tiller. Till to a minimum depth of 8".

3. Pocket planting of shrub, groundcover, and seasonal color is not allowed.

B. Final Grades:

1. Minor modifications to grade may be required to establish the final grade.

2. Finish grading shall ensure proper drainage of the site as determined on Drawings.

3. All areas shall be graded so that the final grades will be 1" below adjacent paved areas, curbs, valve boxes, edging, clean-outs, drains, manholes, etc., or as indicated on Plans.

4. At time of planting, the top 6" of all areas to be planted shall be free of stones, stumps, or other deleterious matter 1" in diameter or larger, and shall be free from all wire, plaster, or similar objects that would be a hindrance to planting or maintenance.

C. Disposal of Excess Soil: Disposal of any unacceptable or excess soil shall be the sole responsibility of the Landscape Contractor. Excess soil may be spoiled on-site per direction of Owner.

3.3 PLANTING INSTALLATION

A. General:

1. Actual planting shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted practice, as approved by the Landscape Architect.

2. Only as many plants as can be planted and watered on that same day shall be distributed in a planting area.

3. Containers shall be opened and plants shall be removed in such a manner that the ball of earth surrounding the roots is not broken and they shall be planted and watered as herein specified immediately after removal from the containers. Containers shall not be opened prior to placing the plants in the planting area.

B. Layout of Major Plantings: Locations for plants and outlines of areas to be planted shall be marked on the ground by the Contractor before any plant pits are dug. All such locations shall be approved by the Landscape Architect. If underground construction or utility line is encountered in the excavation of planting areas, other locations for planting may be selected by the Landscape Architect. Layout shall be accomplished by flagged grade stakes indicating plant names and specified container size on each stake. It shall be the Contractor's responsibility to confirm with the Landscape Architect's superintendent and governing agencies the location and depth of all underground utilities, and obstructions.

C. Excavation:

1. Excavation for planting shall include the stripping and stacking of all acceptable topsoil encountered within the areas to be excavated for trenches, tree holes, plant pits and planting beds.

2. Excess soil generated from the planting holes and not used as backfill, or in establishing the final grades may be spoiled on-site per direction of Owner.

3. Protect all areas from excessive compaction when trucking plants or other material to the planting site.

4. Tree and shrub pits shall be excavated to allow the root ball to set on undisturbed soil and excavated to the following diameters:

Plant Size	Pit Diameter
Up to 5 gallon container	14" greater than root ball diameter
5 gallon container and greater (including trees)	24” greater than root ball diameter

5. All excavated holes shall have vertical sides with roughened surfaces.

6. All holes for trees and large shrubs shall be tested for water retention prior to tree or shrub installation. After hole is excavated, it is to be filled with water to the top of the excavation. If, after 24 hours, the hole still holds water, the Landscape Contractor shall excavate an additional 6" from the bottom of hole. The Landscape Contractor shall then install 6" of native washed gravel covered on the top (and up a minimum of 12" on the sides of the hole) with filter fabric. The Landscape Contractor shall also install a capped 3" diameter PVC sump which will extend from near the bottom of the rock layer to 3" above the proposed finish grade so the hole can be evacuated through mechanical means.

D. Planting Trees:

1. Container Removal:

a. Remove tree from plastic container or box carefully so container can be re-used.

b. Do not injure root ball.

2. Center tree in pit.

3. Face plants with fullest growth into prevailing wind.

4. Set plant plumb and hold rigidly in position until soil has been tamped firmly around ball.

5. Tree Pit Backfill:

   a. Tree backfill should be composed of 5 parts existing of soil excavated from the hole to one part Soil Amendment, thoroughly mixed with 5 lbs. per cubic yard tree backfill fertilizer. Tree backfill to be mechanically mixed prior to backfill operations.

6. Set tree in upright position in the center of the hole and compact the backfill mixture around the ball or roots. Thoroughly water each plant after backfilling. After planting trees not in beds, surround the pits with a 3" height berm.

7. Plant Tablets:

   a. After the water has completely drained from the plant pit, planting tablets shall be placed in the top 3" of the plant pit as indicated below:

      • Four tablets per every foot of rootball diameter per tree.

   b. Planting tablets shall be set with each plant on the top of the rootball while the plants are still in their containers so the required number of tablets to be used in each hole can be easily verified by the Landscape Architect.

8. Pruning: Pruning shall be limited to the minimum necessary to remove injured twigs and branches or to limb-up trees as directed by the Landscape Architect. Pruning may not be done prior to delivery of plants. Cuts over 3/4" in diameter shall be painted with tree paint.

9. Guying and Staking Removal: At no charge to the Owner, the Contractor shall return to the site at the end of the one-year guarantee period and remove all guying and/or staking materials.

E. Planting Shrubs:

1. Container Removal:

   a. Cut cans on two sides with an acceptable can cutter. Do not cut cans with spade or ax.
   b. Do not injure root system.

2. Center plant in pit or trench.

3. Face plants with fullest growth into prevailing wind.

4. Set plant plumb and hold rigidly in position until soil has been tamped firmly around ball or roots.

5. Fill holes with backfill composed of 50% soil taken from the hole and 50% Soil Amendment, thoroughly mixed.

6. Set plant in upright position in the center of the hole and compact the backfill mixture around the ball or roots. Thoroughly water each plant after backfilling. After shrubs not in beds, surround the pits with a 3" height berm.

7. Plant Tablets:

   a. After the water has completely drained from plant pit, planting tablets shall be placed in the top 3" of the plant pit as indicated below:

      - One tablet per one-gallon container and two-gallon container
      - Two tablets per five-gallon container

   b. Planting tablets shall be set with each tablet on the top of the rootball while the plants are still in their containers so the required number of tablets to be used in each hole can be easily verified by the Landscape Architect.

8. Pruning: Pruning shall be limited to the minimum necessary to remove injured twigs and branches. Pruning may not be done prior to delivery of plants. Cuts over 3/4" in diameter shall be painted with tree paint.

F. Planting Groundcover:

1. Space the plants evenly as indicated on the Drawings, staggering.

2. After planting is completed, cover the bed uniformly with a minimum 2" layer of mulch topdressing.

3. Thoroughly water entire planting bed.

3.4 CLEAN-UP

A. After all planting operations have been completed, remove all trash, excess soil, empty plant containers and rubbish from the property. All scars, ruts or other marks in the ground caused by this work shall be repaired and the ground left in a neat and orderly condition throughout the site. Contractor shall pick up all trash resulting from this work no less frequently than each Friday before leaving the site, once a week, and/or the last working day of each week. All trash shall be removed completely from the site.

B. The Contractor shall leave the site area broom-clean and shall wash down all paved areas within the Contract area, leaving the premises in a clean condition.

3.5 MAINTENANCE

A. Maintain the trees, shrubs and groundcovers until Final Completion and Acceptance of the entire project.

B. Maintenance shall include pruning, cultivating, weeding, watering, and application of appropriate insecticides and fungicides necessary to maintain plant free of insects and disease.

1. Re-set settled plants to proper grade and position. Restore planting saucer and adjacent material and remove deal material.

2. Tighten and repair guy wires and stakes as required.

3. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
4. Deep-water trees, plants, and groundcover beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance.

3.6 OBSERVATION SCHEDULE

A. When observations are conducted by someone other than the Landscape Architect, the Contractor shall show evidence in writing of when and by whom these observations were made.

B. No site visits shall commence without all items noted in previous Observation Reports either completed or remedied unless such compliance has been waived by the Owner and/or Landscape Architect.

END OF SECTION

SECTION 334100 – STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.01 SCOPE

A. Section Includes: Furnishing high density corrugated and corrugated smooth lined Polyethylene storm sewer tube and fittings for gravity flow sewers, including all clearing and grubbing, excavation, sheetings, shoring, dewatering, pipe laying, jointing. backfilling, and any other work that is required or necessary to complete the installation as shown on the plans and as specified herein.

1.02 DESCRIPTION

A. This item shall govern for the furnishing and installing of all High Density Corrugated Polyethylene (HDPE) Smooth Lined Pipe and / or materials for constructing of culverts, side road pipes, storm sewers, stubs, and all related connections and fittings, all of which shall conform to ASTM F 2306, latest edition. The pipes shall be of the sizes, types, and dimensions shown on the plans, and contained in this specification. In addition, it shall include all connections and joints to new or existing pipes, storm sewer manholes, inlets, headwalls, and other appurtenances as may be required to complete the work.

1.03 SUBMITTALS

A. The Contractor shall furnish an affidavit that the tubing, specials, fittings, and appurtenances furnished comply with all provisions of this and the ASTM specifications as shown herein.

1.04 RELATED SECTIONS

A. Section 310000 - Earthwork
B. Section 312333 - Trenching and Backfilling

PART 2 - PRODUCTS

2.01 MATERIALS

Unless otherwise specified on the plans or herein, thermoplastic pipe and joint fittings shall conform to the following:

A. High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe & Fittings shall be manufactured in accordance with requirements of ASTM F 2306, latest edition. Type S: This pipe shall have a full circular cross section, with an outer corrugated pipe wall and a smooth inner wall.
B. High Density Polyethylene (HDPE) Corrugated and Smooth Lined Pipe shall be manufactured from virgin PE compounds which conform with the requirements of cell class 335400C as defined and described in ASTM D 3350.
C. Minimum Pipe Stiffness (PS) at five percent deflection shall be as described in ASTM F 2306, Section 6.3 when tested in accordance with ASTM D 2412.
D. All HDPE Corrugated and Smooth Lined Pipe shall be certified through the Plastics Pipe Institute (PPI) Third Party Certification program. All HDPE pipe delivered and used shall bear the Third Party Administered PPI seal.

PART 3 - EXECUTION

3.01 INSTALLATION

Installation shall be in accordance with ASTM D 2321, “Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications”.

Figure 1:
Definitions of Terms for Backfill in Trench Condition:

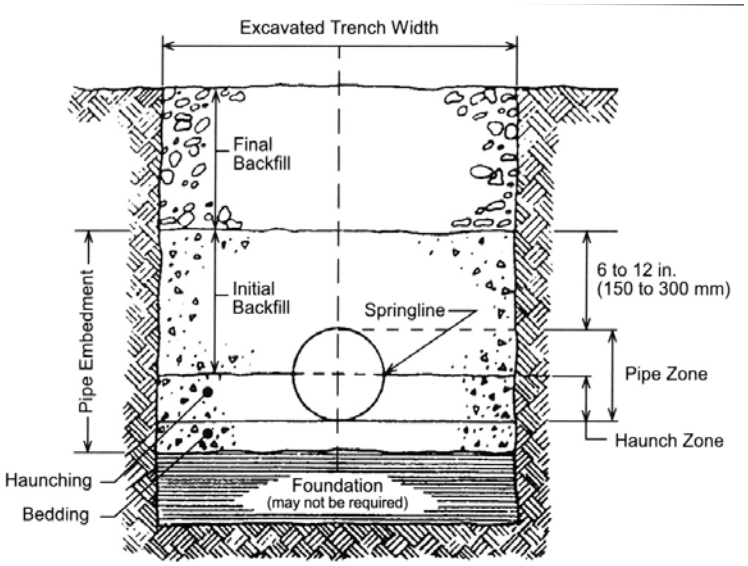

Figure 1. Trench Cross Section Showing Terminology

ASTM D-2321 *

A. General Installation Requirements: Thermoplastic pipe shall be unloaded and handled with reasonable care. Pipe shall be placed in the bed starting at the downstream end. Trenches must be excavated in such a manner as to insure that the sides will be stable under all working conditions. Trench walls shall be sloped or supported in conformance with all standards of safety. Only as much trench as can be safely maintained shall be opened. All trenches shall be backfilled as soon as practicable, but no later than the end of each working day.
Trench details, including foundation, bedding, haunching, initial backfill, final backfill, pipe zone, and trench width are shown in Figure 1.

B. Trench Widths: Trench width shall be in accordance with ASTM D2321 and shall be sufficient to ensure working room to properly and safely place and compact haunching and other backfill materials. Minimum trench width shall not be less than 1.25 times the pipe outside diameter plus 12 inches. (1.25 x O.D. + 12”)
Note: On multiple pipe barrel runs the clear distance between pipes is as follows:
12”-24” Diameters: Clear span =12”
24” & Greater Diameter: Clear span = ½ x Diameter

C. Outside the Right-of-Way Bedding and Backfill: Bedding material shall meet the requirements of ASTM D2321 Class I material. A minimum of 6” of bedding shall be provided prior to placement and shall be loosely compacted. Bedding material size shall be 1½” granular material and shall extend to the springline of the pipe. Initial backfill material shall meet the requirements of ASTM D2321 Class I material and shall extend from the springline to 6” over the top of the pipe. Backfill material shall be placed in 6 inch lifts and compacted to 90% Std. Proctor Density.

D. Inside the Right-of-Way Bedding and Backfill: Bedding material shall meet the requirements of ASTM D2321 Class I material. A minimum of 6” of bedding shall be provided prior to placement and shall be loosely compacted. Bedding material size shall be 1½” maximum granular material. Initial backfill material shall meet the same requirements as the bedding material and shall extend to 6 inches above the top of the pipe. Final backfill material shall meet the requirements of ASTM

D2321 Class I material. All initial and final backfill material shall be placed in 6 inch lifts and compacted to 90% SPD.

E. Minimum Cover: The minimum cover is one foot (1.0') for HS-25 Live Loads (4"-42" Diameters) and two feet for (2.0') for larger diameter structures (48"- 60" Diameter); however, care should be taken when heavy construction equipment loads cross the pipe trench during construction. If the passage of construction equipment over an installed pipeline is necessary during project construction, compacted fill in the form of a ramp shall be constructed to a minimum elevation of three (3.0') feet over the top of the pipe. Any damaged pipe shall be replaced at the contractor's expense.

F. Installation Deflection: At the Engineer's discretion, all pipe exceeding 5% deflection may require replacement at the contractor's expense when measured or inspected not less than 60 days following completion of installation or prior to paving operations. Deflection is defined per ASTM D 2321. All pipe shall be video inspected (CCTV) at the contractor's expense prior to acceptance.

G. Joints: Joints shall be installed that the connection of pipe sections will form a continuous line free from irregularities in the flow line. Joints shall meet one of the following:
   1. Soil tight joints shall be as specified in ASTM F2306.
   2. Watertight joints must meet a 74kPa (10.8 psi) laboratory test per ASTM D3212 and utilize a bell and spigot design with a gasket meeting ASTM F477.

H. High Groundwater Table: In installations where a high groundwater table is encountered, a soil filter fabric as per manufacturer's recommendations shall be installed around the initial backfill material. In flowable fill or high groundwater installations, pipe shall be restrained as per manufacturer's recommendations.

I. Measurement and Payment: This item shall be measured for payment by the linear foot. Such measurements shall be made between the ends of the barrel along its flow line. For multiple pipes, the measured length shall be the sum of the lengths of the barrels, measured as described above. Pipe shall be paid for at the contract unit price per linear foot, complete in place, as provided by the proposal and contract. The contract price per linear foot shall be the total compensation for the furnishing of all labor, materials, tools, equipment, and incidentals necessary to complete the work including excavation, backfill, and disposal of surplus materials in accordance with the plans and these specifications.

J. Comply with requirement in 3.02 A.

3.02 LAYING AND JOINTING

A. Installation: Installed tube produced to these specifications shall be installed according to the standard practice of ASTM Designation F 449 except where installations are under proposed or existing paving. Such installations must utilize an envelope of standard crushed rock bedding materials to a minimum of 6 inches above the crown of the pipe. In either case, the internal diameter of the installed barrel of the tube must not be reduced by more than 5% of its base inside diameter when measured not less than 30 days following completion of installment.

B. Assembly of Joints: All joints shall be assembled in accordance with the recommendations of the manufacturer.

3.03 BACKFILL

A. After the bedding has been prepared and the pipes installed as required, backfill shall be placed in accordance with SECTION 32 18 23. If the material, when tested. fails to meet the density requirements, the backfill shall be required to be removed and replaced to meet the proper density.

B. The backfill shall not be placed until the Architect/Engineer or his representative has observed the trench and authorized the placing of backfill. All debris shall be removed from the trench prior to beginning the backfilling operations. Sheet, shoring and bracing shall be pulled and removed during the progress of the backfilling in such a manner to protect the trench and the pipe.

C. Backfilling shall then be brought up to an elevation slightly above the original ground level to allow for subsequent settlement. The top surface of slopes of all backfill shall be neatly graded off in a workmanlike manner, and where select topsoil, sod, or other material is removed and piled separately, such material shall be carefully replaced in a manner satisfactory to the Architect/Engineer. The top 1' of backfill material shall be of as good quality as the original topsoil which was removed.

3.04 TESTING

A. Testing: All polyethylene tubing shall be tested for elongation, brittleness, joint separation, quality

and ring stiffness as specified in the applicable ASTM Designations.

B. Rejection: This pipe and fittings may be rejected for failure to meet any of the requirements of this specification, and may be retested to establish conformity in accordance with agreement between the Owner and the Contractor.

END OF SECTION 334100